Cornell University

ANNOUNCEMENTS

Graduate School

1967-68

Calendar

FALL TERM — 1966–67

Registration (new students, first day)	Sept. 19, 20
Instruction begins at 1 p.m.	Sept. 21
Last day for filing statement-of-courses form and change of committee form and for new students to file candidacy forms	Oct. 7
Language examinations, French, German, and Russian	Oct. 29
Last day for old students to take qualifying examinations in order to have them considered as of the beginning of the term	Nov. 1
Last day for change of course registration	Nov. 18
Thanksgiving recess: Instruction ends, 12:50 p.m.	Nov. 23
Instruction resumes, 8:00 a.m.	Nov. 28
Christmas recess: Instruction ends, 10 p.m.	Dec. 21
Instruction resumes, 8:00 a.m.	Jan. 5
Last day for completing all requirements for February degrees	Jan. 13
Term ends	Feb. 1

SPRING TERM

Registration for students in residence	Jan. 23
Registration for new and readmitted students	Feb. 4
Instruction begins, 8:00 a.m.	Feb. 6
Last day for filing fellowship and scholarship applications for the following year	Feb. 1
Language examinations, French, German, and Russian	Feb. 4
Last day for filing statement of courses form and change of committee form and for new students to file candidacy forms	Feb. 17
Last day for old students to take qualifying examinations to have them considered as of the beginning of the term	Mar. 1
Spring recess: Instruction ends, 12:50 p.m.	Mar. 25
Instruction resumes, 8:00 a.m.	Apr. 3
Last day for change of course registration	Apr. 14
Last day for completing all requirements for June degrees	May 19
Term ends	June 6
Commencement	June 12

SUMMER

Summer Research period begins	June 7
Registration for Summer Session	June 28
Last day for filing statement of courses form and change of committee form and for new students to file candidacy forms	July 7
Language examinations, French, German and Russian	Aug. 5
Summer Session ends	Aug. 11
Last day for completing all requirements for September degrees	Aug. 18
Summer Research period ends	Sept. 7

(Please see inside back cover for the 1967–68 calendar.)

Cornell University

Graduate School

1967-68

Contents

The courses and curricula described in this Announcement, and the teaching personnel listed therein, are subject to change at any time by official action of Cornell University.

CORNELL UNIVERSITY ANNOUNCEMENTS

Volume 58. Number 8. September 30, 1966. Published twenty times a year: four times in August; twice in March, April, June, July, September, and October; once in January, February, May, and December; no issues in November. Published by Cornell University at Edmund Ezra Day Hall, 18 East Avenue, Ithaca, New York. Second-class postage paid at Ithaca, New York.

Cornell University

GRADUATE EDUCATION AT CORNELL

Graduate education at Cornell is based on the principle that no objective of a university lies deeper in its tradition or springs higher in its aspiration than does the nurture of scholarship. The advancement of learning, the methods of learning, and the criticism of learning occupy the highest reaches of university life and work. Graduate education brings into fruitful contact the most distinguished scholars and the most advanced students, that learning may be shared and that wisdom may be at least glimpsed.

The Graduate School provides an environment within which scholarly capability is encouraged to emerge, thrive, and transmit itself. The School arranges a set of conditions congenial to the student prepared to profit from the availability of advanced courses of study; the opportunity for sustained reflection; the companionship of active, full-time fellow students; the most highly developed libraries, laboratories, and other facilities for research; the prospect of independent discovery or recovery, of evaluation or revaluation; the daily presence of distinguished teachers; and the hope of attaining a firmly based structure of knowledge and a free and independent habit of judgment.

Freedom and independence are key qualities of scholarship, and graduate studies at Cornell are ordered so as to preserve them for both teacher and student. The Cornell principle is that scholars are begotten by other scholars, that judgments are formed by associating with the best judges, that learning lives in the unbroken succession of the learners and the learned, that genuine scholarship is always humane and rests ultimately on personal teaching and personal learning, that success in graduate studies must consist of satisfying the professor rather than a mute schedule of requirements. Graduate School standards are high, but they are maintained there not by the pronouncements of an office but rather by the men after whom such standards are themselves fashioned.

The Cornell graduate student selects not only the study he wishes to pursue, but also the scholar under whose tutelage he wishes to pursue it. The candidate himself, no one else, makes the choice. Some candi-

he Olin Graduate and Research Library.

dates when they apply for admission have in mind the man or men they wish to study with. Those who do not are granted, under a temporary adviser, a semester in which to form an aquaintance and to come to a decision. The supervising professor is called the student's chairman. The chairman and his associate or associates, also chosen by the student, form the student's Special Committee. All such matters as the outlines of study, the observation of progress, the setting of general examinations, the conduct of the thesis, and other exercises leading to a graduate degree are determined within this small circle — the student and the professors he has selected to direct him. So successful is this arrangement and so strongly does Cornell believe in it, that the Special Committee enjoys extraordinary freedom and independence in conducting the student to his degree. The Graduate School sets no course requirement, no credit-hours requirement, no grade requirement. Within the broad agreements of the Graduate Faculty concerning residence, an oral examination, and thesis, the student will be recommended for his degree whenever his Special Committee judges him ready to receive it. When the Committee is satisfied, the requirements are.

The Cornell Graduate School has an enrollment of 3300 students and the Graduate Faculty consists of about 1100 members. In contrast to many other graduate schools, approximately 98 percent of the students are full-time degree candidates, with the majority in programs leading to the Ph.D. degree.

ADMISSION

APPLICATIONS

To be considered for admission to the Graduate School an applicant must (1) hold a baccalaureate degree granted by a faculty or university of recognized standing or have completed studies equivalent to those required for a baccalaureate degree at Cornell, (2) have adequate preparation for graduate study in his chosen field of instruction, (3) have fluent command of the English language, and (4) present evidence of promise in advanced study and research. Students from United States colleges and universities should be in at least the top third of their graduating class.

Applications for admission should be requested from the Graduate School, Sage Graduate Center, Cornell University. Two letters of recommendation from the applicant's major instructors, official transcripts of record from all the institutions of higher learning attended, and the Graduate Record Examination or the Miller Analogies Tests scores where required complete the application.

The applications from United States citizens and from foreign applicants who reside in the United States or Canada must be accompanied by a $15 non-refundable application fee. Foreign applicants residing elsewhere who have been accepted for admission must pay this fee before registration.

Foreign applicants whose native language is not English and who have not received their secondary school or university education in the English language must take the Test of English as a Foreign Language by arrangement with Educational Testing Service, Princeton, New Jersey 08540, U.S.A., or the Michigan English Language Test by arrangement with the English Language Institute, University of Michigan, Ann Arbor, Michigan 48104, U.S.A. The test scores must be reported directly by the testing organization to the Graduate School as part of the essential application information, and no final action on applications will be taken until the scores have been received. Both testing programs are available throughout the world. Information on times and places for administration of the tests may be obtained directly from the addresses given above. Since these tests are diagnostic, admission to those applicants whose scores indicate unsatisfactory command of English may be denied or may be made contingent upon evidence of improved command of English.

If English has been the medium of instruction in the secondary school or university, a statement to this effect signed by a responsible officer of a United States Embassy or Consulate or by an appropriate official of the educational institution involved should be sent to the Graduate School.

All applicants for admission and fellowship consideration are urged to take the Graduate Record Examination (GRE) Aptitude (Verbal and Quantitative) Tests of the Educational Testing Service, and to have the scores sent to the Cornell Graduate School as part of their application materials. Information about the times and places of test administrations may be obtained directly from the Educational Testing Service, Princeton, New Jersey 08540. The Field listings, pages 44–456, should be consulted for Fields requiring the scores of both the Aptitude Test and the pertinent Advanced Test.

CATEGORIES OF ADMISSION

1. Degree Programs

It is expected that most applicants for admission will pursue a program for an advanced degree. Except under unusual circumstances, those who already hold an advanced degree are not permitted to apply for the same degree. Applicants may specify candidacy for the Master of Arts or Master of Science or one of the professional Masters' degrees listed on pages 458–461. However, since Cornell has a strong commitment to doctoral work, most students are encouraged to enroll in a doctoral program. In some fields, students registered in a doctoral program may be required to seek a Master's degree as an initial step in the program.

2. Provisional Candidacy

Under circumstances in which it is difficult to evaluate the academic background of qualified applicants, they may be admitted to *provisional*

candidacy. Ordinarily only one semester of study in provisional candidacy is permitted, and the student who fails to qualify for candidacy at the end of that time may be requested to withdraw from the University.

3. Non-Candidacy

When staff and facilities are available, the Graduate School will admit some applicants who do not intend to work toward an advanced degree at Cornell but who have special objectives for formal study or scholarly work at the graduate level. In order to be admitted for study in non-candidacy, the applicant must satisfy all the entrance requirements expected of degree candidates. Registration in non-candidacy is restricted to two semesters.

CHANGE OF STATUS

A student who wishes to change his status from non-degree candidacy to regular candidacy or from one degree or Field to another, or who, after receiving the Master's degree, wishes to undertake candidacy for the doctorate, must submit a request in writing to the Dean of the Graduate School asking for transfer to the new status. Reasons for the change in status should be given. Provisional candidacy is automatically reviewed at the end of each semester, and no letter is necessary in this instance.

DEGREE REQUIREMENTS

THE SPECIAL COMMITTEE

The general degree requirements of the Graduate School are kept at a minimum in order to give the student maximum flexibility in choosing a desirable program of studies. Since progress in graduate study depends so much on the individual student's situation, there are no course, grade, or credit requirements imposed by the Graduate School. The student's program is developed in conjunction with a Special Committee chosen by the student from the area of studies of interest and is designed to best fit the specific needs and desires of the individual student. Satisfactory progress toward the degree is also judged by the Special Committee rather than by any arbitrary standards imposed by the Graduate School.

The Special Committee under which a Master of Arts or a Master of Science candidate carries on his work is composed of a chairman who represents the major subject, and one representative of an appropriate minor subject. The Special Committee of a doctoral student is composed of a chairman, representing the major subject, and two other members representing other areas of interest. The chairman of the

Special Committee directs the student's thesis research. Some Fields of study require two minor subjects for doctoral programs while for others only one is needed.

The selection of the Field and the major subject, as well as the chairman of the Special Committee, is made by the incoming student. It is the privilege of the graduate student to ask any member of the Graduate School Faculty who is in the Field of his major subject to serve as his chairman. The chairman in turn advises the student about minor subjects and faculty members who might be appropriate to represent them on his Special Committee. The choice of major and minor subjects and the formation of the Special Committee must be recorded in the Graduate School Office within two weeks of the beginning of the first term of residency. However, since the student may be uncertain of his aspirations at that time, he is encouraged to change the membership of his Special Committee as his aims become more definite.

In some of the larger Fields of the Graduate School the difficulty in making a wise selection of a Committee is so great that the Field Representative or other faculty member may serve temporarily as the chairman of the Special Committee while the student seeks a permanent chairman and committee to supervise his programs of study.

The members of the Special Committee decide upon the student's program of study and research and whether he is making satisfactory progress toward the degree. They conduct and report on oral examinations, and they approve the thesis. The Committee and the student constitute an independent working unit. All members of the Graduate School Faculty, however, are free to participate in the scheduled examinations and review the theses of candidates for degrees.

The organization of the Graduate School at Cornell is based on a concept of Fields of Study which is independent of colleges and departments. It is thus possible for a graduate student to take courses in any division of the University and to choose major and minor subjects without regard to organizational lines.

EXAMINATIONS

The Special Committee conducts the examinations that are required for the degree. At the discretion of the Special Committee these examinations may be entirely oral or both oral and written. The following examinations are required:

For the Master's degree: a final examination, which under certain conditions may be combined with the examination for admission to Ph.D. candidacy.

For the doctoral degrees: (1) A comprehensive examination for formal admission to doctoral candidacy. This examination may not be taken until two units of residence credit have been accumulated and is normally taken in the second or third year. Two terms of residence must be credited after this examination. (2) A final examination, which is primarily concerned with the doctoral dissertation.

In some Fields a qualifying examination is given at an early date to

determine the student's fitness for undertaking advanced study and to enable the Special Committee to plan a program which will make him familiar with the requisite knowledge and techniques of his chosen field of study.

When the candidate has completed the thesis, he presents it to the Special Committee at the final thesis examination. This examination is oral and covers subject matter related to the thesis topic.

FOREIGN LANGUAGE REQUIREMENTS

Each Field of instruction has its own foreign language requirements which it considers most useful to the particular area of study. Any Special Committee may, at its discretion, require knowledge of foreign languages beyond the announced requirements.

Candidates required by Fields to demonstrate a reading ability in French, German, or Russian must pass the Graduate School Foreign Language Test given by the Educational Testing Service, Princeton, N.J. 08540, and administered by the Graduate School. A charge is made to cover the cost of administering each test. As an alternative, candidates may pass, or present evidence that they have passed, the reading part of the CEEB college language test with a score satisfactory to the Division of Modern Languages. Students who take examinations in languages other than French, German, or Russian, or in a speaking knowledge of any language, should arrange with the Graduate School Office for assignment of a suitable examiner.

A student may petition the Dean to transfer a language examination taken elsewhere to his record at Cornell.

Courses designed to aid graduate students in learing how to read French, German, and Russian are given by the Division of Modern Languages in cooperation with the Graduate School Faculty. There are two courses offered each term – one at the elementary and one at the intermediate level – in each of the languages. Anyone registering for them is expected to attend regularly throughout the term, take all examinations, and complete assigned work.

ELEMENTARY FRENCH, GERMAN, or RUSSIAN 151. Three hours. M W F (time to be announced).

INTERMEDIATE FRENCH, GERMAN, or RUSSIAN 152. Three hours. M W F (time to be announced).

THESIS

Candidates for the degrees of Master of Arts or Master of Science are required to submit a thesis in fulfillment of the requirements for the degree. In some fields a thesis is also required for professional Masters' degrees. Candidates for the doctoral degree must complete a thesis which constitutes an imaginative contribution to knowledge, and the faculty requires publication of Ph.D. theses by abstract or microfilm.

RESIDENCE

The Graduate Faculty regards study in residence as essential. Although a person working off-campus may attain proficiency in a technique or even in a field of knowledge, he may fail in other ways to attain the breadth of knowledge necessary for scholarly work. In addition to contact with the libraries and physical facilities of the University, he needs the daily acquaintance, company, aid, and stimulus of others engaged in similar pursuits. He should form the habit of attending lectures, seminars, and meetings of groups in whose activities he takes interest.

Full-time study for one semester with satisfactory accomplishment constitutes one residence unit. The Graduate School Faculty requires that each candidate for a Master's degree earn two units of residence, and for the Ph.D. Degree six units of residence. However, the time required to obtain the degree generally exceeds those minimum requirements.

A student must complete all the requirements for the Master's degree in four years and for a doctoral degree in seven years.

A student in a doctoral program may earn no more than two units for work done in Summer Research, Summer Session, and the Division of Extramural Courses. At least four of the six required units must be earned as a full-time student, earning three-quarters of a residence unit or more each term, and two of the last four units must be earned in successive terms of full-time study on the Cornell campus.

Transfer of Residence

Candidates for the Master's degree may not count study in other graduate schools as part of their residence. Candidates for the doctorate may be permitted to count study for the Master's degree as equivalent to two residence units; those who have received training of an exceptional quality and amount may petition for more. No commitment regarding this may be made until after the student has entered into residence and his Special Committee has had further opportunity to judge his accomplishments. The residence transferred must not exceed that which would have been earned under similar circumstances at Cornell. Credits secured during study as an undergraduate or as a Special Student, even for work in courses designed primarily or wholly for graduate students, will not be allowed.

Summer Session

To receive two-fifths of a unit for work in the Summer Session, the candidate must register in both the Summer Session and the Graduate School and must file a statement of courses satisfactory to his Special Committee. Residence credit is not allowed for less than six credit hours or for unit courses, except when two three-week unit courses are taken successively the same summer and, thereby, considered the equivalent of the six-week Summer School. By arrangement with his Committee, a candi-

date may secure all of his residence for the Master's degree by attending Summer School.

SUMMER RESEARCH

To encourage students to continue their studies during the summer period, no tuition or fees are charged for summer research if the student has been registered during the previous academic year. Substantial funds are also available for summer fellowship and research assistantship support. A special summer fellowship program is also available for those students who have held teaching assistantship appointments during the previous academic year. Students have access to the regular services of the University Clinic and Hospital during the summer without charge.

Under certain conditions, students may also accumulate residence credit in the summer term.

Part-Time Studies

Essentially, all graduate students at Cornell are full-time students. In those cases where employment is necessary, students may hold positions requiring up to ten hours of work without reduction of residence credit. Teaching assistants and research assistants whose duties require up to 20 hours a week are able to obtain full residence credit.

Students may register for ¾ residence unit if their employment is for 11 to 20 hours per week, or 21 to 30 hours if the work is contributory to their major field of study and on campus. Non-contributory employment for 21 to 30 hours on campus limits residence to one-half unit per semester.

If the employment is more than 20 clock-hours per week and is off campus, or if it is more than 30 clock-hours per week under any circumstances, a maximum of two-fifths of a residence unit per semester may be earned through registration in the Division of Extramural Courses, but this will be permitted only on the basis of petition approved prior to the time that the work is undertaken. For the degree of Master of Arts or Master of Science a maximum of one unit, and for the degree of Ph.D. a maximum of two units of residence may be earned in this way.

Therefore, under the circumstances described above, degree candidates may accumulate residence units for course work completed through the Division of Extramural Courses. Instruction is offered in certain fields of study both on and off the campus. Fifteen credit hours are the equivalent of one residence unit, and six credit hours the equivalent of two-fifths of a residence unit – the smallest fraction that will be recorded by the Graduate School toward fulfillment of residence requirements. Detailed information concerning extramural courses and registration procedures may be obtained from the Division of Extramural Courses, B-20 Ives Hall.

FINANCIAL SUPPORT

Extensive financial support is available to Cornell graduate students. Approximately 3000 of the 3300 graduate students have financial support in the form of teaching assistantships, research assistantships, and fellowships.

Since the requirements of graduate study are so great, students are discouraged from trying to obtain financial support through employment outside their academic interests.

No special forms are available for financial aid. The applicant is to check the type or types of appointment for which he wishes to be considered on the application for admission form.

TEACHING ASSISTANTSHIPS

The duties of a teaching assistant normally involve classroom and laboratory instruction of undergraduates and as such play a major role in the educational process and the academic atmosphere of the University. Since a large majority of Cornell's graduate students eventually seek a career in teaching, the experience gained from these appointments is an invaluable part of the student's development. In most Fields of Study students are encouraged to spend some time in teaching, and in a few Fields the faculty believe the experience so important that they require it of all students in doctoral programs. A teaching assistantship appointment is usually in the student's major field or in one that is closely related. The duties require from 10 to 20 total clock-hours a week of the student's time, depending on the Field. An assistant whose duties are in his major Field of interest and do not exceed 20 hours, is eligible for full residence credit. The remuneration varies widely, but it is usually from $1900 to $2700 for an academic year and is supplemented by a scholarship which covers tuition and fees. A special summer fellowship program is also available for teaching assistants. Because of possible problems in communication with undergraduates, applicants from non-English speaking countries are not normally appointed as teaching assistants in their first year at Cornell. Appointments are made by department chairmen, and applications for these positions should be made to the Field Representative of the field of the major study chosen.

RESEARCH ASSISTANTS

The duties of a research assistant involve work on a research project. The work performed is frequently applicable to the student's thesis research and is under the direction of the chairman of his Special Committee. The student is required to spend 20 hours a week, but if the research is in the field of his major interest he is able to acquire full-time residence credit. In many Fields of study such appointments are not normally made to students in their first year of graduate study.

FELLOWSHIPS

A fellowship ordinarily is awarded in open competition to a full-time student who is expected to be a candidate for a higher degree. The award is made as a tax-exempt gift, and it covers not only tuition and fees but may also make a substantial contribution toward living expenses during tenure. A student who holds a fellowship is free to select his own research project, and his primary responsibility is to pursue his studies for his degree. The award of the fellowship does not obligate the holder to render services to the University, nor does it commit him in respect to future employment. The holder of a fellowship may accept no other appointment or employment without permission of the Fellowship Board; however, teaching responsibilities will usually be approved as a routine matter if they contribute to the student's graduate program and do not exceed ten clock-hours of work per week.

Fellowships are awarded primarily on the basis of scholastic ability and promise of achievement as a graduate student.

The number of fellowships awarded by the Graduate School is so extensive that it is impractical to present a listing. Many other fellowships are offered to students majoring in certain Fields of Study and some of these are noted in the descriptions of the Fields. In addition, many private and federally supported fellowships are also administered by the Associate Dean of the Graduate School acting with the Fellowship Board. National Science Foundation and National Aeronautics and Space Administration Traineeships are available as well as National Defense Education Act (NDEA) Title IV Fellowships. NDEA Fellowships offer three years of support to doctoral students who are U.S. citizens and who intend to enter a teaching career. (Since completion of a Ph.D. program at Cornell normally requires four years, and because the program is aimed at prospective teachers, NDEA Fellows are normally expected to gain teaching experience and have support during a fourth year as teaching assistants.)

The purpose of the NDFL Fellowship program is to provide encouragement to individuals taking advanced training in languages designated as being of critical importance to the United States and in related subjects such as Area Studies (see pages 26–35). Applicants who are interested in NDFL Fellowship support must so indicate when submitting their application for admission. National Institute of Health Traineeships are available and are offered by Fields which sponsor such grants.

Prospective graduate students should also consider applying for fellowships awarded on a national basis by the National Science Foundation, the Atomic Energy Commission, the Public Health Service, the Woodrow Wilson National Fellowship Foundation, and the Ford Foundation. The deadlines for these programs are usually in the fall for the following academic year. In some cases it is possible for winners of NSF, AEC, and PHS Fellows to hold half-time teaching assistantship appointments for an additional stipend.

New York State provides several forms of financial support. The Herbert H. Lehman Fellowship program is nationwide and is open to

applicants from all states whose interest is in social sciences or public or international affairs. The Fellowships are awarded on a competitive basis and may be used only in New York State institutions. Stipends for Lehman Fellowships are $4000 for first-year graduate students and $5000 for subsequent years. New York State residents are eligible for Regents College Teaching Fellowships or Regents Fellowships for Doctoral Study in Arts, Science, and Engineering. Any of these must be applied for in the fall on forms obtained from the Regents Examination and Scholarship Center, New York State Education Department, Albany, New York 12224.

New York State also grants every resident who applies and is certified to be a full-time student, a Scholar Incentive Payment which may be, for graduate students, from $100 to $300 per term in the first year, and from $200 to $400 per term thereafter, depending on required tuition and income. However, the Scholar Incentive Payment may not exceed the amount that is $100 less than required tuition. Thus, in the state-supported divisions of Cornell University the minimum and maximum Scholar Incentive Payment is $100 a term in any year.

Because all state educational aid is expressly for the purpose of covering educational costs, every winner of a Cornell fellowship or scholarship covering tuition who also wins a state grant, or who is eligible to apply for a Scholar Incentive Payment, will have his Cornell award adjusted downward by at least the amount of the minimum Scholar Incentive Program award.

A space is provided on the admission application form where the student may indicate the type of support for which he wishes to be considered. No special fellowship application form is required.

Under the rules of the Council of Graduate Schools in the United States, the regular time for notification of award of fellowships and scholarships for an academic year is a date in March which is as yet undecided. Notification from Cornell will be sent near the end of March. *All fellowship and scholarship applications received by February 1 will be considered for March awards,* and at that time each applicant will be notified as to whether he has a fellowship or is named as an alternate. In due course those who have not won awards will be so notified. It is hoped that the awardees will notify the Graduate School no later than April 15 of their acceptance or rejection of the award. Failure to do this by April 22 will be considered a declination. Applications received after February 1 may be considered only if vacancies occur.

SUPPORT IN THE HUMANITIES

Recognizing that the availability of financial support for continuing graduate students in the Area of the Humanities is less than in other areas, Cornell has made a particular effort to compensate for this inequity by a special Cornell-supported program. Students in doctoral programs in the Humanities Area who enter with financial support from

Cornell, or with nationally awarded fellowships, are guaranteed support in the form of an assistantship or a fellowship for a four-year period, provided they are making satisfactory progress toward the doctoral degree.

SUMMER FELLOWSHIP SUPPORT

The Graduate School Faculty believes that graduate education, in contrast to undergraduate programs, should be on a year-round basis to enable students to obtain their degrees in a reasonable period of time. The majority of Cornell Ph.D. students are, therefore, supported over the summer period through research assistantships and fellowships. Normally the summer period is devoted to informal study and research rather than to course work, and no tuition or fees are charged.

Two extensive summer fellowship programs based on financial need are noteworthy. One involves awards to those students who have been teaching assistants during the previous term. The other involves fellowship support to students who are in the final stages of their thesis preparation. It is expected that 300 summer fellowships will be awarded for the summer of 1967 under these two programs. Another 1300 students will be supported as research assistants and 250 on twelve-month fellowships.

RESIDENCE HALL ASSISTANTSHIPS

Assistantships in University residence halls are available for men and women graduate students in any academic field. They are most appropriate for graduate students who desire experience in working with undergraduate students and University staff while contributing financially to their own study.

In the women's area one-third of the fifteen assistantships available are reserved for graduate students in the field of Student Personnel Administration. Ten assistantships, offering living expenses and a yearly stipend, are available to graduate women in other disciplines. Particulars and application forms may be obtained by writing to the Office of the Dean of Students, 133 Day Hall.

In the men's housing area there are three types of positions, all requiring a personal interview. There are a number of counselor positions available to single undergraduate and graduate men. Each counselor is responsible for a floor containing 55 freshmen. Counselor positions carry free room for the first year and a $200 stipend in the second. The nine head resident positions are open to married graduate students without children. Each head resident is responsible for a dormitory of 250 men and five staff. The head resident lives in a two-room apartment and receives a $700 stipend.

Applications should be addressed to the Office of the Dean of Students, 133 Day Hall. The deadline for application for positions in men's dormitories is February 1.

LOANS

Only graduate students duly registered in a degree-granting program are eligible for loans. This does not include provisional and non-candidate students.

Cornell utilizes university, state, and National Defense Loan programs. The total amount of loan recommended, regardless of source, is based upon the financial need of the student as analyzed by the University Committee on Financial Aid.

Applications are available at the Office of Scholarships and Financial Aid, 105 Day Hall. State loan applications may also be obtained at this office.

PART-TIME EMPLOYMENT

Additional opportunities for part-time work are often available in connection with departmental research projects or other activities. Applications for this type of work should be made directly to the department concerned. If a candidate is employed in research or other work closely allied to his academic interest, he may find such employment valuable.

Progress in candidacy is difficult when a student attempts to support himself wholly or partially by work unrelated to his studies. It usually is sounder economy to borrow from the Office of Scholarships and Financial Aid and keep employment to a minimum. The University maintains a part-time student employment service, however, in that office.

EMPLOYMENT OPPORTUNITIES FOR WIVES OF GRADUATE STUDENTS

Cornell University offers many non-academic positions for working wives through the Personnel Division, B-12 Ives Hall. Types of work include secretarial and clerical work, work for technicians in the various laboratories, library work, limited nursing positions, and some administrative positions. Applications may be made through the Personnel Division upon arrival on campus. Applicants for academic and professional positions should apply to the specific departments in which they are interested.

In addition to the University positions, the Ithaca area offers opportunities for similar positions in small industrial plants, Ithaca College, the local hospital, and various businesses, as well as for teaching positions in the public school system and some professional positions in service agencies. Applicants should go to the New York State Employment Office for further information regarding these opportunities.

GENERAL INFORMATION

ACTIVITIES FOR GRADUATE STUDENTS

Cornell is in a small academic town in Central New York State. It has the advantages of a small-town atmosphere but at the same time has many cultural aspects that rival those of any large city. A significant concert program brings internationally famous artists to Ithaca. Dramatic programs, talks by visiting lecturers, and art exhibitions fill the weekly calendar of the University and present such a wide choice of events that a student cannot possibly attend all in which he is interested.

There are places for graduate students in many extracurricular activities shared by undergraduates; among others are intramural sports, drama, Glee Club, Sage Chapel Choir, publications, music, and folk dancing. A Graduate Student Activities Committee is active in scheduling weekly social events. A Graduate Wives' Club has had a long tradition of activity for the wives of graduate students. Willard Straight Hall and the Sage Graduate Center provide facilities for graduate groups and aid in planning special functions for them.

Cornell United Religious Work (CURW) includes a range of activities for graduate students. Its offices are in Anabel Taylor Hall, which serves as a headquarters for chaplains who represent several denominations and who may be consulted by students.

Cornell's location in the Finger Lakes Region of New York State stimulates outdoor activity. Many swimming and boating facilities are available. In addition, Cornell operates a private 18-hole golf course; indoor and outdoor swimming pools; an indoor skating rink; tennis, handball, and squash courts; gymnasium; and riding stables, all of which are open to graduate students. A variety of ski resorts also operate near by.

Almost all Fields of study sponsor weekly seminars for their faculty and graduate students.

COUNSELING

The University maintains a variety of counseling services available to graduate students. The primary academic counselors are the members of the Special Committee.

Other counselors who are able to help in matters of various kinds will be found in the Office of the Dean of Students, the Office of Scholarships and Financial Aid, the International Student Office, the Gannett Medical Clinic, and the Sage Graduate Center.

FOREIGN STUDENTS

Cornell has, since its founding, welcomed students from abroad. Currently, 1098 foreign students representing 85 countries are pursuing study in a variety of fields.

In addition, each year over one hundred faculty members spend some time abroad in study and research, often in close association with foreign universities. This creates within the University community opportunities for scholars from other countries to meet and exchange ideas with members of the Cornell faculty, who often have first-hand knowledge of several countries and understand and appreciate a variety of cultures.

Special study programs within the Graduate School permit study in depth of particular areas such as Africa, Asia, Southeast Asia, Latin America, and the Near East. Students from those areas have an opportunity to contribute to such programs.

The Ithaca community is in a natural setting which allows for enjoyment of many recreational activities. In addition, varied cultural and intellectual activities are sponsored by the University. Tours of the community are conducted at the beginning of the fall semester. A group of Cornell faculty and Ithaca families maintain a Host Family Program, in which foreign students are invited to share in some aspects of American family life in the Ithaca community. With the University population a varied one, the community itself, although not large, tends to have a more cosmopolitan atmosphere than most other small cities, and the student can usually find an outlet for a wide variety of interests.

The University maintains an International Student Office at 142 Day Hall. Students from abroad are invited to consult the staff of that office on any questions they may have. The office works in close association with academic advisers and sponsors, and also with persons involved in a number of student and community programs in efforts to enrich the international and cultural life of Cornell. Students are asked to report to this office upon arriving in Ithaca.

HEALTH REQUIREMENTS ON ENTRANCE

The following health requirements for entering graduate students have been adopted by the Board of Trustees of Cornell University. Failure to fulfill these requirements may result in loss of privilege of registering the following term. The responsibility for fulfilling these requirements rests upon the student.

IMMUNIZATION. A satisfactory certificate of immunization against smallpox, on the form supplied by the University, must be submitted before registration. It will be accepted as satisfactory only if it certifies that within the last three years a successful vaccination has been performed. If this requirement cannot be fulfilled by the student's home physician, opportunity for immunization will be offered by the Cornell medical staff during the student's first semester, with the cost to be borne by the student. If a student has been absent from the University for more than three years, immunity will be considered to have lapsed and a certificate of revaccination must be submitted.

It is strongly recommended by the University Health Services that all graduate students have immunization against tetanus before entering the University. All graduate students may, however, obtain initial and all booster tetanus toxoid immunizations at the Gannett Clinic for a nominal charge.

HEALTH HISTORY. Students accepted for admission will be required to submit health histories on forms supplied by the University.

X-RAY. Every student is required to have a chest X-ray. He may present a chest film made by a private physician on or before entering Cornell, provided that it was obtained within six months of initial registration and is of acceptable quality; *or* he may have a chest X-ray at Cornell during the orientation period or at some other specified time shortly thereafter.

When a student who has been away from the University for more than a year wishes to re-enter, he must, at his own expense, once more fulfill the chest X-ray requirement, and he must also submit a new health history.

HEALTH SERVICES AND MEDICAL CARE

Health services and medical care for students are centered in two Cornell facilities: the Gannett Medical Clinic (out-patient department) and the Sage Hospital. Students are entitled to unlimited visits at the Clinic. (Appointments with individual doctors at the Clinic may be made by calling or coming in person; an acutely ill student will be seen promptly whether he has an appointment or not.) Students are also entitled to laboratory and X-ray examinations indicated for diagnosis and treatment; hospitalization in the Sage Hospital with medical care for a maximum of fourteen days each term and emergency surgical care. The cost of these services is covered in the General Fee.

On a voluntary basis, insurance is available to supplement the services provided by the General Fee. For further details, including charges for special services, see the *Announcement of General Information*. If, in the opinion of the University authorities, the student's health makes it unwise for him to remain in the University, he may be required to withdraw.

If a student prefers to consult a private physician rather than go to the Clinic, or to have the services of a private doctor while a patient in the Hospital, he must bear the cost of these services.

LIVING ARRANGEMENTS

DORMITORY ACCOMMODATIONS. The University has established Sage Hall as a graduate residential center. Its dormitory facilities accommodate approximately 100 men in the north side of the building and 105 women in the south side. The Graduate Center, which is available for use by all graduate students and faculty, also contains a cafeteria seating 200, study rooms, and lounges. In addition, Cascadilla Hall has been remodeled to accommodate approximately 140 single graduate men.

Applications for dormitory accommodations may be obtained any time after January 1 for the coming academic year by writing the Department of Housing and Dining Services, 223 Day Hall.

FAMILY ACCOMMODATIONS. The University, through the Department of Housing and Dining Services, has three apartment developments for married students and their families. They are Cornell Quarters, Pleasant Grove Apartments, and Hasbrouck Apartments, with total housing for about 400 families. All apartments are unfurnished. For further information and application, write the Department of Housing and Dining Services, Room 223, Day Hall.

OFF-CAMPUS HOUSING. As it is required that all students live in Cornell-approved housing, an office listing off-campus housing facilities is maintained by the Department of Housing and Dining Services in Room 223, Edmund Ezra Day Hall. It functions as a bureau of information, maintaining files of voluntarily listed accommodations for use of students and staff members who call at the office. Because the list of available accommodations is constantly changing, it is not practical to mail listings, nor is it feasible to maintain a waiting list of persons seeking accommodations.

PLACEMENT

The University Placement Service, 122 Day Hall, makes arrangements for interviews on or off campus with employers, supervises the assembling and presentation of personnel records, and assists Cornell men and women who are ready for positions in business, industry, government, and other institutions. Graduate students are advised to register with the office approximately a year before they will be available for employment.

The Educational Placement Service, 320 Wait Avenue, performs a similar function for those whose vocation is teaching. Many of the professional schools and colleges maintain separate placement offices for the special professions; their services are available to registered graduate students and alumni.

TUITION AND FEES

Tuition and fees* become due when the student registers. Any student who fails to pay his tuition charges, other fees, and other indebtedness to the University, or who, if entitled to free tuition, fails to claim it at the Treasurer's Office and to pay his other fees within the prescribed period of grace, will be dropped from the University unless the Treasurer has granted him an extension of time to complete payment. The Treasurer is permitted to grant such an extension when, in his judgment, the circumstances of a particular case warrant his doing so. For any such extension the student is charged a fee of $5. A reinstatement fee of $10 is assessed against any student who is permitted to continue or return to classes after being dropped from the University for default

* All statements in this section are prepared by the Treasurer, who alone is authorized to interpret them.

in payments. The assessment may be waived in any instance for reasons satisfactory to the Treasurer and the Registrar when such reasons are set forth in a written statement.

Students registering at any time during the last ten weeks of any term are required to pay tuition at the rate of 10 per cent of the regular tuition of the term for each week or fraction of a week between the day of registration and the last examination day of the term. Students registering at any time during the last five weeks in the short summer courses are required to pay tuition at the rate of 20 per cent of the term's tuition for each week or fraction of a week between the day of registration and the last examination day of the term.

Tuition or fees may be changed by the Trustees at any time without previous notice.

FEES PAYABLE BY GRADUATE STUDENTS

Registration Deposit

A deposit of $28 must be made by every applicant for admission after the applicant has received notice of acceptance, unless the candidate has previously matriculated as a student at Cornell University. This deposit is used at the time of first registration to pay the matriculation fee, chest X-ray, and examination-book charge, and covers certain expenses incidental to graduation if the student receives a degree. The deposit will not be refunded to any candidate who withdraws his application after May 22 or after 20 days of his admission approval. This fee is *not* covered by university fellowships, scholarships, or assistantships.

Tuition

Tuition is $200 a term for all students registered in the Graduate School whose major chairman is in the faculty of the state-supported divisions† of the University. Those with major work in the School of Nutrition also pay $200 a term. Tuition in the Field of Education is generally $200 except in a few cases, where it is $760. All students in other divisions must pay tuition of $760 a term. Tuition is payable at the beginning of each term.

Upon recommendation by the appropriate college dean and by action of the Controller, for each appointment in a state-supported school or college, waiver of tuition in the Graduate School may be made to a member of the teaching or scientific staff, whose major field of study is in a state-supported school or college.

Assistants in state-supported schools or colleges on a twelve-month appointment who are registered for Summer Research for credit in the Graduate School may be recommended for waiver of tuition during the summer period under the above limitations. This waiver of tuition does not apply if the student registers in the Summer Session or is not doing productive work for the department.

† The state-supported divisions are the Veterinary College, the Colleges of Agriculture and Home Economics, and the School of Industrial and Labor Relations.

Any student who is to receive less than full residence because of his employment should apply for proration of tuition on forms procurable at the Graduate School Office. *Tuition is based on residence eligibility.* See pages 11, 12.

General Fee

A fee of $237.50, payable at the beginning of each term, is required of each student registered in the Graduate School whose major chairman is on the faculty of one of the state-supported divisions,* or on the faculty of the School of Nutrition, or (in most cases) of the School of Education. All others pay a fee of $215. This General Fee contributes toward the services supplied by the libraries, Clinic and Hospital, and the student union in Willard Straight Hall, and pays a portion of the extra cost of laboratory courses and general administration.

A student who is regularly registered in the Graduate School for either one or both terms of the academic year and has paid the above fee is entitled to these services while in residence during the summer immediately following the academic year without payment of an additional General Fee. If such a student registers with the University during the summer, he is liable for payment of any tuition and other fees, and must present his ID card at the time of payment of these charges in order to claim exemption from payment of the General Fee.

A graduate student who returns to the University to present his thesis and to take the final examination for an advanced degree, all other work for that degree having been previously completed, must register as a "Candidate for Degree Only" and pay a fee of $35.

Other Fees

THESIS FEE. Each doctoral candidate must pay $30 at the time of depositing the approved thesis and abstract in final form. This fee covers the cost of preparing a master microfilm of the entire thesis; of publishing the abstract in the bimonthly periodical, *Dissertation Abstracts;* of mailing the microfilm and abstract to the microfilm publisher; and of binding both copies of the thesis for deposit in the University Library.

LIMITED REFUNDS. Part of the tuition and General Fee will be refunded to students who officially withdraw during the first nine weeks of a term. A student arranges for withdrawal at the Graduate School Office. Students who withdraw are charged tuition and the General Fee at the rate of 10 per cent for each week or fraction of a week from registration to the effective date of withdrawal. No charge is made if the student withdraws within six days of registration. No part of the registration or matriculation fee is refundable.

SUMMER SCHOOL. Graduate students who attend classes in the Summer Session must register both in the Graduate School and in the

* The state-supported divisions are the Veterinary College, the Colleges of Agriculture and Home Economics, and the School of Industrial and Labor Relations.

Summer Session; they must pay the tuition and fees listed in the *Announcement of the Summer School.*

SUMMER RESEARCH. Students registered for Summer Research pay one half of the General Fee for a registration period of not more than eight weeks and the full fee for a registration period of over eight weeks unless they were regularly registered in the Graduate School during the previous academic year. For those students eligible for and desiring residence, a prorated tuition is charged in accordance with the fraction of a residence unit to be earned, based on the tuition in effect for the subsequent academic term.

IN ABSENTIA. A graduate student registered *in absentia* will pay a fee of $35 each term.

SPECIAL RESOURCES FOR RESEARCH AND ADVANCED STUDY

The descriptions below are limited to major general facilities at the service of graduate students in any of a variety of fields of instruction. In addition, substantial collections and facilities, in many instances unique, have been assembled for the use of graduate students. Although the facilities cannot be described adequately in this Announcement, some of them are mentioned in the statements given under the Fields of Instruction on pages 44–456.

CORNELL UNIVERSITY LIBRARIES

The libraries are among the principal facilities in the University's program of graduate studies. The total number of volumes at Cornell is now 2,900,000, and that figure increases by about 175,000 each year. For the convenience of students and faculty, the holdings are organized into a controlled system of distinct libraries. Some of the libraries are large, some have limited holdings. Some are general, some selective. Each library, whether within one of the colleges or housed in a building of its own, is situated where its books and its facilities lie most easily available to those who use them most. The libraries, whatever their nature, have been developed over many years by scholarly librarians and professors with the view of achieving breadth and depth in the central libraries, utility and coherence in the specialized ones.

The University's libraries offer support for graduate studies at several levels. They provide basic readings in virtually all subjects, collateral studies for classroom and seminar instruction, and highly specialized materials for advanced students. An unusually rich collection of reference works, both modern and antiquarian, expedites both daily study and dissertational research. Of journals and periodicals, about 35,000 titles are available, most of them in complete runs, some of them in multiple copies, all of them immediately available. Special departments are maintained for maps, microtexts, documents, newspapers, and other such collections.

To most graduate students, Olin Library, designed primarily as a research library, becomes the most familiar. Olin Library, completed in 1961, offers every modern library facility for its readers. The building is completely air-conditioned, scientifically lighted, comfortably furnished, and organized for efficient operation. It provides easy access to the book stacks, convenient photocopying facilities, and a comfortable lounge area for graduate students. Congestion is reduced not only because of architectural design but also because undergraduates have their own open-stack library in a separate building. A graduate student whose work has advanced to the writing stage may apply for use of a carrel adjoining the book stacks in order to facilitate completion of his dissertation. Olin Library is open in term time from 8 a.m. to 11:30 p.m. weekdays and from 1 p.m. to 11:30 p.m. Sundays.

Within Olin are a number of special collections likely to be of particular interest to advanced students of the social sciences and the humanities. The Department of Rare Books houses several distinguished collections, among them books and manuscripts relating to Dante, Petrarch, Wordsworth, Joyce, Shaw, and other literary figures. The Noyes collection is rich in American historical documents, especially those pertaining to Lincoln and the Civil War. Students in the social sciences will also find extraordinarily interesting manuscripts and books in the collections of slavery and abolition, of witchcraft, of the French Revolution, and of the life and times of Lafayette. Long familiar to professional scholars are the Wason Collection on China and the Chinese, Japan, and Southeast Asia collections, and also the Fiske Icelandic Collection. The History of Science collections include the Adelmann library of embryology and anatomy and the library of the French scientist, Lavoisier. The collection of Regional History and Cornell University archives is a manuscript depository with total holdings of more than 14 million items. These manuscripts relate to all aspects of the economic, political, and social history of this region and the areas historically connected with it. Here too are the documents and manuscripts relevant to the founding and development of Cornell University. In addition to the collections in Olin Library, many of the college and department libraries also contain materials unique in their respective fields. Curators and reference librarians in all the libraries are available for counsel concerning the availability and use of research materials.

The University libraries in aggregate consist of Olin Library, as mentioned, Uris Library for undergraduates, the Physical Sciences Library, the Mann Library of Agriculture and Home Economics, and the libraries of the following colleges and schools: Architecture and Fine Arts, Business and Public Administration, Engineering, Hotel Administration, Industrial and Labor Relations, Law, Medicine (in New York City), and Veterinary Medicine. Added to these are the libraries of academic divisions and departments, together with those of the Agricultural Experiment Station at Geneva, New York, and of the Cornell Aeronautical Laboratory at Buffalo.

INTERNATIONAL STUDIES PROGRAMS

Center for International Studies

The Center for International Studies supports and co-ordinates Cornell University's exceptional combination of resources for graduate study and research in contemporary international affairs. It serves to link together the activities of the specialized programs, to stimulate new research and development, and to advise and assist the University on contract commitments abroad sponsored by government or private agencies.

At Cornell the graduate student is offered substantial facilities for international studies in a wide variety of fields, including the physical and biological sciences. Active programs of instruction or research on the problems of foreign areas and international relations are found not only in the relevant social and humanistic studies, but also in such fields as agriculture, veterinary medicine, nutrition, engineering, regional planning, industrial and labor relations, business and public administration, education, home economics, law, and other fields. Cornell University is in a unique position to apply to international problems many diverse disciplines whose urgent relevance is too often disregarded.

The Center for International Studies, as such, does not have a separate faculty of its own nor does it offer courses of instruction. Instead, Center-sponsored projects and research activities, as well as the various programs and committees associated with the Center, draw on the participation of the University faculty. In addition, the Center brings to Cornell visiting faculty, postdoctoral research fellows, and distinguished academic and professional personnel in the area of international affairs.

Services to graduate students include provision of information regarding research activities in international studies both on and off campus, and the opportunity to participate in Center-sponsored faculty research projects. Among the latter are the Modernization Workshop, which studies the process of modernization in developing societies, and a faculty study group on problems of disarmament and arms control. Fellowships and assistantships in international studies may be obtained from the several relevant fields, or support may be secured through National Defense Education Act Fellowships or other sources outside Cornell. In addition, two predoctoral research fellowships in international studies are offered annually by the Graduate School upon the recommendation of the Center for International Studies.

The student interested in a particular foreign area or in particular international problems may find that the faculty of his own major discipline includes specialists qualified to provide appropriate instruction or supervision. Or the student may wish to major or minor in one of the relevant functional fields of international studies recognized by the Graduate School, such as anthropology, comparative government, international relations, international law and organization, sociology, international and comparative labor relations, international economics and the economics of development, agricultural policy and economic development, international and foreign operations, and international

legal studies. The student seeking a specialized knowledge of a foreign area may work in one of the three major interdisciplinary graduate areas and language programs on China, South Asia, Southeast Asia, and Latin America. In all of them Cornell has outstanding facilities in staff, library, and other resources in a broad range of disciplines: in the International Agricultural Development Program; in the International Population Program; in African or Soviet studies (under the guidance of faculty committees); or in major or minor subjects in history, linguistics, or a foreign literature.

The offices of the Center for International Studies are in Rand Hall. Further information may be obtained from the Director, 216 Rand Hall.

African Studies

ADVISORY FACULTY COMMITTEE ON AFRICAN STUDIES: William H. Friedland, Chairman; Eqbal Ahmad, Douglas Ashford, Harold Feldman, Milton Konvitz, Chandler Morse, Stephen Muller, Thomas Poleman, Victor Turner, Frederick Tom, Mary Wood.

Cornell University has substantial facilities for graduate study and research on Africa. Many members of the faculty in a variety of fields are qualified by research experience in Africa to provide instruction or guidance to students who wish to specialize in some aspect of African studies, who plan to work there, or who are interested in a general or comparative knowledge of the area. Instruction and training in general linguistics are available for students expecting to deal with tribal peoples, and special courses on particular African languages (e.g., Ibo, Yoruba) have been given in recent years. Courses are regularly offered on the cultures and social systems of Africa and on the problems of economic, political, and social development of the area. The University libraries provide a good working collection of books, documents, maps, newspapers, and periodicals on Africa of sufficient scope to enable students and staff to carry on regional research. A representative group of African students is attracted to Cornell each year, most of whom are eager to discuss African life and problems with interested students from other areas.

Inquiries should be directed to Professor William H. Friedland, Chairman, Committee on African Studies, Ives Hall.

China Program

FACULTY: Knight Biggerstaff, Nicholas C. Bodman, Nai-ruenn Chen, John W. Lewis, Ta-chung Liu, John McCoy, David Mozingo, Harold Shadick, Judith M. Treistman, Arthur P. Wolf, Martie W. Young.

Maurice Freedman, Professor of Anthropology at the University of London, will conduct a seminar in the fall semester.

The China Program provides comprehensive graduate-level training and sponsors a wide range of research. The faculty represent the following Fields: Anthropology, Economics, Government, History, History of Art and Archaeology, Linguistics, and literature.

Graduate students in the program take a major in one of the Fields listed above. They are expected at an early stage to attain sufficient mastery of the Chinese language to permit use of Chinese sources in their courses and seminars and in their research.

The focus of much of the research and teaching in the Program is the society, polity, economy, culture, and arts of modern and contemporary China. Students with this concentration are also expected to develop a general knowledge of traditional institutions and culture. Students majoring in History concentrate on nineteenth- and twentieth-century China; no chronological limits apply to those in the History of Art, Linguistics, or literature.

Several China Program fellowships are offered each year to first-year graduate students. They carry stipends of up to $3,000 plus tuition and fees. Research assistantships are available from time to time. London-Cornell Studentships are open to advanced Ph.D. candidates in the social sciences (including modern institutional history) who are in the China Program. They are tenable for study during an academic year at the London School of Economics and Political Science or at the School of Oriental and African Studies of the University of London. Stipends range up to $3,000 plus air fares and tuition and fees.

London-Cornell Field Research Grants are open to Ph.D. candidates in the social sciences (including modern institutional history) who are in the China Program. They are tenable for up to 22 months for the purpose of dissertation research. London-Cornell Field Research grantees may conduct their field work in any part of East Asia where Chinese communities or materials on modern and contemporary China are accessible. Stipends range up to $12,000 for 22 months, including travel and research expenses.

National Defense Foreign Language fellowships and Foreign Area Training fellowships are tenable in the Program. Graduate students may also apply for other assistantships, fellowships, and scholarships offered by the University and by its departments.

Additional information on the Program and the various fellowships and awards may be obtained by writing to the Director, China Program, Franklin Hall.

International Agricultural Development Program

Cornell University provides unusual scope and facilities for graduate-level study and research concerning development of the critical agricultural sector of newly developing nations. An integrated program of research and graduate training is available in the various biological, physical, and social science fields which are relevant to agricultural development. All fields of study in the New York State College of Agriculture at Cornell University have faculty members with intensive foreign experience and students training for overseas work.

A student preparing for work in International Agricultural Development majors in a specific Field. In addition to basic preparation in that

Field, he will minor in the Field of International Agricultural Development. The student may follow courses which help him in applying his knowledge to the special conditions of newly developing nations, consult with experienced faculty members in regard to such application, and pursue a research project for his dissertation which is relevant to the special problems of newly developing countries. In much of this work the program in agriculture draws upon the strong international programs in other colleges of the University, including the area study programs and the extraordinarily varied offerings in modern languages and linguistics.

Faculty experience in overseas work is continuously developed through work on College overseas programs, individual consulting assignments, and the ongoing research of faculty members and their students. The environment for the International Agricultural Development Program is further enhanced by more than 250 foreign graduate students majoring in the various Fields represented by the College of Agriculture.

Substantial expansion has recently taken place in the international program of the three rural social science departments – agricultural economics, rural education, and rural sociology. In addition to nineteen regular faculty members with extensive overseas experience, several members of these departments devote themselves full time to research and teaching in international agricultural development; they have built special programs of research and continuing contact with particular geographic areas. The three departments have a number of assistantships designed to finance graduate students while they work closely with the teaching and research program in international agricultural development. Doctoral candidates in these departments who are interested in international agricultural development are expected to do field research in newly developing countries for their doctoral dissertations. Emphasis in field research lies largely in Latin America, Southeast Asia, and South Asia.

Similar expansion of international activities is under way in other subject matter areas of the College of Agriculture. At present, most departments in the College also have departmental assistantships which are open to outstanding students in those departments.

Additional information may be obtained by writing to Professor K. L. Turk, Director, International Agricultural Development Program, Roberts Hall.

International Legal Studies

A program of concentrated study in the international legal field is offered. A number of foreign scholars and students have come to Cornell for research and study in the comparative and international law fields. The Ford Foundation in 1956 made a substantial long-term grant to the Law School, the proceeds of which have principally been expended in conducting faculty seminars in the field of comparative law and summer conferences in the field of public international law. In addition, the Center for International Studies sponsors a limited number of research fellowships in international legal studies, which are awarded

by the Graduate School on the joint recommendation of the Center and of the Law School.

For more detailed information, see the current *Announcement of the Law School,* the current *Annual Report of the Center for International Studies,* and the current issue of "International Studies at Cornell University – Courses of Instruction." Further information may be obtained by writing to Professor Robert S. Pasley, Chairman, Graduate Study Committee, Cornell Law School, or to the Director, Center for International Studies, 216 Rand Hall.

Latin American Program

FACULTY: Tom E. Davis, Director; Charles Ackerman, Frederick B. Agard, Solon Barraclough, Jerome S. Bernstein, Dalai Brenes, Frank Cancian, Martin Dominguez, Charles L. Eastlack, Donald K. Freebairn, Rose K. Goldsen, Richard Graham, Allan R. Holmberg, Eldon Kenworthy, Henry A. Landsberger, James O. Morris, Thomas Poleman, Bernard Rosen, Donald F. Sola, J. Mayone Stycos, William W. Whyte, Frank W. Young.

The Latin American Program of studies enables the graduate student to develop specialized competence in the history, culture, social organization, and language of Latin American countries. The student majoring in a relevant discipline can minor in Latin American Studies.

In addition to an interdisciplinary seminar, twenty courses directly pertaining to Latin America are offered by the Departments of Agricultural Economics, Anthropology, Economics, Government, History, Industrial and Labor Relations, Romance Studies, Rural Sociology, and Sociology. The courses constitute the basis for formulating programs leading to a graduate *minor* in Latin American Studies. Normally, five or six semester-long offerings satisfy the formal course requirements. In addition, the degree candidate minoring in Latin American Studies must exhibit proficiency in reading and speaking either Spanish or Portuguese.

Applications for scholarships, fellowships, or teaching assistantships should be made to the relevant departments. Ford Foundation support for the Program enables the University to award annually approximately ten fellowships providing an academic-year stipend of $2,000 to supplement an award of tuition and fees. The holders of the fellowships are designated Ford Foundation Fellows in Latin American Studies. Students minoring in Latin American Studies also qualify for Title VI N.D.E.A. Modern Language fellowships. Application forms may be obtained from the Graduate School.

Summer research travel grants are available to selected graduate students through the Latin American Studies Program, and to undergraduate and graduate students through the Columbia-Cornell-Harvard-Illinois Summer Field Studies Program and the Cornell-Brazil Project.

Support for thesis research in Latin America may be obtained from the Foreign Area Training Fellowship Program, the Social Science Research Council, Fulbright-Hays, the Doherty Foundation, the Organization of American States, and Cornell University.

Because of the considerable volume of research on Latin America currently being carried out by Cornell faculty members, students will normally be afforded the opportunity of participating in on-going projects while in residence and will generally be expected to do field work in Latin America at some stage of their graduate training. Major research projects are under way in the fields of (1) Andean community development, (2) comparative economic development, (3) fertility and population, (4) descriptive linguistics, and (5) urbanization.

Additional information may be obtained by writing to Professor Tom E. Davis, Director, Latin American Program, Rand Hall.

Near Eastern Studies

ADVISORY FACULTY COMMITTEE ON NEAR EASTERN STUDY: Isaac Rabinowitz, Chairman; J Milton Cowan, A. Henry Detweiler, Alfred E. Kahn, Stephen A. McCarthy.

Students wishing to relate the work of their major or minor subjects to Near Eastern area or language studies should seek advice or information from the Faculty Committee on Near Eastern Studies. In a number of fields, the University's resources for specialized graduate study and research on countries of the Near East are of considerable value. Members of the Committee can provide suggestions regarding relevant courses in various subjects, assistance in planning research on the Near East, and guidance in applying for area training or research fellowships. Inquiries should be addressed to Professor Isaac Rabinowitz, Chairman, Department of Semitic Languages and Literatures, 173 Goldwin Smith Hall.

South Asia Program

(Bhutan, Ceylon, India, Nepal, Pakistan, Sikkim)
STAFF: Morris E. Opler, Director; Messrs. Leonard P. Adams, Eqbal Ahmad, Douglas E. Ashford, Harold R. Capener, Arch T. Dotson, Gordon H. Fairbanks, Harold Feldman, James Gair, Michael Hugo-Brunt, Gerald Kelley, Kenneth A. R. Kennedy, John W. Mellor, Stanley J. O'Connor, Robert A. Polson.

The increasing importance of the peoples of the Indian subcontinent and of the role they play in world affairs enhances the need for providing opportunities in America for training and research in the field of Indic studies. The South Asia Program at Cornell, dealing primarily with India, Pakistan, Ceylon, and Nepal, is organized and equipped to help meet this need. Since 1948 it has sponsored a series of research projects on India and Ceylon, and it has trained a distinguished group of younger American and South Asian scholars in South Asian area and language studies. The Program faculty includes members from agricultural economics, anthropology, government, history of art, child development and family relationships, business and public administration, rural sociology, industrial and labor relations, city and regional planning, and languages. Sanskrit, Pali, Hindu, Urdu, Telugu, and Sin-

halese are languages regularly offered at Cornell. Arrangements may be made for the intensive study of other South Asian languages at summer institutes held on different American university campuses each year.

Qualified graduate students interested in specializing in the study of South Asia minor in Asian Studies with concentration on South Asia, in South Asian art history, or in South Asian linguistics. Advanced degree requirements for this minor are roughly comparable in terms of South Asian materials to those for the Southeast Asia concentrations given below. The doctoral candidate must have a reading knowledge of Hindi or, depending upon the subarea of his specialization, some other important language of South Asia.

RESEARCH AND FIELD TRAINING

The doctoral dissertations of students in the South Asia Program are normally based on research done in India, Pakistan, Ceylon, or Nepal. Students' field research may benefit from the advice and guidance in the field of a program staff member. At least one member of the faculty of the South Asia Program has been in South Asia for each of the last several years. Cornell is a charter member of the American Institute of Indian Studies, which was organized to facilitate study and research in India by American advanced students and by faculty specializing in various aspects of Indian civilization and contemporary affairs. The University also maintains close links with a number of research agencies, programs, and institutions of higher learning, such as the Deccan College Linguistic Program. Staff members of these institutions have provided valuable assistance to Cornell students working in India. There are opportunities for graduate students to become associated with Cornell-sponsored research in South Asia or to carry on independent research abroad. Every effort is made by the Program staff to aid qualified students to obtain financial support for a field training or research project in one of the countries of the area.

Research interests under the South Asia Program are focused largely on recent or contemporary developmental problems of the countries of the area — on changes taking place in the economic, political, social, religious, artistic, and intellectual life of the region. A long-term research project in progress in India is primarily concerned with the ramifying problems of introducing technological changes and the influence of such changes when adopted. For this research program, faculty and students in anthropology have carried on, since 1949, an extended and varied series of rural and urban community studies in several different regions of India from the Deccan into the Himalayan foothills. A major related project, the Cornell International Agricultural Development Program, which is supported by Ford Foundation funds, is concerned with the development of the entire agricultural sector of the Indian economy. At the same time other studies in urban renewal and regional planning, public administration, the role of government in cultural change, and recent movements in the arts and in religions and ideologies are in process under faculty direction. Cornell is also making a special study of the Sinhalese language and of linguistic

problems of Ceylon, a nation so far much neglected by American scholars. Research is also under way on Oriya, an important regional language of eastern India. The new nations of South Asia present so many problems for study that the areas of inquiry open to students and staff members are limited only by availability of research means.

FELLOWSHIPS AND ASSISTANTSHIPS

Fellowship and assistantship awards are available to qualified graduate students minoring in Asian Studies with a concentration on South Asia. The South Asia Program fellowships are open to incoming graduate students with South Asia interests. Stipends range up to $2,500 plus tuition and General Fee, and should be applied for by writing to the Director, South Asia Program, 400C White Hall. Students in the South Asia Program are also eligible for assistantships in their major discipline departments, for fellowships and scholarships offered by the Cornell Graduate School, for National Defense Foreign Language fellowships, and for Foreign Area Training fellowships. Additional information on financial aid may be obtained by writing to the Director, at the address given above.

Southeast Asia Program

FACULTY: John M. Echols, Frank H. Golay, Alexander B. Griswold, Tom Harrisson, Robert B. Jones, Jr., George McT. Kahin, Stanley J. O'Connor, Robert A. Polson, Lauriston Sharp, James T. Siegel, Selo Soemardjan, Oliver W. Wolters, John U. Wolff.

The Southeast Asia Program possesses substantial facilities for study and research on the graduate level and provides exceptional opportunities for general or specialized work on all of Southeast Asia in various disciplines of the humanities, social sciences, and some natural sciences, as well as in interdisciplinary area seminars. Much basic and pioneering research remains to be done in this area, and the Southeast Asia Program is organized and equipped to help meet such needs.

Southeast Asia Program fellowships are available on a competitive basis to graduate students. They carry stipends of up to $3,000 plus tuition and fees, and are available only to qualified candidates for advanced degrees at Cornell. Competition for these awards is open to citizens of the United States or Canada, nationals of Southeast Asian countries, and, in exceptional cases, nationals of other countries.

The fellowships are available to applicants who are able to demonstrate a serious scholarly interest in Southeast Asian studies; who show the greatest promise of becoming qualified regional experts with specialization in a relevant discipline of the humanities, social sciences, or certain natural sciences; and who are admitted to the Cornell Graduate School for advanced work in such a discipline. Previous experience in Southeast Asia or in the study of that area is not necessarily required. It is important that the applicant be able to show that advanced work in a major subject offered at Cornell, combined with work in the Southeast Asia Program, will make his future professional activities

more effective; this requirement is particularly important for a student in the natural sciences.

Fellowships are normally awarded for one academic year. Where the student's work during the first year has been of high caliber, reappointment is sometimes possible. In such cases, formal reapplication is expected from the student. The primary purpose of these awards is to encourage graduate students to acquire a substantial knowledge of Southeast Asia while majoring in one of the discipline Fields of the Graduate School. Accordingly, they are usually offered only to students who take a minor in Asian Studies and participate fully in the Southeast Asia Program. The recipient of a fellowship may be asked to devote up to six hours a week under faculty supervision to work connected with the Program.

London-Cornell Studentships are available for advanced Ph.D. candidates in the social sciences (including modern institutional history) who have already had at least one year of resident study in the Southeast Asia Program. These fellowships are tenable for study during an academic year at the London School of Economics and Political Science or at the School of Oriental and African Studies in the University of London. Stipends range up to $3000 plus air fares and tuition and fees. London-Cornell Field Research Grants are open to Southeast Asia Program Ph.D. candidates in the social sciences (including modern institutional history) after they have had appropriate training at Cornell, or at Cornell and London. They are tenable for up to 22 months for the purpose of dissertation research. Recipients of London-Cornell Field Research Grants may conduct research in any part of Southeast Asia. Stipends range up to $12,000 for 22 months including travel and research expenses.

National Defense Foreign Language fellowships, Title VI, are offered by the United States Office of Education and application should be made to the Sage Graduate Center, Cornell University. Foreign Area Training fellowships, administered by the Social Science Research Council, may be obtained by writing to the Foreign Area Fellowships Program, 444 Madison Avenue, New York, New York 10022. Graduate students may also apply for other assistantships, fellowships, and scholarships offered by the University and its departments.

Additional information on the Program and the various fellowships and awards may be obtained by writing to the Director, Southeast Asia Program, Franklin Hall.

Soviet Studies

COMMITTEE ON SOVIET STUDIES: George Gibian, Chairman; Urie Bronfenbrenner, M. Gardner Clark, Jack Fisher, Richard Leed, Walter Pintner, Myron Rush, George Staller.

OTHER FACULTY MEMBERS IN SOVIET STUDIES: Patricia Carden, Frederick Foos, Antonia Glasse, Martin Horwitz, Augusta Jaryc, Alexander Lipson, John Menaker, Hugh Olmsted.

The University offers a number of courses and seminars on the Soviet

Union as well as Imperial Russia. Instead of a separate area program, graduate students have a choice of majors and minors in the established Fields of the Graduate School. Some of the subjects focus on area specialization: Russian history, Russian literature, Slavic linguistics. Other subjects combine area specialization with a non area framework: comparative government, economic planning, regional planning, social psychology.

Graduate students pursuing Soviet Studies in any of these subjects are expected to attain proficiency in the Russian language either before entering the Graduate School or soon thereafter.

The University's academic activities related to Russia are coordinated by the Committee on Soviet Studies. The Committee also sponsors a colloquium for faculty members and graduate students in Soviet Studies. In the Soviet Studies Graduate Study in the John M. Olin Library, major reference works and key current periodicals from and about the U.S.S.R are brought together.

The Committee on Soviet Studies selects a limited number of graduate students each year as research assistants. The Russian section of the Division of Modern Languages also appoints several graduate students annually as teaching assistants in the Russian language. For other teaching assistantships, fellowships, and scholarships, students apply directly to the Graduate School or the Department concerned. N.D.E.A. Title IV and Title VI fellowships are available in various subjects.

FACULTY SPECIALIZATION

ECONOMICS: M. Gardner Clark, George J. Staller.

HISTORY: Walter M. Pintner.

LANGUAGES and LINGUISTICS: Frederick Foos, Richard Leed, Alexander Lipson, Mrs. Augusta Jaryc, Hugh Olmsted, John Menaker.

LITERATURE: George Gibian, Miss Patricia Carden, Miss Antonia Glasse, Martin Horwitz.

POLITICAL SCIENCE: Myron Rush.

PSYCHOLOGY: Urie Bronfenbrenner.

REGIONAL and CITY PLANNING: Jack C. Fisher.

Inquiries about fellowships and other aspects of Soviet Studies should be addressed to Professor George Gibian, Chairman, Committee on Soviet Studies.

OTHER PROGRAMS AND CENTERS

American Studies

COMMITTEE ON AMERICAN STUDIES: Robert H. Elias, Acting Chairman; Stuart M. Brown, Jr., David B. Davis, Douglas F. Dowd, Andrew Hacker, Clinton Rossiter, S. Cushing Strout, Robin M. Williams, Jr.

Although there is no formal program leading to a degree in American Studies, candidates for the doctorate in English and in History will find

ample opportunity to do interdisciplinary work in conjunction with a major in the American area of their Field. There are members of the staff in both Fields who are professionally trained and currently active in the study of the interrelationships of American intellectual, literary, and social history, so that a student concentrating in American literature or American history may take advantage of the freedom permitted by Graduate School regulations and, in collaboration with his special committee, readily build an individual doctoral program that systematically embraces more than a single discipline. Inquiries concerning opportunities in this area should be addressed to Professor Robert H. Elias, Acting Chairman, American Studies Committee, Goldwin Smith Hall.

Brookhaven National Laboratory

Cornell is one of nine eastern universities participating in Associated Universities, Inc. (AUI). Operating under contract with the Atomic Energy Commission, this corporation has the responsibility for the management of Brookhaven National Laboratory. The laboratory provides unusual research facilities for studies in biology, chemistry, applied mathematics, medicine, physics, high-energy particle physics, and reactor and nuclear engineering.

Graduate students may participate in research at Brookhaven by association with Cornell staff members who are engaged in research at the laboratory. Members of a variety of science departments at Cornell are currently involved in programs at Brookhaven. The laboratory also offers temporary summer appointments to a limited number of selected graduate and undergraduate students majoring in science or engineering.

Center for Advancement of Education

The Center for Advancement of Education represents the commitment of the total University to educational research and development. Members of the Center are drawn from various academic units. Projects are carried out under the auspices of the Center; such projects may increase to reflect the interests of faculty members. At present, research programs in language development and literacy, in mathematics, and in science education are under way. In addition, a research program on the administration of higher education as well as one on the undergraduate collegiate curriculum are being planned.

The Center provides predoctoral and postdoctoral training through research assistantships, training grants, and postdoctoral fellowships. For information write to the Director, Center for Advancement of Education, Stone Hall.

Center for Aerial Photographic Studies

Photographic interpretation has applications in agriculture, engineering, geology, and city and regional planning. The Center for Aerial Photographic Studies offers a broad program in various scientific fields

for training personnel in aerial photographic interpretation. The objectives are, first, to train scientists who will be able to use aerial photographs for surveys and planning in fields where they are needed and, second, through research to extend the use of aerial photographs into all fields which can be benefited.

The Center comprises a staff of educators, scientists, and technicians experienced in research and the application of aerial photographs to their respective fields. The program consists of primary courses in interpretation of aerial photographs, map reproduction, photogrammetry, cartography and map projections, together with specialized study in a particular field of the candidate's choice, such as agricultural development, national resource explorations, city planning, or engineering project planning.

For more information, write to Professor Donald J. Belcher, Director, Center for Aerial Photographic Studies, Hollister Hall.

Center for Housing and Environmental Studies

The purposes of the Center for Housing and Environmental Studies are to aid and guide basic research in the field of man's shelter and environment, to facilitate graduate study, and to aid the flow of information among colleges and departments and between the University and sources of information off campus. A small central staff assists in the initiation and conduct of projects.

The facilities of the Center for Housing and Environmental Studies are available to faculty members and graduate students in all fields. Through the Center, students who cut across traditional lines of research may draw upon the knowledge and experience of specialists in such various subject areas as design, materials, equipment, structural methods, environment, family living, economics and finance, government, and health. The Director of the Center is Professor Glenn H. Beyer, West Sibley Hall.

There are two divisions in the Center, one focusing on urban and the other on regional problems. The Division of Urban Studies is under the direction of Professor Barclay G. Jones, Associate Director of the Center, West Sibley Hall, and the Division of Regional Studies is under the direction of Professor Jack C. Fisher, Assistant Director of the Center, West Sibley Hall.

Center for Radiophysics and Space Research

The Center for Radiophysics and Space Research unites research and graduate education carried on by several academic departments in the space sciences. It furnishes administrative support and provides facilities for faculty members and graduate assistants who are engaged in space research activities, and it offers opportunity for graduate students to undertake thesis work leading to the degrees of Master of Science and Doctor of Philosophy. A student's major professor can be chosen from the following Fields in the Graduate School: Aerospace

Engineering, Astronomy and Space Sciences, Electrical Engineering, Applied Physics, Physics.

Thesis research in the following areas is now possible:

(a) Astronomy and Astrophysics. Astronomical aspects of cosmic rays, gamma-radiation, X-rays, neutrinos; cosmology; experimental studies and theory relating to the surface of the moon and the planets; processes in the interstellar gas; solar-system magnetohydrodynamics; stellar statistics; theory of stellar structure, stellar evolution, nuclear processes in stars.

(b) Atmospheric and Ionospheric Radio Investigations. Dynamics of the atmosphere; incoherent electron scattering; study of refraction, scattering, attenuation due to the inhomogeneous nature of the troposphere and ionosphere; theory and observation of propagation of radio waves in ionized media such as the ionosphere.

(c) Radar and Radio Astronomy. Distribution and classification of radio sources; radar investigations of the moon and planets; solar radio observations; studies of gaseous nebulae.

(d) Space Vehicle Instrumentation. Instrumentation relating to lunar exploration; magnetic field measurements; tenuous gas and particle flux measurements; infrared observations from rockets.

The facilities of the Center include the lunar surface and electronics laboratory on the Cornell campus, the radio astronomy and ionospheric laboratories close to Ithaca, and the Arecibo Ionospheric Observatory in Puerto Rico. At Arecibo an extremely sensitive radio telescope and an unusually powerful space radar are available for use by qualified graduate students. In addition, certain facilities of Sydney University, Australia, are available through the Cornell-Sydney University Astronomy Center (see below).

Cornell-Sydney University Astronomy Center

The Center is an inter-University organization designed to create a larger pool of facilities and skills for research in astronomy and related fields than would be separately available to either university. Graduate students can be interchanged between the two institutions whenever appropriate for the research work in which they are engaged. Both universities recognize research supervision extended by the sister university and the time spent by a student on thesis work in the sister university can be accepted toward residence requirements with the proviso that the approval of the home research supervisor is given and also that the home university bylaws are not contravened.

The facilities available through the Center, in addition to those of Cornell's Center for Radiophysics and Space Research, are the 1-mile by 1-mile Mills Cross situated at Hoskinstown, New South Wales; the stellar intensity interferometer situated at Narrabri, New South Wales; the Criss-Cross, the Shain Cross, and Mills Cross situated at Fleurs, New South Wales; the Wills Plasma Physics Department, the Basser Computing Department, the Falkiner Nuclear Department, and the facilities of the cosmic ray group at the University of Sydney. The Center includes

H. Messel, R. Hanbury Brown, W. N. Christiansen, C. B. A. McCusker, and B. Y. Mills from the University of Sydney faculty.

Further information can be obtained from Professor T. Gold, Joint Director, Cornell-Sydney University Astronomy Center, Clark Hall.

Computing Center

The Computing Center is equipped with a Control Data Corporation 1604-160A Computing System with eight magnetic tape units, 1200-cards-per-minute reader, 1000-lines-per-minute printer, card punch, and plotter. This is supported by a normal complement of Unit Record equipment and numerous keypunches. An IBM System 360 Model 67 Time Shared computer is scheduled for delivery in the third quarter of 1967.

The Center is designed to service the research and instructional needs of the University. The professional staff provides consultation in computer use and project feasibility, and presents informal training seminars. Their work is supplemented by that of several research associates and six or more graduate students from a number of Fields.

The service areas of the Center are keypunching, programming, and operations. The computer operations are "closed-shop" with operators scheduled for all the required hours. Students are allowed access to the Unit Record equipment and keypunches. The Center makes an hourly rate charge for each service. Staff or students requiring these services are provided with funds by their departments if they have no other source of support.

For further information about the Computing Center, write to the Director, Computing Center, Rand Hall.

Division of Biological Sciences

The Division of Biological Sciences was established in 1964 to bring together into a single administrative unit a number of investigators and teachers representing a broad spectrum of interests in basic biology. Its members hold appointments in one or more of four schools and colleges but serve the University as a whole through the Division. The Division is responsible for all the undergraduate teaching of biology, including the establishment of requirements for the major in its various branches. It also has the primary responsibility for the promotion of research in basic biology, and its members engage in graduate teaching through participation in appropriate Fields in the Graduate School Faculty. At present the following subject areas are represented by separate sections of the Division: biochemistry; ecology and systematics; genetics, development, and physiology; microbiology; and neurology and behavior. A number of graduate teaching and research assistantships, fellowships, and traineeships are available through the Division.

Materials Science Center

The Materials Science Center (MSC) at Cornell is an interdisciplinary laboratory created to promote research and graduate student training

in all phases of the science of materials. The subjects of study represented in the MSC program are applied physics, chemistry, electrical engineering, materials engineering, materials science, metallurgy, and physics.

The extent of the benefits a graduate student may derive from the MSC program depends on the actual research he pursues. If the student chooses to follow the more conventional course of becoming a specialist in one specific area, some of the ways the MSC program could help him would be to provide new equipment; to provide, in some cases, the help of a technician to carry out routine measurements; and to provide financial assistance through research assistantships.

If the student wishes to follow a program of considerably more breadth than usual in his research training, the MSC program provides an additional advantage. Several central facilities have been set up where more specialized apparatus such as crystal-growing furnaces, high-pressure equipment, X-ray and metallography equipment, electron microscopes, etc., are available to all MSC members and their students. In addition to the equipment, expert advice on its use and the interpretation of the results will be available. In these central facilities, it is expected that the student will come in contact with students from other disciplines, resulting in a mutually profitable interaction.

The office of the Director of the Materials Science Center, Professor Henri Sack, is in Room 627, Clark Hall.

Military Science and Aerospace Studies (AFROTC)

The advanced course in military science (Army ROTC) and aerospace studies (Air Force ROTC) is open to graduate students who have satisfactorily completed a basic course in ROTC or who enroll in the two-year ROTC program. Successful completion of the two-year advanced ROTC course will qualify a graduate student for appointment as a Second Lieutenant in the U.S. Army or Air Force Reserve, or in the Regular Army or Air Force. Interested graduate students should consult the *Announcement of Officer Education* and apply to the Professor of Military Science or Professor of Aerospace Studies (ROTC), Barton Hall.

Statistics Center

The methods of statistics find important applications in many diverse fields of research. It is therefore necessary that (1) subject matter specialists be able to obtain assistance in using or developing statistical theory, (2) students who intend to do research in a particular field which makes extensive use of statistical methods receive adequate training in statistics, and (3) individuals be trained as statisticians.

The staff members of the various schools and colleges of Cornell University who are interested in the development and application of statistical methods are associated with the Cornell Statistics Center. A major responsibility of the Center is to provide a focal point to which in-

dividuals, projects, and departments may come to receive assistance and guidance with respect to the statistical aspects of research and training programs.

The Acting Director of the Center is Professor Philip J. McCarthy, Ives Hall.

Water Resources Center

The Center is an interdisciplinary organization serving the entire University at the graduate study and research level. Its purpose is to promote and coordinate a comprehensive program in water resources planning, development, and management in such areas as the sciences, engineering, agriculture, law, economics, government, regional planning, and public health.

Its responsibilities are to undertake water resources research in engineering, in the physical, biological, and social sciences, and in the humanities; encourage and contribute to graduate studies in water resources; coordinate research and training activities in areas concerned with water resources; encourage new combinations of disciplines in research and training which can be brought to bear on water resources problems; disseminate the results of research; and develop and operate central facilities which may be needed to serve participants in research and training.

See also the section on the Field of Water Resources, page 455.

Correspondence concerning the Center should be directed to Professor L. B. Dworsky, Director, Water Resources Center, Hollister Hall.

Correspondence related to graduate study in the Field of Water Resources should be directed to the Field Representative, Professor C. D. Gates, Hollister Hall.

SPECIAL FACILITIES AND SERVICE ORGANIZATIONS

Cornell Aeronautical Laboratory

The Laboratory, a separate corporation wholly owned by Cornell University, is in Buffalo, New York. Applied and fundamental research in the aeronautical sciences and allied areas is conducted in this completely equipped laboratory under contracts mainly with government and industry. Close relationships, both research and educational, are maintained with the campus in Ithaca.

New York State Agricultural Experiment Station at Geneva

The New York State Agricultural Experiment Station was established in 1880 to promote agriculture through scientific investigations and experimentation. It is located at Geneva, 50 miles from Ithaca, and has been under the administration of Cornell University since 1923.

Professors on the Geneva staff are eligible to serve as members of the Special Committees of graduate students along with professors on the Ithaca campus of the University. Normally the graduate training provided at Geneva consists of research experience and supervision of the student's work on a thesis problem. The formal course work part of the student's training program is given on the Ithaca campus. Students who plan to do part of their graduate work at Geneva should correspond with their major advisers or with the Dean of the Graduate School concerning regulations as to residence, Special Committees, etc.

The Station is equipped to care for graduate students in certain specific lines of research, viz., bacteriology, chemistry, economic entomology, food technology, plant pathology, pomology, seed investigations, and vegetable crops. Ample facilities are available for graduate research under laboratory, greenhouse, pilot plant, insectary, orchard, and other field conditions.

Certain phases of the investigations now being conducted at the Station and other problems for which the facilities of the Station are suitable may be used as thesis problems by graduate students.

The Director is Professor D. W. Barton, who may be addressed at the New York State Agricultural Experiment Station, Geneva.

University Press and Photography

Cornell University Press, founded by Andrew D. White in 1869, is the oldest university press in America and is among the leaders in number of volumes published annually. The Press publishes scholarly books on nearly every academic subject, serious nonfiction of general interest, and advanced or experimental textbooks for use in universities. The imprint of Comstock Publishing Associates, a division of the Press, is placed on certain books in the biological sciences. The Press also publishes a distinguished paperbound series, Cornell Paperbacks.

The University owns and operates the Photo Science Studios, which create or cooperate in the creation of photographic studies and visual aids of all kinds.

The extension services of the New York State Colleges, which form integral parts of the University, disseminate knowledge through an intensive program of publication, photography, and recording supervised by professional staffs. Materials of graduate students may find outlets through these channels.

Other Research Units

Some other research units allied with the University, either as wholly owned and operated divisions or as wholly or partially autonomous organizations with which the University has a working agreement, are the Sloan-Kettering Cancer Research Institute in New York City, through the Graduate School of Medical Sciences, and the Veterinary Virus Research Institute in Ithaca.

Cornell is also one of fourteen founding members of the University Corporation for Atmospheric Research which, under National Science

Foundation support, operates the National Center for Atmospheric Research at Boulder, Colorado.

In addition, opportunities for formal study, field work, and independent research by Cornell graduate students are available in many institutions, laboratories, and libraries both in the United States and in other countries. For example, the Cornell-Harvard Archaeological Exploration at Sardis, Turkey, and the Museum of Northern Arizona at Flagstaff, Arizona, both provide opportunities for field research related to doctoral work of Cornell graduate students. Information on this kind of arrangement is available directly from the Field Representatives.

FIELDS OF INSTRUCTION

REPRESENTATIVES. Since instruction in the Graduate School is primarily individual, those interested in becoming students are encouraged to communicate with individual members of the faculty with whom they may want to study. Personal interviews in advance of formal application for admission are especially encouraged. For the benefit of those who are not acquainted with appropriate members in the Field or Fields of their interest, each Field has selected a representative, as director of graduate studies, to whom inquiries may be addressed.

HUMANITIES

Fields of: Architecture, Art, History of Art and Archaeology, City and Regional Planning, Classics, Comparative Literature, English Language and Literature, German, History, Medieval Studies, Music, Philosophy, Romance Studies, Semitic Studies, Slavic Studies, and Speech and Drama.

Architecture

Field Representative: Colin Rowe, 156 East Sibley Hall.

The three programs in which graduate study in architecture may be pursued are Urban Design, Architectural Structures, and Architectural History. Graduate study is also offered in the Fields of Art and City and Regional Planning. Every applicant for graduate study is expected to select and identify in advance the program he intends to follow.

Foreign students whose undergraduate training has been outside the United States are admitted to provisional candidacy during the first semester, during which their qualifications to continue in their selected programs will be evaluated. In most cases, they should plan to spend at least four terms in residence.

URBAN DESIGN

Students who have satisfactorily completed a five-year course in architecture at an approved institution, or its equivalent, may be admitted as candidates for the degree of Master of Architecture in the professional program of Urban Design.

Urban design is an integrated approach concerned with the solution in architectural terms of the developments proposed by city and regional planning. The program of study includes an interpretation of such course material from architecture and planning as will equip the student with an adequate conceptual framework for practice, and is particularly concerned with the three-dimensional definition of the urban environment in terms which give significance to the individual.

The program of study, cooperatively worked out between the faculties of Architecture and City and Regional Planning, permits a degree of special treatment for the individual student. Normally, four semesters of study are required, and the student should not anticipate completing his studies in less than this time, though in certain special circumstances the requirements for a degree may be completed within a three-semester period. It is possible in

individual cases, by specific arrangement in advance, to complete the requirements for both the Master of Architecture and Master of Regional Planning degrees in three years.

Faculty

Colin Rowe, B.Arch. (University of Liverpool), M.A. (University of London), M.A. (Cambridge). Professor of Architecture. Professor Rowe is in charge of the program in urban design. In addition to his teaching activities in this area, Mr. Rowe, whose graduate work was in the history of art, also teaches architectural history and is a critic of architecture.

In addition to visiting critics, members of the College of Architecture faculty take part in the urban design program. Those participating have been as follows:

Lee F. Hodgden, B.Arch.Engr. (University of Kansas), M.Arch. (Massachusetts Institute of Technology). Associate Professor of Architecture.

Werner Seligmann, B.Arch. (Cornell University). Associate Professor of Design.

John P. Shaw, B.Arch. (University of Texas), M.Arch. (Massachusetts Institute of Technology). Associate Professor of Architecture.

J. Alan Wells, B.Arch. (University of Texas). Assistant Professor of Architecture.

Stuart W. Stein, B.Arch. (Massachusetts Institute of Technology), M.C.P. (Massachusetts Institute of Technology). Associate Professor of Design.

Courses

In addition to the basic core courses listed below, the student will also take a substantial number of courses in city and regional planning (see p. 59). The student may also take courses in related areas such as architectural history, architectural structures, the psychology of perception, sociology, government, etc. For illustrative curriculum see the *Announcement of the College of Architecture.*

ARCHITECTURE 190–191. PROBLEMS IN URBAN DESIGN

Throughout the year. Credit as assigned.

The basic first-year design course for graduate students in urban design. Instruction consists of individual criticism over the drafting board.

ARCHITECTURE 192–193. PROBLEMS IN URBAN DESIGN

Throughout the year. Credit as assigned. Continuation of Architecture 190–191.

ARCHITECTURAL STRUCTURES

Qualified students enrolled by the Graduate School of the University in programs leading to the degree of Master of Science may elect Architectural Structures as either a major or a minor subject, and those enrolled in programs leading to the degree of Doctor of Philosophy may elect it as a minor subject. Programs of study will be arranged to meet the needs of the individual student.

The objectives of the graduate program in Architectural Structures are:

1. To afford an opportunity for students of architecture to expand their creative design potential by increasing their knowledge and understanding of structural technology.

2. To provide a framework within which students graduating in related technical disciplines, for example, civil engineering, can explore structural technology as it applies specifically to architecture. For students with such background, this type of training would prepare them for joining the ranks of consultants to the architectural profession who are well versed in the architectural implications of structure.

Students with undergraduate degrees in architecture, architectural engineering, or the various branches of engineering are likely candidates for this program. The program as it is organized is extremely flexible and can be arranged to meet the specific needs and desires of the individual student and to build on his prior technical preparation and competence. For those students who are applying with a straight engineering background, exposure to architectural disciplines would be included in the program of study.

Candidates for the Master of Science degree with a major in Architectural Structures must satisfy the following requirements: (a) completion of the program of study prescribed by the student's Special Committee; (b) a minimum of two terms of residence; (c) presentation of a satisfactory thesis; and (d) passing of a final comprehensive examination.

Ordinarily more than two terms of residence will be required to complete the program of study; depending on the student's background and experience related to his needs and interests. A portion of the student's program will consist of formal course work. Structures courses offered by the College of Architecture are shown below. In addition, a student may select courses offered elsewhere in the University, such as civil engineering, engineering mechanics, mathematics, etc.

The scope of the program has been expanded by the addition of a structural model laboratory. Also, the facilities of the Cornell Computing Center are available to make it possible to explore, in detail, digital computer applications in architecture and structure.

Faculty

Raymond A. DiPasquale, B.S.C.E. (Purdue University), M.Arch. (University of Illinois), M.S.Arch.Engr. (University of Illinois). Associate Professor of Architecture. (In charge of graduate program of Architectural Structures.)

Professor DiPasquale's teaching, research, and practice are concentrated in the area of structural technology. Particular interests are in computer applications in Architecture and structural model analysis.

Ludlow D. Brown, B.Arch. (Cornell University), M.Arch. (Cornell University). Professor of Architecture.

Professor Brown's teaching and research activities center on the evolution and development of fundamental principles and theory as applied to architectural structure. Interest in particular focuses on ultimate strength theories, limit design, and the strategy of prestress as applied to buildings.

Francis W. Saul, B.S. (U.S. Military Academy), M.S. (Harvard University). Associate Professor of Architecture.

Professor Saul's teaching activities lie in the area of structural steel and reinforced concrete building design. Main research interests are in structural plastics and blast-resistant design.

Courses

ARCHITECTURE 221. ADVANCED STEEL BUILDING DESIGN

Fall term. Credit three hours. Elective. Prerequisite, Architecture 204 and permission of the instructor. Mr. Saul.

Design and investigation of advanced systems of steel building structure, including plastic design of continuous beams and rigid frames, and composite steel beam and concrete slab construction.

ARCHITECTURE 222. ADVANCED REINFORCED CONCRETE BUILDING DESIGN

Fall term. Credit three hours. Elective. Prerequisite, Architecture 204 and permission of the instructor. Mr. DiPasquale.

Continuity in building design. Review of methods and specifications for design of reinforced concrete members. Behavior and design of two-way framing systems. Rigid frames. Precast construction. Ultimate strength, yield line theory, and torsion.

ARCHITECTURE 223. BUILDING SUBSTRUCTURE

Spring term. Credit three hours. Elective. Prerequisite, Architecture 204 and permission of the instructor. Mr. Saul.

The principles of soil mechanics, subsurface exploration, and design of building foundations. Footings, piles, subgrade walls.

ARCHITECTURE 224. PRESTRESSED BUILDING STRUCTURES

Spring term. Credit three hours. Elective. Prerequisite, Architecture 204 and permission of the instructor. Mr. Brown.

The application of prestress as a fundamental strategy. Design of prestressed steel and concrete building elements.

ARCHITECTURE 225. STRUCTURES SEMINAR

Either term. Credit two hours. Elective. Prerequisite, Architecture 204. Registration limited to ten. Staff.

Contemporary structural systems, materials, and ideas discussed from a comparative and analytical point of view.

ARCHITECTURE 230. ADVANCED STRUCTURAL PRINCIPLES

Fall term. Credit three hours. Elective. Prerequisite, Architecture 202, a course in differential and integral calculus, and permission of the instructor. Mr. DiPasquale.

Planned to prepare the student for advanced structural theory applied to architectural structures. Topics will include a review and elaboration of basic structural principles and extension of previous work in mechanics of materials. The formation and qualitative behavior aspects of structural systems. Introduction to digital computers.

ARCHITECTURE 231. ADVANCED STRUCTURAL THEORY

Either term. Credit three hours. Elective. Prerequisite, Architecture 230 or permission of the instructor. Mr. DiPasquale.

Fundamental methods for analysis of building structures: classical and approximate. Lateral load analysis of multi-story building frames. Introduction to model analysis. Use of digital computers.

ARCHITECTURE 232. ADVANCED STRUCTURAL THEORY

Fall term. Credit three hours. Prerequisite, Architecture 231. Mr. DiPasquale.

Extension of Architecture 231 to analysis of three-dimensional frameworks, cable-supported, and other complex structures.

ARCHITECTURE 233. SURFACE STRUCTURES

Spring term. Credit three hours. Elective. Prerequisite, Architecture 231 and permission of the instructor. Mr. DiPasquale.

The qualitative and quantitative analysis and design of folded plate and thin shell architectural structures.

ARCHITECTURE 234. DESIGN FOR DYNAMIC LOADING

Fall term. Credit three hours. Elective. Prerequisite, Architecture 204 and 231. Mr. Saul.

The considerations involved in the design of building structures to resist earthquake, explosion, and other dynamic loads.

ARCHITECTURE 240. SPECIAL PROBLEMS IN ARCHITECTURAL STRUCTURES

Either term. Registration and credit by arrangement. Elective. Staff.

ARCHITECTURE 241. MODEL ANALYSIS OF STRUCTURES

Spring term. Credit three hours. Elective. Prerequisite, Architecture 231. May be concurrent with 231. Mr. DiPasquale.

Principles of similitude. Design of structural models for direct and indirect methods of stress analysis. Instrumentation. Selected projects.

ARCHITECTURE 250. ULTIMATE STRENGTH THEORY

Fall term. Credit three hours. Elective. Prerequisite, Architecture 204 and permission of the instructor. Mr. Brown.

A survey of flexural theory beyond the elastic range and the principles of limit design relationships applied to continuous steel and reinforced concrete construction.

ARCHITECTURE 251–254. GRADUATE READINGS IN STRUCTURES

Either term. Credit two hours. Open to graduate students only. Mr. DiPasquale.

Critical review and discussion of classical and current literature in architectural structures.

ARCHITECTURE 290. THESIS OR RESEARCH IN ARCHITECTURAL STRUCTURES

Either term. Credit as arranged. Graduate students only. Staff.

ARCHITECTURAL HISTORY

Graduate work in Architectural History may be undertaken by students whose undergraduate programs emphasized history of art, architecture, or related subjects. Architectural history may be elected as either a major or a minor subject by students enrolled in the Graduate School of the University. All applicants resident in the United States during the year preceding matriculation must submit scores of the Graduate Record Examination Aptitude Tests with their transcripts and other credentials.

To complete the requirements for the degree of Master of Arts in architectural history, candidates must pass examinations in their major and minor subjects of study. Unless special conditions obtain, a reading knowledge of one approved foreign language must be demonstrated and a thesis submitted. To complete the requirements for the degree of Doctor of Philosophy with architectural history as their major subject, candidates must pass examina-

tions in their major and two minor subjects. A reading knowledge of two approved foreign languages must be demonstrated and a dissertation submitted.

The graduate program in architectural history is concerned with methods of scholarship and research, as well as the development of architecture and related arts from the earliest times to the present day. A special feature of the program is the opportunity for the student to prepare for the teaching of the history of architecture in the context of the professional school of design. Opportunities are usually available for students to take part in special activities, such as the Cornell-Harvard Archaeological Exploration of Sardis, Turkey. In cooperation with the Department of City and Regional Planning, coordinated programs are arranged to permit study of both the history of urban development and of planning for the appropriate use and conservation of historic buildings.

Close coordination is maintained with the Department of History of Art in the College of Arts and Sciences, enabling students to benefit from courses and special studies in the history of art and architecture offered there. Programs in the history of interiors and of housing are available in the Department of Housing and Design of the College of Home Economics. There is a cooperative program in archaeology involving several departments on the campus, and there are strong area programs with architectural potential, in particular the Southeast Asia Program and Slavic and Latin American studies. The Fine Arts Library of 32,000 volumes, in Sibley Hall, the College of Architecture's main building, provides resources for study and preparation of the thesis or dissertation. It is particularly strong in the areas of American architecture and of modern art and architecture. Additional materials on the history of architecture are available in the Olin Research Library and the Mann Library, described elsewhere in this Announcement.

Faculty

Stephen W. Jacobs, A.B. (Harvard University), B.Arch. (Harvard University), M.F.A. (Princeton University), Ph.D. (Princeton University). Associate Professor of Architecture.

The graduate program in history of architecture is under the direction of Professor Jacobs, whose teaching covers the spectrum of the history of art and architecture. His special field is the history of American and European architecture since 1750. His research has centered in problems of identification, evaluation and preservation of architecture, and other environmental aesthetic and cultural resources. He has also been active in the archaeological work at Sardis.

Robert G. Calkins, A.B. (Princeton University) M.A. (Harvard University), Assistant Professor of History of Art.

Professor Calkins' area of specialization is medieval art and architecture. Currently his research centers in Burgundian illuminated manuscripts of the fourteenth and fifteenth centuries.

A. Henry Detweiler, B.Arch. (University of Pennsylvania). Professor of Architecture.

Professor Detweiler's area of interest is ancient and medieval architecture, including the Islamic. For many years he has been active in archaeological field work in the Middle East, and he is associate director of the Cornell-Harvard Expedition to Sardis in Turkey. His current studies center in the transition from the classic to the architecture of the Early Middle Ages.

Michael Hugo-Brunt, B.Arch. (University of Capetown), M.C.D. (University of Liverpool), M.Arch. (Cornell University). Associate Professor of City and Regional Planning.

Professor Hugo-Brunt's teaching is concerned with the history of architecture, landscape architecture, and city planning. His research has centered in the development of colonial towns in both the Eastern and the Western hemispheres. He has also made extensive studies of the development of Georgian London and the maritime settlements.

Kermit C. Parsons, B.Arch. (Miami University), M.R.P. (Cornell University). Professor of City and Regional Planning.

Professor Parsons' teaching, research, and practice are devoted to urban design, land use, and institutional planning. His special interests include the history of collegiate architecture.

John W. Reps, A.B. (Dartmouth College), M.R.P. (Cornell University). Professor of City and Regional Planning.

Professor Rep's teaching includes planning administration as well as the history of city planning in the United States and Europe. His special interest is the development of urban America, with particular emphasis on the design character of its cities.

Colin Rowe, B.Arch. (University of Liverpool), M.A. (University of London), M.A. (Cambridge University). Professor of Architecture.

In addition to directing the graduate program in urban design, Professor Rowe teaches in the area of history of Renaissance and modern architecture. His special interests include architectural criticism and contemporary European and American architecture.

Courses

ARCHITECTURE 430. THE ANCIENT NEAR EAST

Credit three hours. Prerequisite, Architecture 400 or permission of the instructor.

Architecture of the oldest historic civilizations associated with Western tradition, with emphasis on Egypt and Mesopotamia.

ARCHITECTURE 431. THE CLASSICAL WORLD

Spring term. Credit three hours. Prerequisite, Architecture 400 or permission of the instructor. Mr. Detweiler.

Architecture of the ancient Mediterranean civilizations, with emphasis on Greece and Rome.

ARCHITECTURE 432. THE EARLY MIDDLE AGES

Fall term. Credit three hours. Prerequisite, Architecture 400 or permission of the instructor. Mr. Detweiler.

Christian architecture of the first millennium, with emphasis on the early Christian and Byzantine.

ARCHITECTURE 433. THE LATER MIDDLE AGES

Spring term. Credit three hours. Prerequisite, Architecture 400 or permission of the instructor. Mr. Calkins.

Medieval architecture in western Europe, with emphasis on the Romanesque and Gothic.

ARCHITECTURE 434. ISLAMIC ARCHITECTURE

Spring term. Credit three hours. Prerequisites, Architecture 400 and 401 or permission of the instructor. Mr. Detweiler.

ARCHITECTURE 435. (PLANNING 704.) ARCHITECTURE AND PLANNING IN THE FAR EAST

Fall term. Credit three hours. Prerequisite, Architecture 400 or permission of the instructor. Mr. Hugo-Brunt.

An introduction to the evolution of architecture and urbanization in India, China, Thailand, Cambodia, and Japan.

ARCHITECTURE 436. THE RENAISSANCE

Spring term. Credit three hours. Prerequisite, Architecture 401 or permission of the instructor. Mr. Rowe.

European architecture of the fifteenth and sixteenth centuries.

ARCHITECTURE 437. THE BAROQUE

Spring term. Credit three hours. Prerequisite, Architecture 401 or permission of the instructor.

European architecture of the seventeenth and eighteenth centuries.

[ARCHITECTURE 438. AMERICAN ARCHITECTURE]

Spring term. Credit three hours. Prerequisite, Architecture 401 or permission of the instructor. Mr. Jacobs. Not offered in 1966–67.

Building in the United States from colonial times, with emphasis on the nineteenth and twentieth centuries.

[ARCHITECTURE 439. MODERN EUROPEAN ARCHITECTURE]

Fall term. Credit three hours. Prerequisite, Architecture 401 or permission of the instructor. Mr. Jacobs. Not offered in 1966–67.

Nineteenth- and twentieth-century architecture of Europe.

ARCHITECTURE 450–451. HISTORICAL SEMINARS IN ARCHITECTURE

Throughout the year. Credit two hours a term. Permission of the instructor is required.

Qualified students will prepare papers based on historical evidence, discussing problems relating to design or architecture.

ARCHITECTURE 455. SPECIAL INVESTIGATIONS IN THE HISTORY OF ARCHITECTURE

Either term. Hours as assigned. Permission of the instructor is required.

ARCHITECTURE 460. INTRODUCTION TO ARCHITECTURAL ASPECTS OF ARCHAEOLOGICAL FIELD WORK

Fall term. Credit two hours. Mr. Detweiler.

For architects, archaeologists, and laymen. A presentation of architectural techniques used in archaeology.

ARCHITECTURE 465. (PLANNING 746.) DESIGN AND CONSERVATION

Fall term. Credit two hours. Messrs. Jacobs and Jones.

The rationale for and methods of utilizing existing cultural and aesthetic resources in the planning and design of regions and cities.

ARCHITECTURE 472. SEMINAR IN THE HISTORY OF EARLY MEDIEVAL ARCHITECTURE

Either term. Credit two hours. Undergraduates admitted by permission of the instructor. Mr. Detweiler.

ARCHITECTURE 473. GOTHIC ARCHITECTURE

Spring term. Prerequisite, consent of the instructor. Mr. Calkins.

[ARCHITECTURE 478. SEMINAR IN THE HISTORY OF AMERICAN ARCHITECTURE]

Fall term. Credit two hours. Undergraduates admitted by permission of the instructor. Mr. Jacobs. Not offered in 1966–67.

Investigation, by means of reading, lectures, and reports, of historical problems in architecture of the nineteenth and twentieth centuries in the United States.

[ARCHITECTURE 479. SEMINAR IN THE HISTORY OF MODERN ARCHITECTURE]

Spring term. Credit two hours. Undergraduates admitted by permission of the instructor. Mr. Jacobs. Not offered in 1966–67.

Investigation, by means of readings, lectures, and reports, of historical problems in architecture of the eighteenth, nineteenth, and twentieth centuries in Europe.

ARCHITECTURE 488–489. PROBLEMS IN MODERN ARCHITECTURE

Throughout the year. Credit one hour a term. Prerequisite, consent of the instructor. Mr. Rowe.

ARCHITECTURE 490. THESIS IN ARCHITECTURAL HISTORY

Either term. Credit as assigned.

Independent study by candidates for the Master's degree.

ARCHITECTURE 499. DISSERTATION IN ARCHITECTURAL HISTORY

Either term. Credit as assigned.

Independent research by candidates for the Ph.D. degree.

PLANNING 700. HISTORY OF CITY PLANNING

Fall term. Credit three or four hours. Open to graduate and upperclassmen. (Four hours credit required for graduate students in city planning.) Mr. Hugo-Brunt.

The history of the planning of communities from ancient times to the present.

PLANNING 702. SEMINAR IN THE HISTORY OF AMERICAN CITY PLANNING

Fall term. Credit two hours. Prerequisites, Course 700 or permission of the instructor. Mr. Reps.

PLANNING 704. (ARCHITECTURE 435.) ARCHITECTURE AND PLANNING IN THE FAR EAST

Fall term. Credit three hours. Prerequisite, Architecture 400 or permission of the instructor. Mr. Hugo-Brunt.

An introduction to the evolution of architecture and urbanization in India, China, Thailand, Cambodia, and Japan.

PLANNING 705. INTRODUCTION TO THE HISTORY OF LANDSCAPE ARCHITECTURE AND DESIGN

Spring term. Credit three hours. Mr. Hugo-Brunt.

Classical landscape in the Mediterranean and the Middle East; the Islamic Byzantine tradition; medieval cityscape and the agrarian system; the Renaissance; landscape of gardens in Persia, India, China, Thailand, and Japan. The Victorians; landscape in North America; Colonial landscape; the twentieth century; horticulture and techniques; landscape in contemporary planning and architecture.

PLANNING 707. SEMINAR IN THE HISTORY OF COLONIAL CITY PLANNING

Spring term. Credit three hours. Mr. Hugo-Brunt.

Colonial city and regional planning in Southeast Asia, Africa, South America, and Canada.

PLANNING 709. INFORMAL STUDY IN THE HISTORY OF CITY PLANNING

Either term. Credit as assigned. Open to advanced students by permission. Mr. Hugo-Brunt or Mr. Reps.

Art

Field Representative: James O. Mahoney, 109 Franklin Hall.

Graduate courses in the practice of painting, sculpture, graphic arts, and art education are offered in the Department of Art in the College of Architecture. (See also the *Announcement of the College of Architecture.*)

As major subjects painting, sculpture, and graphic arts lead to the Master of Fine Arts degree. As minor subjects they may be elected by Master of Arts candidates in other Fields with the consent of the chairmen of their respective Special Committees and by arrangement with the Department of Art.

MASTER OF FINE ARTS

Students who hold Bachelor's degrees and have demonstrated special aptitude in art may be admitted as candidates for the M.F.A. degree in any one of three programs described below — Painting, Sculpture, or Graphic Arts. The course of study requires four terms of residence and is intended for those who wish to complete their education as artists. In addition to the appropriate studio core course and the graduate seminar described below, students are encouraged to do studio work outside their major subject. Graduate students in art are eligible for courses in any area of study offered at the University; courses in writing, cinema, stagecraft, and music are available, as well as those in the usual academic subjects of the history of art, philosophy, anthropology, and the like. Students are required to take at least three hours of academic work outside the college of Architecture each term.

The faculty is composed of practicing artists who teach rather than teachers who practice art. The entire resident faculty and the visiting critics are available to the graduate students for criticism.

The buildings in which the programs are housed are open 24 hours a day; they are adjacent to the Fine Arts Library (32,000 volumes) and not far from the University's White Art Museum.

PAINTING. The program in painting is intended for those who are competent to do independent work of high quality. At the end of his third term the

candidate is required to present a one-man exhibition of work done while in residence. The principal effort of the fourth term is a thesis painting which is designed to demonstrate creative ability and technical proficiency. Graduate painting is under the direction of Professors Dine and Richenburg. Students work in separate studios in Franklin Hall, a five-story building occupied by the Department of Art.

SCULPTURE. The graduate student in sculpture will design his own work program leading to a one-man show at the end of the third semester. Graduate sculpture is under the direction of Professors Colby and Squier. The sculpture program has its own building, a 45-by 180-foot converted foundry with 14-foot ceilings. Complete gas and arc welding facilities, heavy-duty grinders, drill press, and band saw and a variety of portable power tools are provided for the graduate students, as well as separate studios.

GRAPHIC ARTS. Graduate students in this program study the various graphic techniques, including relief, intaglio, lithography, and various photographic processes. Experiment and tradition, theory, history, and practice are part of the program, including the relation between image and typography, idea and communication. Graduate graphic arts is under the direction of Professors Singer and Kahn. A full range of graphic arts facilities is available in the program's quarters in Franklin Hall, including etching presses, lithographic presses, proof presses, and a type shop.

Faculty

Victor E. Colby studied at the Corcoran School of Art, Indiana University (B.A.) and Cornell University (M.F.A.). Professor of Art (Sculpture).

Norman D. Daly studied at the Parsons School of Design, Paris, University of Colorado (B.A.), Ohio State University (M.A.) and the Graduate Institute of Fine Arts, New York University. Professor of Art (Painting).

Jim Dine studied at the University of Cincinnati, the Boston Museum School, and Ohio University. Associate Professor of Art (Painting).

Kenneth W. Evett studied at Colorado State College (B.F.A.), Colorado Springs Fine Arts Center, and Colorado College (M.A.) Professor of Art (Painting).

John A. Hartell studied at Cornell University (B.Arch.) and at the Royal Institute of Fine Arts in Stockholm. Professor of Art (Painting).

Peter Kahn studied at Pratt Institute, the Art Students League, Hans Hofmann School, and New York University (M.A.) Professor of Art (Graphic Arts).

James O. Mahoney studied at Southern Methodist University (B.A.), Yale University (B.F.A.) and the American Academy in Rome (F.A.A.R.). Professor of Art (Painting). Chairman, Department of Art.

Gillian Pederson-Krag studied at the Rhode Island School of Design (B.F.A.) and Cornell University (M.F.A.). Instructor in Art (Painting).

Robert B. Richenburg studied at Boston University, George Washington University, Art Students League, Ozenfant School, and the Hans Hoffmann School of Art. Associate Professor of Art (Painting).

Arnold Singer studied at the Art Students League. Associate Professor of Art (Graphic Arts).

Jack L. Squier studied at Oberlin College (B.S.) and Cornell University (M.F.A.). Professor of Art (Sculpture).

Courses

ART 390. GRADUATE PAINTING

Either term. Credit as assigned. May be repeated for credit.

The core studio course for the first three terms of graduate study in painting.

ART 392. GRADUATE PRINTMAKING

Either term. Credit as assigned. May be repeated for credit.

The core studio course for the first three terms of graduate study in the graphic arts.

ART 393. GRADUATE SCULPTURE

Either term. Credit as assigned. May be repeated for credit.

The core studio course for the first three terms of graduate study in sculpture.

ART 396. GRADUATE THESIS

Either term. Credit as assigned.

For graduate students in their last term in the programs in painting, sculpture, and graphics.

ART 398. SEMINAR IN ART CRITICISM

Either term. Credit as assigned. May be repeated for credit. Open to graduate students and to upperclassmen by permission.

A study of critical opinions, historical and modern, and their relation to problems in the theory of art.

MASTER OF ARTS IN TEACHING

A limited number of students may be admitted, in cooperation with the School of Education, to a program leading to the degree of Master of Arts in Teaching, a degree which will prepare interested and qualified students for teaching in the secondary schools. The program requires a minimum of two regular semesters and one summer of full-time study. Admission standards for these students are the same as those for the M.F.A. candidates above. It is under the direction of Professor Kahn (see above).

Courses

ART 394. THE ARTIST AS TEACHER

Fall term. Credit as assigned.

The problems, methods, theories, and practices of teaching art in the secondary school. Emphasis on the special nature of the artistic process, major modern theories, and their application in the classroom. Study of the implications of learning and perception theories. At the same time, the student is actively engaged in studio work, continuing work in the area of his major interest, such as painting, sculpture, graphics, or another area in the arts.

ART 395. TEACHING INTERNSHIP

Spring term. Credit as assigned.

Observation and supervised teaching of art in the secondary school.

History of Art and Archaeology

Faculty: Robert G. Calkins, William C. Lipke, Stanley J. O'Connor, Albert S. Roe, James H. Turnure, Frederick O. Waage, Martie W. Young. Visiting Professor of the History of Southeast Asian Art and Archaeology: Alexander B. Griswold.

Field Representative: Stanley J. O'Connor, 35 Goldwin Smith Hall.

APPROPRIATE MAJOR SUBJECTS	APPROPRIATE MINOR SUBJECTS
American Art	American Art
Ancient Art and Archaeology	Ancient Art and Archaeology
Modern Art	Medieval Art
Oriental Art	Modern Art
Renaissance and Baroque Art	Oriental Art
	Renaissance and Baroque Art

ADMISSION REQUIREMENTS. An undergraduate major in the history of art is, of course, recommended; however, students who have completed with distinction majors in related fields of the humanities such as literature, philosophy, history, etc., and have had some basic course work in the history of art, should feel encouraged to apply. In certain cases some additional advanced undergraduate course work may be recommended for first-year students to round out their previous experience.

LANGUAGE REQUIREMENTS. All students before admission will be expected to present evidence of proficiency in French, German, Italian, or some other foreign language appropriate to the applicant's intended program. Those intending to proceed to candidacy for the Ph.D. should be prepared to meet requirements in a second language preferably not later than the end of the third term of residence; in any case this requirement must be satisfied prior to being admitted to the Examination for Admission to Ph.D. Candidacy. The second language will be recommended by the student's committee as being most applicable to his particular program; normally two closely related languages (e.g. French and Italian) will not fulfill the second language requirement. It cannot be overemphasized how essential proficiency in languages is to advanced study in this Field.

EXAMINATIONS. The general examination for the doctoral degree (officially referred to in Graduate School Legislation as "The Examination for Admission to Ph.D. Candidacy") will be both written and oral and will test extensive knowledge of the material, bibliography, and scholarship of the major and two minor subjects. It will normally be taken at the end of the sixth semester of residence and will complete the requirements for the degree other than the dissertation and the final oral examination on the dissertation. For those seeking a Master of Arts degree as a terminal degree, there will be an examination, both oral and written, to test general knowledge of basic areas of the discipline and more substantial and detailed familiarity with the areas of the major and minor. This examination will ordinarily come at the end of the third or fourth term of residence.

Students from other Fields who choose a minor in the history of art and archaeology will be assigned course work as appropriate; they will also be expected to sustain an oral and written examination in the general area of the minor.

RESEARCH AND STUDY OPPORTUNITIES. For beginning graduate students a program of regular course work will be set up by the student's committee; in each course additional individual work will be assigned. More advanced graduate students will pursue independent study under faculty direction.

Major study facilities are provided by the collections of the main University Library, which contain resources of primary material for this Field, and of the Fine Arts Library in Sibley Hall, which provides a constantly expanding collection of holdings in art and architectural history totaling at the present time approximately 35,000 volumes. The Andrew Dickson White Museum of Art has in its permanent collection significant study material, especially in the areas of graphic arts, American art, and the art of the Far East. A program of special exhibitions is provided and a number of major exhibitions are organized annually. Opportunities are made available for graduate students to gain experience in the operations of the Museum and to assist with problems of installation, catalog preparation, etc. In addition to having occasional opportunities to visit the major collections in New York City, the graduate student in Ithaca is within reasonable distance of such important institutions as the Albright Art Gallery in Buffalo, the Memorial Art Gallery in Rochester, and the Munson-Williams-Proctor Institute in Utica. The Department of the History of Art is the repository of a study collection of photographs of works of art and of a rapidly expanding collection of some 50,000 slides, which is especially strong in the areas of American, modern, and Oriental art.

In certain areas a balanced graduate program will normally entail work in various other Fields and in related Area Programs. In the history of architecture there is a joint program with the College of Architecture. An interdepartmental program is available in archaeology, and a pamphlet describing the various offerings will be sent on request. The Asian Studies Program also issues a publication with a full description of the facilities in the various areas of Far Eastern studies. A study Archive of Chinese Art is being developed within the Department of the History of Art. Students working in the area of Southeast Asian art will be able to attend a short but intensive seminar to be conducted each summer by Mr. Alexander Griswold at the Breezewood Foundation near Baltimore, Maryland, which houses an outstanding study collection of Siamese art. Other related Fields, such as history, philosophy, literature, etc., provide the opportunity for strong minor programs in connection with many areas of the history of art.

The areas of specialization of the members of the graduate faculty are as follows: American art: Mr. Roe, Mr. Lipke. Ancient art and archaeology: Mr. Waage, Mr. Turnure. Medieval art and architecture: Mr. Calkins. Modern art: Mr. Roe, Mr. Lipke. Oriental art: Mr. Young (Chinese and Japanese art), Mr. O'Connor, and Mr. Griswold (art of Southeast Asia and India). Renaissance and baroque art: Mr. Roe, Mr. Turnure.

FINANCIAL AID. The Department is able to award two Teaching Fellowships which carry a stipend of $2000 plus tuition and fees. Normally these will be held by students who have already had one or two years of graduate work. The Franklin and Gretel Goldring Memorial Fellowship, which provides a stipend of $1000, is also awarded to a student in this Field. The Field is among those which participate in the NDEA Title IV Program. Further information on opportunities for financial aid will be found in an earlier section in this Announcement.

COURSES

421. NUMISMATICS

Fall term. Credit four hours. T 2–4:30. Mr. Waage.

Students will work with Greek and Roman coins from the University's collection to acquire a knowledge of their archaeological, artistic, and historical importance.

[423. CERAMICS AND THE TECHNIQUES OF EXCAVATION]

Fall term. Credit four hours. T 2–4:30. Mr. Waage. Offered in 1967–68 and alternate years.

[425. EGYPTIAN ART AND ARCHAEOLOGY]

Fall term. Credit four hours. F 2–4:30. Mr. Turnure. Not offered in 1966–67.

[428. PROBLEMS IN ANCIENT ART AND ARCHAEOLOGY]

Spring term. Credit four hours. T 2–4:30. Mr. Waage. Not offered in 1966–67.

GOTHIC ARCHITECTURE

Spring term. Hours to be arranged. Mr. Calkins. (Architecture 473, College of Architecture).

[446. LITERARY SOURCES IN THE ITALIAN RENAISSANCE]

Spring term. Credit four hours. M 2–4:30. Not offered in 1966–67.

448. PROBLEMS IN SIXTEENTH-CENTURY ART

Spring term. Credit four hours. Th 2–4:30. Mr. Roe.

Major monuments and trends of the century of transition from the High Renaissance to the Baroque. The center of attention will be Italy, but other countries will also be included.

[454. STUDIES IN SEVENTEENTH-CENTURY ART]

Spring term. Credit four hours. Th 2–4:30. Mr. Turnure. Not offered in 1966–67.

461. PROBLEMS IN THE ORIGINS OF MODERN ART

Fall term. Credit four hours. Th 2–4:30. Mr. Lipke.

Topic, fall term, 1966–67: Sources of Surrealism. The seminar will deal with British, French, and Northern European artists whose works can be viewed as prototypes for the Surrealist point of view. Conducted as a seminar; discussion, lectures, reports.

[463. PROBLEMS IN TWENTIETH-CENTURY ART]

Fall term. Credit four hours. Open to students who have had 464. W 2–4:30.

Topic, fall term 1966–67: *Avant-garde* painting in America, from the Ash-Can School to Abstract-Expressionism. Conducted as a seminar; discussion, lectures, reports, museum study.

464. PROBLEMS IN TWENTIETH-CENTURY ART

Spring term. Credit four hours. Open to students who have had 463. T 2–4:30. Mrs. Benson.

[472. PROBLEMS IN AMERICAN ART]

Spring term. Credit four hours. W 2–4:30. Not offered in 1966–67.

[483. METHODS OF RESEARCH IN ASIAN ART]
Fall term. Credit four hours. T 2–4:30. Mr. Young. Not offered in 1966–67.

[484. PROBLEMS IN CHINESE ART]
Spring term. Credit four hours. T 2–4:30. Mr. Young. Not offered in 1966–67.

[486. CHINESE PAINTING: THE LATER CENTURIES]
Spring term. Credit four hours. T 2–4:30. Mr. Young. Not offered in 1966–67.

[488. SOUTHEAST ASIAN ART AND ARCHAEOLOGY]
Spring term. Credit four hours. F 2–4:30. Mr. O'Connor. Not offered in 1966–67.

[495. PROBLEMS IN ENGLISH ART]
Spring term. Credit four hours. M 2–4:30. Mr. Roe. Not offered in 1966–67.

Chinese Literature

(See Asian Studies, page 136.)

City and Regional Planning

Field Representative: Barclay G. Jones, West Sibley Hall.

MASTER OF REGIONAL PLANNING

Graduate study for the Master's degree is administered by a professional division of the Graduate School. Study at the Master's level provides the basic professional skills in analysis, methods, and techniques of area planning and administration needed for practice in the field of City and Regional Planning.

Admissions Requirements

A professional degree in architecture, landscape architecture, or engineering, or a Bachelor's degree with a major field in planning, political science, public administration, economics, geography, or sociology is required for admission to candidacy. Applicants of exceptional promise who hold Bachelors' degrees with majors in some other discipline may be considered for admission.

All applicants resident in the United States during the year preceding matriculation must submit scores of the Graduate Record Examination Aptitude Tests with their other credentials.

Field Requirements

The course of study for the degree of Master of Regional Planning ordinarily requires two years. Students in the College of Architecture or in the School of Civil Engineering at Cornell who are interested in graduate study in city and regional planning may, with the permission of their faculty advisers and approval of the chairman of the Department of City and Regional Planning, follow a specialized undergraduate program which may enable them, if admitted as graduate students, to earn the degree of Master of Regional Planning in three terms of graduate study.

Students in their first year follow a prescribed program of courses which provides training in the basic elements of planning. These include studies in theory, history, analytical methods, design, and administration. The second year provides opportunities for students to pursue several of these subjects at a more advanced level or to concentrate on intensive studies in a specialized aspect of planning. With the assistance of his faculty adviser, a student may select courses from a list of approved electives in theory and history of urban design, in research and analysis, in administration or in regional studies. Elective courses outside the field, but relevant to the specialized interests of the student, may also be taken.

A summer office practice and training program is offered in New York City. It is designed to provide work experience in planning agencies and consulting firms in the New York metropolitan area, combined with lectures, seminars, and field trips. Graduate credit is given, but participation in the program is not required for the M.R.P. degree.

Further information about admissions, the course of study, financial aid, and teaching and research assistantships may be obtained by writing to the Chairman, Department of City and Regional Planning, Sibley Hall.

DOCTOR OF PHILOSOPHY

APPROPRIATE MAJOR SUBJECTS	APPROPRIATE MINOR SUBJECTS
City Planning	City Planning
Regional Planning	Regional Planning

Admissions Requirements

All applicants resident in the United States during the year preceding matriculation at Cornell must submit the scores of the Graduate Record Examination Aptitude Tests with their other credentials.

Major study for candidates for the degree of Ph.D. is limited to those who hold the degree of Master of Regional Planning or its equivalent.

Field Requirements

Language Requirements:

1. Reading proficiency in two of three languages: French, German or Russian; or

2. Reading and speaking proficiency in one of the three languages listed above;

3. Foreign students whose native language is not English, may substitute English for any *one* of the three languages under 1).

The candidate may, with the recommendation of his Special Committee petition the field to (a) substitute any language for one of the languages listed under (1); (b) substitute any language under (2).

For admission to candidacy for the Ph.D. degree with a major in City Planning or Regional Planning, a Master's degree in City or Regional Planning with course work equivalent to that required in the program at Cornell is ordinarily required. Candidates who lack the equivalent of this training or who hold the Master's degree in a related field and have had acceptable experience in city or regional planning practice or research may be required to take additional course work at the Master's level.

Candidates for the Ph.D. degree proposing to major in this Field must select a major subject from the two listed above. It is the policy of the Field to en-

courage selection of both minor subjects from related subjects outside the Field. Prospective students should therefore consult the descriptions in this Announcement of other subjects such as administrative engineering, aerial photographic studies, agricultural economics, architectural history, comparative government, econometrics and economics statistics, economic development, economic theory, housing and design, law, natural resources conservation, operations research, the political process, political theory, public administration, research methodology, sociology, statistics, sanitary engineering, and transportation engineering.

Since work for the Ph.D. is considered preparatory to making creative contributions to the Field, substantial competence and knowledge of basic analytical and research methods will be required. Candidates may fulfill this requirement by preparation previous to entrance or by course work at Cornell which may be in a minor subject. Candidates for the Ph.D. degree are expected to present a thesis of either a theoretical or applied nature.

Requirements for a minor subject in the Field while less rigorous than a major presume a suitable preparation for advanced work.

The Department of City and Regional Planning conducts a program of research in urban studies in cooperation with the Center for Housing and Environmental Studies.

In addition to the scholarships and fellowships available through the Graduate School and the Department of City and Regional Planning, the College of Architecture appoints a number of Master's degree and doctoral candidates to part-time teaching and research positions. Prospective students interested in applying for assistantships should write to the Dean of the College of Architecture.

Faculty

Henry Cohen, B.Soc.Sci. (City College, New York), M.C.P. (Massachusetts Institute of Technology). Visiting Professor of Planning and Public Administration.

Professor Cohen's teaching, research and practice are focused on systems of planning for human resource development and their relationship to urban development. He has had extensive experience in research and administration in the New York metropolitan area.

Stanislaw Czamanski, Lic.esSc.Comm. (University of Geneva, Switzerland), Ph.D. (University of Pennsylvania). Associate Professor of City and Regional Planning.

Professor Czamanski's teaching and research interests focus on methods of economic analysis for planning, including urban growth models, regional social accounts, and regional applications of input-output analysis. Other interests include location theory, housing economics, and urban land economics.

Allan G. Feldt, B.S., A.M., and Ph.D. (University of Michigan). Assistant Professor of City and Regional Planning.

Professor Feldt's research and teaching deal primarily with problems of urban sociology, human ecology, and urbanization. His publications reflect interests in comparative metropolitan studies, demography, methodology, and operational gaming.

Jack Carrington Fisher, B.A., M.A., and Ph.D. (Syracuse University). Assistant Professor of City and Regional Planning.

Professor Fisher's research and teaching are concerned with urban and

regional quantitative analysis, planning theory, regional planning development, and administration, and socialist city and regional planning.

Michael Hugo-Brunt, B.Arch. (University of Capetown), M.C.D. (Liverpool University), M.Arch. (Cornell University). Associate Professor of City and Regional Planning.

Professor Hugo-Brunt's research and teaching are primarily in the history of architecture and city planning and development. His writing on this subject is based on practice and research in the United States, England, Southeast Asia, and Canada.

Barclay Gibbs Jones, B.A., B.Arch. (University of Pennsylvania), M.R.P., Ph.D. (University of North Carolina). Associate Professor of City and Regional Planning.

Professor Jones' research and teaching are concerned with urban and regional quantitative analysis, urbanization theory, planning theory, environmental health planning, and historic preservation.

Burnham Kelly, A.B. (Williams College), LL.B. (Harvard University), M.C.P. (Massachusetts Institute of Technology). Dean of the College of Architecture and Professor of Planning.

Professor Kelly's principal teaching and research interests are in land use regulation, development controls, and the housing industry.

Thomas W. Mackesey, B.Arch., M.C.P. (Massachusetts Institute of Technology). Vice Provost of the University and Professor of Regional Planning.

Professor Mackesey's interests in the Field are in the history of city planning and in university planning. While he no longer teaches extensively in the program, he maintains an active interest in the work of the Department.

Kermit C. Parsons, B.Arch. (Miami University), M.R.P. (Cornell University). Professor of City and Regional Planning and Chairman.

Professor Parsons' teaching, research, and practice are in the fields of comprehensive land use planning and institutional planning and urban design. His writing and practice, focused primarily on the latter fields, include work on urban university planning and participation in urban renewal and the history of college and university planning.

John W. Reps, A.B. (Dartmouth College), M.R.P. (Cornell University). Professor of City and Regional Planning.

Professor Reps's teaching, research, and practice are primarily in the subjects of land use regulation, planning administration, comparative planning and the history of city planning in the United States, based on practice and research in the United States and Europe.

Stuart W. Stein, B.Arch., M.C.P. (Massachusetts Institute of Technology). Associate Professor of Urban Planning.

Professor Stein's teaching and professional activities are concerned primarily with the design of the urban environment. His course work focuses on site planning and urban design within the context of comprehensive planning, but other interests and activities lie in the area of preservation of historic districts and the enhancement of the visual assets of the city.

Oliver C. Winston, B.A. and B.S., (Rice University). Lecturer in City Planning, and Director, Office of Regional Resources and Development.

Mr. Winston's teaching and practice are in the areas of urban renewal planning and administration.

Courses

The time and place of each course of study and the name of the instructor will be given in a separate memorandum issued by the Department office prior to registration for each term. Most courses in the Department of City and Regional Planning are open to students in any college of the University who have fulfilled the prerequisites and who have the consent of the instructor. In general, an elective course is not offered to fewer than five students.

PLANNING HISTORY

PLANNING 700. HISTORY OF CITY PLANNING

Fall term. Credit three or four hours. Open to graduates and upperclassmen. (Four hours credit required for graduate students in city planning.) Mr. Hugo-Brunt.

The history of the planning of communities from ancient times to the present.

PLANNING 702. SEMINAR IN THE HISTORY OF AMERICAN CITY PLANNING

Fall term. Credit two hours. Prerequisites, Course 700 or permission of the instructor. Mr. Reps.

PLANNING 704. (ARCHITECTURE 435.) ARCHITECTURE AND PLANNING IN THE FAR EAST

Fall term. Credit three hours. Prerequisite, Architecture 400 or permission of the instructor. Mr. Hugo-Brunt.

An introduction to the evolution of architecture and urbanization in India, China, Thailand, Cambodia, and Japan.

PLANNING 705. INTRODUCTION TO THE HISTORY OF LANDSCAPE ARCHITECTURE AND DESIGN

Spring term. Credit three hours. Mr. Hugo-Brunt.

Classical landscape in the Mediterranean and the Middle East; the Islamic Byzantine tradition; medieval cityscape and the agrarian system; the Renaissance; landscape of gardens in Persia, India, China, Thailand, and Japan. The Victorians; landscape in North America; Colonial landscape; the twentieth century; horticulture and techniques; landscape in contemporary planning and architecture.

PLANNING 707. SEMINAR IN THE HISTORY OF COLONIAL CITY PLANNING

Spring term. Credit three hours. Mr. Hugo-Brunt.

Colonial city and regional planning in Southeast Asia, Africa, South America, and Canada.

PLANNING 709. INFORMAL STUDY IN THE HISTORY OF CITY PLANNING

Either term. Credit as assigned. Open to advanced students by permission. Mr. Hugo-Brunt or Mr. Reps.

URBAN AND REGIONAL THEORY

PLANNING 710. PRINCIPLES OF CITY AND REGIONAL PLANNING

Fall term. Credit three hours. Open to graduates and upperclassmen. Mr. Reps.

A review of the basic influences in the development of cities. A general view of the theory and accepted practice of city and regional planning, including a study of the social, economic, and legal phases.

PLANNING 711. INTRODUCTION TO URBAN PLANNING

Spring term. Credit one hour. May not be taken for credit by those who have taken Planning 710. Staff.

A concise survey of urban planning for students seeking an introduction to the field.

PLANNING 712. INTRODUCTION TO URBAN AND REGIONAL THEORY

Fall term. Credit two hours. Messrs. Jones and Czamanski.

Survey of basic social science theories concerning man's occupancy of the earth: urbanization, intra-regional distribution of population and activity, location of cities, demographic and functional structure of areas, intra-urban distribution of population and activity.

PLANNING 713. INTRODUCTION TO HUMAN ECOLOGY

Spring term. Credit three hours. Mr. Feldt.

An examination of the form and development of the human community with respect to spatial, temporal, and functional patterns of organization. Demographic, environmental, and technological characteristics are treated as parameters relevant to the ecological structure of the community.

PLANNING 714. SEMINAR IN URBAN ECOLOGY

Fall term. Credit two hours. Mr. Feldt.

A survey of major social science studies and theories of urban space and social development. Intended primarily for students with little or no previous training in the social sciences.

PLANNING 715. APPLIED LOCATION THEORY AND PRACTICE

Fall term. Credit two hours. Prerequisite, consent of the instructor. Mr. Czamanski.

A terminal course for students in various fields. Topics include interregional and intraregional location of activities such as manufacturing, retailing, offices, hotels, health centers, communal facilities, etc. Various techniques of selecting optimum locations are reviewed. Knowledge of mathematics and of modern quantitative methods is not a precondition for admission, but ability to master them during the course is assumed.

PLANNING 716. ADVANCED URBAN AND REGIONAL THEORY

Fall term. Credit two hours. Open to advanced students by permission. Mr. Jones.

Seminar in the theory of urban spatial organization. Economic, technological, and social factors leading to urbanization and various kinds of spatial organizations will be explored. Major theoretical contributions to the understanding of intra-regional and intra-urban distribution of population and economic activity will be reviewed.

PLANNING 717. SEMINAR IN URBAN AND REGIONAL THEORY

Spring term. Credit two hours. Open to advanced students by permission. Mr. Jones.

A continuation of Planning 716 concentrating on recent developments.

PLANNING 719. INFORMAL STUDY IN PLANNING THEORY

Either term. Credit as assigned. Open to advanced students by permission. Mr. Jones.

PLANNING ADMINISTRATION AND IMPLEMENTATION

PLANNING 721. CITY PLANNING ADMINISTRATION

Spring term. Credit two hours. Prerequisite, Planning 710 or permission of the instructor. Staff.

An examination of the principal administrative problems in planning, including the organization of the municipal planning agency, office management, relations with legislative bodies and executive departments, public works programing, public relations activities, metropolitan planning agencies, and state and federal planning assistance programs.

PLANNING 723. LEGAL ASPECTS OF PLANNING

Spring term. Credit two hours. Prerequisite, Course 710 or permission of the instructor. Mr. Reps.

Legal aspects of preparing and administering zoning ordinances, subdivision regulations, housing codes, official map regulations, and related subjects.

PLANNING 724. INFORMAL STUDY IN CITY PLANNING ADMINISTRATION

Either term. Credit as assigned. Open to advanced students by permission. Mr. Reps.

PLANNING 725. INFORMAL STUDY IN LEGAL ASPECTS OF PLANNING

Either term. Credit as assigned. Open to advanced students by permission. Mr. Kelly.

PLANNING ANALYSIS

PLANNING 730. PLANNING ANALYSIS.

Fall term. Credit four hours. Open to graduate students. Mr. Jones.

Introduction to methods of city and regional planning analysis. Planning is considered as a method of decision making with the purpose of achieving a command over the major tools for problem identification, analysis, and resolution. Laboratory in governmental information systems.

PLANNING 731. ADVANCED PLANNING ANALYSIS

Spring term. Credit four hours. Prerequisite, Planning 730. Messrs. Jones and Czamanski.

City planning applications of general analytical techniques of social sciences; population, economic, land-use, and transportation models.

PLANNING 732. SEMINAR IN QUANTITATIVE URBAN ANALYSIS I

Fall term. Credit three hours. Prerequisite, Planning 731 or consent of the instructor. Mr. Czamanski.

An advanced seminar in applied methods of economic analysis for planning. Topics include demographic projections, regional economic description methods, multiplier type growth models, methods of constructing regional social accounts, interindustry relations, methods of construction, and regional applications of input-output. Extensive references are made to recent planning studies.

PLANNING 733. SEMINAR IN QUANTITATIVE URBAN ANALYSIS II

Spring term. Credit three hours. Prerequisite, Planning 732 or consent of the instructor. Mr. Czamanski.

Sequel to 732. Regional money flows, wealth accounting, design of advanced regional models, industrial complex and urban complex studies, gravity and potential models, intra-regional allocation models, principles and use of mathematical programming, cost-benefit studies, urban renewal priorities analysis. Discussion of case studies.

PLANNING 734. PLANNING METHODS AND TECHNIQUES

Fall term. Credit two hours. Prerequisite, Planning 710 or permission of the instructor. Mr. Parsons.

Standards and survey methods for measuring education, recreation, and other community facility needs. Commercial, industrial, and residential land-use planning; transportation, housing, and environmental quality surveys.

PLANNING 735. RESEARCH METHODS IN PLANNING

Spring term. Credit two hours. Mr. Feldt.

Basic coverage of some of the more common research techniques used in the social sciences, including a survey of basic data sources, methods of survey research, ecological methods, and some of the more fundamental statistical methods. A number of the methods covered will be utilized in developing a major research report in conjunction with requirements for the following year's field problem.

PLANNING 736. SEMINAR IN URBAN GEOGRAPHIC ANALYSIS

Fall term. Credit two hours. Mr. Fisher.

Urban geography as related to the professional field of geography. Includes an introduction to the discipline of geography as a basis for an intensive review of the fundamental concepts and literature in the field of urban geography. Essential techniques of urban spatial analysis applicable to the field of urban planning. Historical interpretation methods relevant to the understanding of contemporary urban areas. Field and analytical methods of urban geography applied in case studies.

PLANNING 737. OPERATIONS RESEARCH IN PLANNING I.

Fall term. Credit three hours. Prerequisite, Planning 731. Mr. Allderige.

Examination of basic systems models developed in industrial operations research. Their applicability to planning is studied. Models considered are simple linear, regressive, matrix, algebraic, elementary queuing, linear programing, and assignment. Also studied are introductory concepts of modeling and intermediate sampling processes.

PLANNING 738. OPERATIONS RESEARCH IN PLANNING II

Spring term. Credit three hours. Prerequisite, Planning 737. Mr. Allderige.

Advanced examination of more extensive systems models developed in industrial operations research and their applicability to planning. Considered, along with expanded changes of models studied in Planning 737, are complex regression analysis, factor analysis, simulation, stochastic processes, and competitive strategies. Emphasis on theories of the modeling process and an introduction to public systems design.

PLANNING 739. INFORMAL STUDY IN PLANNING ANALYSIS
Credit as assigned. Open to advanced students by permission. Staff.

PLANNING DESIGN AND PRACTICE

PLANNING 740. INTRODUCTION TO PLANNING DESIGN
Fall term. Credit two hours. Required of all graduate planning students without undergraduate training in design. Mr. Stein.

Introduction to the tools of physical design and graphic presentation. Investigation of the sources of basic information for physical design, the formulation of a physical design program, the preparation of solutions to elementary design problems and presentation techniques.

PLANNING 741. PLANNING DESIGN
Spring term. Credit four hours. Limited to graduate students. Graduate students in architecture may substitute one or more of the problems for required design studies in Architecture 190 with permission of their adviser. Messrs. Stein, Parsons, and visiting lecturers.

Lectures, seminars, and problems in the basic principles of site planning, subdivision large-scale, three-dimensional design, and the interrelationships of land uses in a variety of urban and metropolitan situations. Alternative patterns of urban development and their implications will be examined. Students are assigned a series of problems including the design of the neighborhood, the district, parts of the existing city, and the new town. Students will work individually and in teams.

PLANNING 742. FIELD PROBLEM IN URBAN PLANNING
Fall term. Credit six hours. Prerequisites, Planning 731 and 741 or permission of the instructor. Messrs. Parsons, Stein, Feldt, and visiting lecturers.

Research and analysis in an urban area leading to the preparation of comprehensive plans and effectuation programs; use of operational gaming techniques in the planning process; lectures, field trips, and individual and group reports.

PLANNING 743. CITY PLANNING PRACTICE
Summer term. Credit three hours. Open to graduate students in planning and others by permission. Messrs. Stein, Parsons, staff, and visiting lecturers.

Summer internship in New York metropolitan area in public planning, development and renewal agencies, or planning consultants' offices, combined with lectures and discussions two evenings a week and field trips in the New York area and to other east coast cities (Instruction period for the course in the College of Architecture New York City Program facilities is limited to July and August.)

PLANNING 744. SEMINAR IN URBAN DESIGN I
Fall term. Credit two hours. Prerequisites, Architecture 105 or Planning 740 and permission of the instructor. Mr. Parsons.

Investigation of historical and current thought on the visual aspects of cities, including evaluation of technological and cultural influences on urban design, perception of urban form, and relationships between contemporary city planning process and visual form in cities.

[PLANNING 745. SEMINAR IN URBAN DESIGN II]

Spring term. Credit two hours. Prerequisite, Planning 744 or permission of the instructor. Mr. Stein. Not offered in 1966–67.

Case studies of urban design projects presented by various faculty members and visitors plus independent research to allow students to pursue urban design issues in depth.

PLANNING 746. (ARCHITECTURE 465.) DESIGN AND CONSERVATION

Fall term. Credit two hours. Messrs. Jacobs and Jones.

The rationale for and methods of utilizing existing cultural and aesthetic resources in the planning and design of regions and cities.

PLANNING 747. SYSTEMS DESIGNING

Spring term. Credit two hours. Prerequisite, Planning 731. Messrs. Jones and Allderige.

Thorough study of the designing process in the planning context. Using first simple, then complex examples, the aim is to define the designing process explicitly, then explore different formal and informal methods of producing public systems designs or plans.

PLANNING 748. WORKSHOP IN HEURISTIC GAMING TECHNIQUES

Fall term. Credit two hours. Limited enrollment with priority to students taking the planning field problem currently. Mr. Feldt and staff.

Exploration and use of a limited number of heuristic gaming devices dealing with problems in planning and urban theory. Special attention will be given to models representing the community under analysis in the field problem as well as to models dealing with more abstracted urban and regional configurations.

PLANNING 749. INFORMAL STUDY IN URBAN DESIGN

Either term. Open to advanced students by permission. Staff.

URBAN RENEWAL AND HOUSING

PLANNING 751. SEMINAR IN URBAN RENEWAL

Spring term. Credit two hours. Prerequisite, Planning 710 or permission of the instructor. Mr. Winston.

An exploration of current programs to revitalize our cities, the concepts of blight and urban renewal, and discussion of current policies and procedures in federal, state, and local government.

PLANNING 753. THE ECONOMICS OF HOUSING AND OF URBAN LAND USE

Spring term. Credit three hours. Open to advanced students by permission. Mr. Czamanski.

The place of housing in the economy, value as determinant of land use, measurement methods, the spatial arrangement of urban functions, urban structures and forms, public interest and controls, urban renewal and redevelopment, social and economic costs and benefits.

PLANNING 759. INFORMAL STUDY IN HOUSING AND URBAN RENEWAL

Either term. Open to advanced students by permission. Messrs. Kelly, Parsons, and Stein.

REGIONAL AND COMPARATIVE PLANNING

PLANNING 760. SEMINAR IN REGIONAL PLANNING

Fall term. Credit two hours. Prerequisite. Planning 710 or permission of the instructor. Mr. Fisher.

Designed as the basic course in regional planning. The guide lines of regional planning and the nature of regional planning under various social and economic conditions. An introduction to regional planning techniques and methodology, and a survey of the character of regional planning in several countries.

PLANNING 761. STATE PLANNING

Spring term. Credit two hours. Prerequisite, Planning 760 or permission of the instructor. Mr. Fisher.

History of state planning and the current status and trends in state planning in the United States. Emphasis will be given to an analysis of contemporary state planning functions, administrative position of the state planning agency, federal-state relations, state and regional planning, coordination of the state planning agency and other state agencies, and the place of functional planning at the state level.

[PLANNING 762. SOVIET AND EAST EUROPEAN REGIONAL AND URBAN PLANNING]

Fall term. Credit two hours. Prerequisite, Planning 710 or permission of the instructor. Mr. Fisher. Not offered in 1966–67.

Brief survey of the history, contemporary organization, and trends of Soviet and East European Planning. Intended to provide an understanding of the professional nature of Soviet and East European planning, a familiarization with basic planning literature, and an introduction to Soviet and East European planning techniques. Contrasts between the Soviet and the East European organization and approach will be stressed.

PLANNING 763. REGIONAL PLANNING AND DEVELOPMENT IN PLANNING COUNTRIES

Spring term. Credit two hours. Prerequisite, Planning 760 or permission of the instructor. Mr. Fisher.

The status of regional planning in developing countries. The strategy of regional development and implementation of physical planning goals. Examination of regional planning activities in two or three countries and evaluation of project implementation and effectiveness.

PLANNING 767. INFORMAL STUDY IN URBAN GEOGRAPHY

Credit as assigned. Open to advanced students by permission. Mr. Fisher.

PLANNING 769. INFORMAL STUDY IN REGIONAL PLANNING

Either term. Credit as assigned. Open to advanced students by permission. Staff.

ENVIRONMENTAL HEALTH PLANNING

PLANNING 770. ENVIRONMENTAL HEALTH PLANNING

Fall term. Credit two hours. Mr. Jones.

Introduction to concepts and issues in environmental health planning. Topics covered include the planning problems involved in the control of water quality, liquid and solid waste disposal, air quality, and housing quality.

PLANNING 774. SEMINAR IN NEIGHBORHOOD THEORY

Spring term. Credit three hours. Limited enrollment with consent of instructors required. Messrs. Feldt and Stein.

An examination of the concept of neighborhood in urban society based upon a consideration of the interrelationship between design elements and human behavior. Major theoretical and empirical approaches to the neighborhood will be reviewed and placed in the context of recently developing thought, practice, and research in urban planning theory.

PLANNING 779. INFORMAL STUDY IN ENVIRONMENTAL HEALTH PLANNING

Either term. Credit as assigned. Open to advanced students by permission. Mr. Jones.

SOCIAL AND SOCIAL FACILITIES PLANNING

PLANNING 780. HUMAN RESOURCE DEVELOPMENT PROBLEMS IN THE METROPOLIS

Fall term. Credit two hours. Mr. Cohen.

Introduction to systems of planning for human resource development. Review of social, health, and educational problems and programs, and their relationship to urban development.

PLANNING 781. CASE STUDIES IN HUMAN RESOURCE DEVELOPMENT PLANNING

Spring term. Credit two hours. Mr. Cohen.

A review of methods and techniques of planning for human resource development. Specific illustrations from the field of social, health and educational planning, as well as more comprehensive social planning efforts, will be examined.

PLANNING 785. INSTITUTIONAL PLANNING

Spring term. Credit two hours. Prerequisites, Planning 710 or 730 or permission of the instructor. Mr. Parsons.

A seminar in programing and area planning of facilities for institutions including universities, medical centers, and churches. Administrative organization, space use studies, program development, location and function analysis, enrollment projection, and institutional systems. Application of city planning techniques to institutional planning.

PLANNING 789. INFORMAL STUDIES IN SOCIAL AND SOCIAL FACILITIES PLANNING

Either term. Credit as assigned. Staff.

THESES

PLANNING 790. THESIS IN CITY OR REGIONAL PLANNING

Either term. Credit as assigned.

Independent research by candidates for the Master's degree.

PLANNING 799. DISSERTATION IN CITY OR REGIONAL PLANNING

Either term. Credit as assigned.

Advanced independent research by candidates for the Ph.D. degree.

The Classics

Faculty: Harry Caplan, Phillip H. DeLacy, Gordon H. Fairbanks, James Hutton, Donald Kagan, Gordon M. Kirkwood, Elizabeth Milburn, Pietro Pucci, Frederick O. Waage.

Field Representative: P. Pucci, 125 Goldwin Smith Hall.

APPROVED MAJOR AND MINOR SUBJECTS

MAJOR	MINOR
Ancient Philosophy	Ancient History
Classical Archaeology	Classic Rhetoric in Original or Translation
Greek Language and Literature	Classics
Latin Language and Literature	Indo-European Linguistics
Medieval and Renaissance Latin Literature	

Although it is not a requirement, it is recommended that candidates submit Graduate Record Examination Aptitude Test scores when applying for admission.

Admission to graduate study in a subject included in the Field of Classics, except in archaeology, assumes a knowledge equivalent in general to that expected of a student who has pursued the subject concerned throughout four years of undergraduate study in a college of recognized standing.

To qualify for the M.A. degree in Classics, the candidate with adequate undergraduate training is ordinarily expected to spend two semesters at Cornell University, attending the seminars for which he is prepared; to write a Master's thesis; and to pass a general oral examination. Within these two semesters, and as early as possible, he must also pass the Graduate School foreign language test in either French or German. The final examination for the M.A. degree may serve as the Qualifying Examination for the Ph.D. degree. The M.A. candidate chooses a major and a minor subject, and the two faculty members representing these subjects constitute his Graduate Committee, the one representing the major subject being his principal adviser.

A candidate for the Ph.D. degree is expected to take a qualifying examination which will determine his fitness for undertaking advanced studies, to spend not less than two full years in course work taking seminars in Greek and Latin as well as in other special fields such as archaeology, palaeography, other literatures, and history which his program of study may require; to write a Ph.D. dissertation, and to take a final examination — Examination A, in the classical authors, and Examination B on the doctoral dissertation and related subjects. The candidate for the Ph.D. degree chooses a Special Committee formed of three professors of the staff. This committee will advise him both in the choice of his courses and in his work for the dissertation. Ph.D. candidates are expected to demonstrate ability in reading French and German, and must pass, before the completion of the dissertation, the Graduate School foreign language test. Course work for graduate students in the Field of Classics is conducted mainly in small seminars, the object of which is training in the methods, the principles, and the performance of independent research and criticism. As far as possible, therefore, the work is put into the hands of the students themselves. The seminars are conducted by different members of the department, so that the students have the experience of different critical approaches.

SPECIAL INTERESTS OF THE FACULTY

Gordon M. Kirkwood, Professor of Classics. Greek and Roman theater, Greek lyric poetry.

Harry Caplan, Goldwin Smith Professor of the Classical Languages and Literature. Greek and Latin rhetoric, Augustan poetry, medieval Latin literature.

Phillip H. DeLacy, Professor of Classics. Greek and Roman philosophy. Co-Director of the program leading to the Ph.D. in classics and ancient philosophy.

Gordon Fairbanks, Professor of Linguistics. Sanscrits and Indo-European comparative studies.

James Hutton, Kappa Alpha Professor of Classics. Greek anthology, Greek and Latin epic, humanism and Renaissance.

Donald Kagan, Associate Professor of History. Greek political thought.

Elizabeth Milburn, Assistant Professor of Classics. Classical archaeology with special fields of Mycenaean archaeology and Greek ceramics.

Pietro Pucci, Associate Professor of Classics, Field Representative. Text history, Greek drama.

Noel Robertson, Assistant Professor of Classics. Greek and Latin religion, Greek epic.

Frederic O. Waage, Professor of History of Art. Numismatic and ceramic.

In related Fields the graduate students in the Field of Classics may follow the courses of:

Allan Bloom, Associate Professor of Government. Political theory.

James J. John, Professor of Palaeography and Mediaeval History. Latin palaeography.

Isaac Rabinowitz, Professor of Biblical and Hebrew Studies.

David Sachs, Associate Professor of Philosophy. Ancient philosophy.

Richard Sorabji, Assistant Professor of Philosophy. Ancient philosophy.

Abraham Udovitch, Assistant Professor of Arabic and Hebrew Studies.

ANCIENT PHILOSOPHY. The Department of Classics, in cooperation with the Department of Philosophy, offers a program leading to the Ph.D. in Classics with ancient philosophy as the major subject. The Department of Philosophy offers a corresponding program to graduate students in philosophy. The aim of the program is to meet the demand for experts in ancient philosophy who have been trained in both philosophy and the classics. Students entering the program in classics will be asked to present evidence of promise in philosophy. Their course of study will include along with other work in classics two courses in Plato (one in the Department of Classics, one in the Department of Philosophy), two courses in Aristotle (similarly divided), and at least two further courses in the Department of Philosophy. The Special Committee will include at least one member of the Department of Philosophy.

CLASSICAL ARCHAEOLOGY. Graduate students who choose archaeology as a major subject are advised to select Greek and Latin as minor subjects. Archaeology may also be chosen as a minor subject, complementing studies in the classics. Previous training in archaeology, at either the undergraduate or graduate level, is not prerequisite.

Formal courses within the Department of Classics include Introduction to Classical Archaeology, Pre-Classical Greece, and the Archaeology of Classical Greece. Students may supplement these by courses in archaeology offered by other departments and by independent study undertaken in consultation with members of the Department of Classics. It is expected that graduate students interested in archaeology will from time to time have the opportunity of participating in excavations during the summer.

COURSES FOR 1966–67

(The list includes advanced undergraduate courses as well as courses primarily for graduate students.)

Lecture Courses

301–302. SOPHOCLES, ARISTOPHANES, HERODOTUS

Throughout the year. Credit four hours a term. Prerequisite, Greek 203. Fall term, Mr. Kirkwood. Spring term, instructor to be appointed.

305–306. LYRIC POETRY, AESCHYLUS, THUCYDIDES, DEMOSTHENES

Throughout the year. Credit four hours a term. Prerequisite, Greek 301–302. T Th S 9. Fall term, Mr. Robertson. Spring term, Mr. DeLacy.

401–402. INDEPENDENT STUDY IN GREEK

For qualified majors.

315–316. THE GREATER REPUBLICAN WRITERS

Throughout the year. Credit four hours a term. Prerequisite, Latin 205–206. M W F 10. Offered in 1966–67 and alternate years. Fall term, Mr. Pucci. Spring term, Mr. DeLacy.

Works by Plautus, Cicero, Sallust, and Lucretius will be studied.

[317–318. LITERATURE OF THE EARLY EMPIRE]

Throughout the year. Credit four hours a term. Prerequisite, Latin 205–206. Not offered in 1966–67. Offered in 1967–68 and alternate years.

369. MEDIEVAL LATIN LITERATURE

Spring term. Credit four hours. Prerequisite, three years of high school Latin or the equivalent. Hours to be arranged. Mr. Caplan.

451–452. INDEPENDENT STUDY IN LATIN

For qualified majors.

220. INTRODUCTION TO CLASSICAL ARCHAEOLOGY

Spring term. Credit three hours. M W F 9. Miss Milburn.

History of Classical Archaeology with emphasis upon contributions of Archaeology to our understanding of ancient Greece.

319. PRECLASSICAL GREECE

Fall term. Credit four hours. T Th S 11. Miss Milburn.

Greece, Crete and the Cyclades from the Neolithic period to the end of the Bronze Age.

320. ARCHAEOLOGY OF CLASSICAL GREECE

Spring term. Credit four hours. T Th S 11. Miss Milburn.

Study of principal monuments of ancient Greece from the end of Bronze Age to the Hellenistic period.

421. NUMISMATICS

Fall term. Credit four hours. Prerequisite, consent of the instructor. T 2–4:30. Mr. Waage.

Students will work with Greek and Roman coins from the University's collection to acquire a knowledge of their archaeological, artistic, and historical importance.

[423. CERAMICS AND THE TECHNIQUES OF EXCAVATION]

Fall term. Credit four hours. Prerequisite, consent of the instructor. T 2–4:30. Mr. Waage. Offered in 1967–68 and alternate years.

403. PLATO AND ARISTOTLE

Spring term. Credit four hours. Open to philosophy majors, graduate students, and others by consent of the instructor. M W F 11. Discussion sections to be arranged. Mr. Sorabji.

Topic for 1966–67: To be announced.

429. THE TRANSITION FROM REPUBLIC TO PRINCIPATE IN ROME — I

Fall term. Credit four hours. Prerequisite, consent of the instructor. M W 3–4:30. Mr. Yavetz.

The economic, social, political, and legal aspects of the late Republic. The latter part of the course will be devoted to modern historiography on Caesar's personality.

430. THE TRANSITION FROM REPUBLIC TO PRINCIPATE IN ROME — II

Spring term. Credit four hours. Prerequisite, History 429 or consent of the instructor. M W 3–4:30. Mr. Yavetz.

The Principate of Augustus and its aftermath.

[431. THE ROMAN REPUBLIC, 133–30 B.C.]

Fall term. Credit four hours. Prerequisite, History 302 or consent of the instructor. M W 3–4:30. Mr. Kagan. Not offered in 1966–67.

[432. GREEK HISTORY, 500–336 B.C.]

Spring term. Credit four hours. Prerequisite, History 301 or consent of the instructor. M W 3–4:30. Mr. Kagan. Not offered in 1966–67.

[433. THE ROMAN EMPIRE, 30 B.C.–A.D. 180]

Fall term. Credit four hours. Prerequisite, History 302 or consent of the instructor. M W 3–4:30. Mr. Kagan. Not offered in 1966–67.

[434. HELLENISTIC AGE]

Spring term. Credit four hours. Prerequisite, History 301–302 or consent of the instructor. M W 3–4:30. Mr. Kagan. Not offered in 1966–67.

[531–532. ELEMENTARY SANSKRIT]

Throughout the year in alternate years. Credit three hours a term. Hours to be arranged. Not offered in 1966–67.

534. COMPARATIVE INDO-ARYAN

Spring term in alternate years. Credit four hours. Prerequisite, Linguistics 202 and 102 or equivalent of an Indo-Aryan language. Hours to be arranged. Mr. Fairbanks.

Comparative reconstruction of Proto-Indo-Aryan phonology and grammar.

Honors Courses in Greek and Latin, and Greek and Latin Composition

370. HONORS COURSE

Spring term. Credit four hours. To be taken in the junior year. A program of readings and conferences centered in an author or a topic to be announced before the beginning of the term.

371. HONORS COURSE

Fall term. Credit four hours. To be taken in the senior year. Continuation of 370, with change of author or topic.

372. HONORS COURSE: SENIOR ESSAY

Spring term. Credit four hours. For students who have successfully completed course 371. Topics must be approved by the Honors adviser at the end of the first term of the senior year.

309–310. ADVANCED GREEK COMPOSITION

Throughout the year. Credit one hour a term. Prerequisite, Greek 209–210 or the equivalent. M 2. Mr. Pucci.

321–322. LATIN COMPOSITION

Advanced course. Credit one hour a term. For undergraduates who have completed Latin 221–222 and for graduate students. M 2. Mr. Hutton.

Seminars

571. PLATO'S PHAEDRUS

For graduate students. Fall term. Th 2–4, Mr. DeLacy.

572. ARISTOTLE'S POETICS

For graduate students. Spring term. W 2–4. Mr. Hutton.

581–582. HORACE

Throughout the year. Credit four hours a term. For graduate students. T 2–4. Mr. Caplan.

576. PLATO

Fall term. Credit three hours. T 3–5. Mr. Sachs.

Topic for 1966–67: An examination of Plato's later dialogues.

631–632. SEMINAR IN ANCIENT HISTORY

One or two terms. Credit four hours a term. Hours to be arranged. Mr. Yavetz.

639–640. SEMINAR IN LATIN PALEOGRAPHY

Throughout the year. Credit four hours a term. First term prerequisite to the second. Hours to be arranged. Mr. John.

FELLOWSHIPS AND FINANCIAL AID

Several departmental awards are available to incoming students in the Field of Classics:

The Florence May Smith Fellowships, with a stipend of $2000 plus tuition and fees, are granted especially to students in the Field of Classics.

Two Classical Scholarships carrying tuition and fees are available.

Since 1966–67 N.D.E.A. Fellowships have become available for students in the Field of Classics.

Several N.D.E.A. Fellowships are granted to Cornell incoming students in the Field of Classics.

The income of the Charles Edwin Bennett Fund for Research in the Classical Languages is used each year in the way best suited to promote the object for which the fund was established.

CORNELL STUDIES IN CLASSICAL PHILOLOGY. In 1887 the following paragraph appeared as the Introduction to this series: "It is proposed to publish, in connection with the classical work of Cornell University, such papers, by instructors or students, as may be thought to have an interest for workers in classical philology elsewhere. These papers will appear at indeterminate intervals."

Since 1887, thirty-four volumes have appeared; at present all out-of-print volumes are being reprinted. The series has always taken a broad view of classical philology and has included grammatical, historical, and archaeological studies, as well as studies in classical literature and thought.

Today the series continues to publish scholarly works by members of the Department; doctoral dissertations of an appropriate nature are eligible for inclusion.

OTHER FACILITIES. Olin Library, a new and modern library, has a very large collection of books and periodicals in the Field of Classics. Facilities for graduate students include carrels in the stacks of the library itself and a seminar room reserved for students in classics and ancient history, in which the principal reference works and current periodicals are kept.

Seminary classes are held in the library, in a room suitably equipped and conveniently located.

Comparative Literature

Faculty: Paul de Man, Acting Chairman, Herbert Dieckmann (French and Comparative Literature), Geoffrey H. Hartman (English and Comparative Literature)*, Burton Pike (German and Comparative Literature);* Harold Shadick (Chinese); Harry Caplan, Gordon M. Kirkwood, Pietro Pucci (Classics); M. H. Abrams, Robert M. Adams, Ephim G. Fogel, Robert E. Kaske, Edgar Rosenberg (English); Jean-Jacques Demorest, David I. Grossvogel, Edward P. Morris (French); Eric A. Blackall, O. J. Matthijs Jolles (German); Isaac Rabinowitz (Hebrew); Dalai Brenes, Karl-Ludwig Selig (Spanish); George Gibian (Russian).

Visitor: Hans-Jost Frey, University of Zurich (German and French).

Field Representative: Paul de Man, 169 Goldwin Smith Hall.

The graduate program in the Field of Comparative Literature is limited to about twenty-five students. The applicant must be mature enough to cross departmental lines and map out a field of study that combines his interests in a meaningful way. At the time of application, he should be prepared to study three literatures (they can include English) in the original language. The Field requires scores of the Graduate Record Examination (both aptitude

* On leave, 1966 67.

and advanced tests) though in special circumstances this requirement may be waived. The examination must be taken no later than December.

No Master of Arts Degree is offered in comparative literature. Candidates are admitted directly to the Ph.D. but are frequently advised to take a Master's degree in the literature which interests them most and constitutes their major Field. The candidate's two minor subjects must involve national literatures other than that chosen as the major; English and American literature cannot be counted as separate literatures. Standards of historical coverage and of critical discrimination in the major are equal to those expected from a Ph.D. in that Field. In the two minors, historical coverage is limited to a period (for example, Middle Ages, Renaissance, Romantic) or to a genre (drama, novel, poetry, literary criticism and theory). Under normal circumstances, students can complete course and examination requirements in three years of study and the Ph.D. degree in four years.

The graduate program in comparative literature allows specialization in almost every major area from medieval studies to criticism and literary theory. Under a unique arrangement, students can spend a year in Europe under the supervision of a member of the Department and receive full graduate credit. Cornell fellowships can be applied to this graduate year abroad.

COURSES

332. HUMANISM AND THE RENAISSANCE

Spring term. Credit four hours. M W F 10. Mr. Hutton.

Readings in translation from Petrarch, Erasmus, Ariosto, Rabelais, Tasso, Montaigne, and others, designed to bring out typical ideas and attitudes of the Renaissance period. Attention will be given to such topics as fifteenth-century humanism, neo-Latin literature, Ciceronianism, Renaissance Platonism, theories of poetry, the influence of the Counter-Reformation.

401. PRINCIPLES OF LITERARY CRITICISM

Fall term. Credit four hours. M 2–4 or W 2–4. Mr. Caplan.

Theories of Greek and Roman criticism. Spring term: see English 468 (English Literary Critics).

[402. THE ENLIGHTENMENT IN GERMANY, FRANCE AND ENGLAND]

Spring term. Credit four hours. M W F 11. Mr. Dieckmann. Not offered in 1966–67.

404. GREEK AND ROMAN DRAMA

Spring term. Credit four hours. T Th S 10. Mr. Kirkwood.

A study, by lecture and discussion, of the evolution of forms and meanings in ancient tragedy and comedy as exemplified by the works of Aeschylus, Sophocles, Euripides, Aristophanes, Menander, Plautus, Terence, and Seneca. Representative plays are read in translation. Consideration is given also to the origins of tragedy and comedy, their connection with myth and ritual and with other literary forms, and to the ancient theater and its stage.

[407. VARIATIONS ON A LITERARY THEME]

Fall term. Credit four hours. M W 11. Mr. R. Adams. Not offered in 1966–67.

409. POST-SYMBOLIST POETRY

Fall term. Credit four hours. M W F 10. Mr. de Man or Mr. Frey.

A study of the poetry of Rimbaud, Yeats, and Trakl. Reading knowledge of either French or German required.

411. MODERN GERMAN LITERATURE

Spring term. Credit four hours. M W F 11. Mrs. Cowan.

Nietzsche, the man and the artist. An intensive study of his major works and of his position as a key figure in regard to twentieth century problems. All reading in English translation.

414. MODERN ITALIAN LITERATURE

Spring term. Credit four hours. M 2–4. Mr. Biasin.

A thematic study of such authors as Verga, Svevo, Pirandello, Tomasi di Lampedusa, Basani, Pavese, and Moravia. Readings, lectures, and discussion in English.

416. MYTH AND LITERATURE

Spring term. Credit four hours. Enrollment limited to 35 upperclassmen and graduate students. M W F 9. Mrs. Siegel.

An examination of theories of myth as well as writers who treat myth as a form of literature. Emphasis will be on the relevance of myth to literature, with some reference to criticism. Texts will include works of Frazer, Jung, Campbell, Harrison, and Eliade.

501–502. TOPICS IN COMPARATIVE LITERATURE

Throughout the year. Credit four hours a term. Primarily for graduate students in Comparative Literature. Hours to be arranged. Mr. de Man.

Fall term: The theme of Narcissus in nineteenth-century literature. Spring term: Topic to be announced.

506. STUDIES IN RENAISSANCE MYTHOGRAPHY

Spring term. Credit four hours. Permission of instructor required. T 4–6. Mr. Selig.

Critical analysis of major Renaissance treatises on mythography, with special reference to their relationship to emblem literature, certain aspects of iconography, and the treatment of some mythological themes in selected literary texts.

515. ELEMENTS OF NEO-CLASSIC TASTE

Fall term. Credit four hours. Primarily for graduate students in Comparative Literature and English; a few qualified undergraduates may be admitted. Enrollment limited to 20. M W F 11. Mr. Robert Adams.

Successive waves of inspiration from Greek and Roman antiquity, to be studied through selected dramas, odes, satires, and imitations, from the Renaissance forward, in connection with illustrative materials from the plastic arts.

522. EUROPEAN ROMANTICISM

Fall term. Credit four hours. Hours to be arranged. Mr. de Man or Mr. Hartman.

A study of selected aspects of European Romanticism.

526. SEMINAR ON THE NOVEL

Spring term. Credit four hours. T 2–4. Mr. Dieckmann.

For courses in medieval studies, please see the listings under the Field of Medieval Studies.

English Language and Literature

Faculty: M. H. Abrams, Barry B. Adams, Robert M. Adams, Judith H. Anderson, Evelyn Barish, Jonathan P. Bishop, Jean F. Blackall, Anthony Caputi, Michael J. Colacurcio, J M. Cowan, G. Ferris Cronkhite, Donald D. Eddy, Robert H. Elias, Scott B. Elledge, Francis G. Fike, John A. Finch, Ephim G. Fogel, Kenneth C. Frederick, Paul Gottschalk, Geoffrey H. Hartman, Baxter Hathaway, George H. Healey, Judith S. Herz, Charles F. Hockett, Robert E. Kaske, Don W. Kleine, John W. Marchand, Carol L. Marks, James R. McConkey, H. Scott McMillin, Dorothy M. Mermin, Francis W. Mineka, Arthur M. Mizener, David Novarr, Stephen M. Parrish, Fred C. Robinson, Edgar Rosenberg, William M. Sale, Jr., W. David Shaw, Michael Shinagel, Walter J. Slatoff, S. Cushing Strout.

Field Representative: Anthony Caputi, 235 Goldwin Smith Hall

APPROPRIATE MAJOR SUBJECTS

English and American Literature
Creative Writing

APPROPRIATE MINOR SUBJECTS

American Literature
Creative Writing
Dramatic Literature
English Linguistics
The English Renaissance to 1660
The Nineteenth Century
Old and Middle English
Poetry
Prose Fiction
The Restoration and Eighteenth Century
The Twentieth Century

ADMISSION REQUIREMENTS. An applicant for graduate study in English is required to have completed an acceptable undergraduate degree and to submit a dossier of materials testifying to his record. These materials — the same as those required and processed by the Graduate School — consist of a completed application, including a statement of professional goals; undergraduate and, if appropriate, graduate transcript; and two letters of recommendation by persons capable of evaluating the applicant's professional promise. Additionally, the Department of English requires scores of the Graduate Record Examination (aptitude and advanced tests), though in special circumstances this requirement may be waived. Applicants should plan to take this examination by mid-January (preferably in November) so that their scores will be available in time.

Applicants can apply for admission to either the Master's or the doctoral programs, depending on their needs and intentions. Those who have completed a graduate degree will normally apply for the doctoral program. Those who have had no prior graduate study may apply for direct admission to the doctoral program with the expectation that a few with superior qualifications will be admitted directly. Others will be admitted as candidates for the Master's degree and reconsidered during the second term of their work in residence for admission to the doctoral program.

LANGUAGE REQUIREMENTS. The graduate student's work in English is structured to allow a wide range of choice within a framework of requirements designed to insure a superior level of professional competence. Highly important to the development of ancillary skills and knowledges are the language requirements. Students in the Master's program are required to demonstrate proficiency in French, German, Greek, Italian, or Latin; those failing to demonstrate proficiency during the first semester of residence will

be required to complete two residence units after passing the proficiency examination, unless an exception is made by the Field. Students in the doctoral program are required to demonstrate proficiency in French and German, either one of which must be passed before the Qualifying Examination may be scheduled and both of which must be completed before Examination A may be scheduled. In addition, doctoral students must have a knowledge of Old English, both the language and the literature, and students in the Middle Ages and the Renaissance are recommended to have a knowledge of Latin and Italian.

REQUIREMENTS PERTINENT TO MAJOR AND MINOR SUBJECTS. Since the student's work in English studies is intended to prepare him for teaching and research, the program is in the first instance designed to lead to a command of the Field. Apart from Master's degree students who major in creative writing, both Master's degree and doctoral students are required to major in English and American literature. But the student, in consultation with the members of his Special Committee, may use this major in a variety of ways: to work in areas in which his preparation is weak, to concentrate on areas of special interest, or, what is normal for doctoral students, to prepare for the Qualifying Examination, which is a comprehensive examination in the major subject. While Master's degree candidates are not expected to specialize, doctoral students are required to choose two areas of special interest. Doctoral students normally indicate their areas of specialization by their choice of two minor subjects; for example, the nineteenth century could be a "first minor," while the second could come from other areas of English or from another literature, classics, history, philosophy, linguistics, or speech and drama. But students in special programs can elect both minors from outside Fields (for example, a student in American Studies could choose as minors American history and philosophy); doctoral students are examined in these minor subjects in Examination A.

Under the guidance of a Special Committee, the student plans a program calculated to develop literary sophistication and mature scholarship. Since the enrollment in English is limited to about 85 students, with a first-year class of about 30, no student has difficulty in forming a Special Committee to meet his needs. During their first year in residence, all students plan to complete eight one-term courses, at least four of them numbered 500 or above. For the Master's degree candidates who are not moved into Ph.D. candidacy in the spring term of their first year, or whose Special Committee feels they should write a Master's thesis, one of these courses will be a thesis course, with the chairman of the Special Committee in charge; the Master's thesis of a candidate majoring in creative writing will consist of original fiction or poetry. Candidates for the Master's degree who expect to complete their work entirely in summer sessions may take two courses in each of their first four summers and then in the fifth summer register for the thesis course. All doctoral candidates will take the course in Research Methods and Materials and will complete two starred seminars; otherwise the Field imposes no specific course requirements beyond the first year of study. Doctoral candidates who have received their Masters' degrees elsewhere than at Cornell will be excused from the courses in Old English and Research Methods and Materials only if they satisfy the Field Representative that they have already completed equivalent work.

RESEARCH AND STUDY OPPORTUNITIES. Graduate work at Cornell offers the opportunity for study in a distinguished academic community with extensive resources. The books and manuscripts held by the John M. Olin Research Library, completed in 1961, place it among the top half-dozen uni-

versity libraries in the United States; its special collections range from Dante and Petrarch collections unique in this country to a splendid and comprehensive Wordsworth collection and one of the great Joyce collections of the world. Among the staff normally available for the direction of graduate studies are the following (the listing of areas of interest and of instructors is illustrative, not exhaustive):

Anglo-Saxon and Medieval Studies: Robert E. Kaske, Fred C. Robinson.
The Renaissance: Baxter Hathaway, Ephim G. Fogel, Barry B. Adams, Judith H. Anderson.
The Seventeenth Century: Robert M. Adams, David Novarr, Carol L. Marks.
The Eighteenth Century: William M. Sale, Jr., Scott B. Elledge, Donald D. Eddy, Michael Shinagel.
The Romantic Period: M. H. Abrams, Geoffrey H. Hartman, Stephen M. Parrish, John A. Finch.
The Victorian Period: Francis E. Mineka, Jonathan P. Bishop, Francis G. Fike, W. David Shaw.
The Twentieth Century: Arthur Mizener, Don W. Kleine.
American Literature: Robert H. Elias, S. Cushing Strout, Walter J. Slatoff, Jean F. Blackall, Michael J. Colacurcio.
The Novel: James R. McConkey, Edgar Rosenberg, Kenneth C. Frederick.
The Drama: Anthony Caputi, H. Scott McMillin.

Students interested in choosing a second minor can draw, of course, upon the faculties of related Fields.

Candidates in English may apply for fellowships open to students in all Fields; the George Lincoln Burr Fellowship, open to doctoral candidates in various Fields who wish to concentrate in medieval and Renaissance studies; and the Martin Sampson or the Class of 1916 Fellowships, awarded only to students in English. Every year, furthermore, the Department appoints to teaching assistantships a number of doctoral candidates who are completing, or have already completed, a year of graduate study. Candidates interested in assistantships must first apply for admission to the Graduate School; thereafter, they need only write a brief letter of assistantship application to the chairman, Department of English, Goldwin Smith Hall, by March 1.

In addition to these standard sources of support and those which can be drawn upon outside the University, the Graduate School is experimenting with an auxiliary system of support for students in the Humanities Area who are not otherwise supported, by awarding them $1800 plus a tuition and fees scholarship. By this means it is hoped that support of some kind can be arranged for virtually all Humanities Area students.

Inquiries about graduate work should be directed to the Field Representative.

COURSES

The following courses are for graduate students and a few especially qualified undergraduates. All students must secure the consent of the instructor before registering in any of them. Those courses preceded by an asterisk are seminars with a limited enrollment. Fall term courses, with odd numbers 501–535, are listed first, followed by spring term courses, with even numbers beginning with 552.

501. READINGS IN OLD ENGLISH

Fall term. Credit four hours. Mr. Robinson.

Elements of Old English grammar and readings in the shorter literary texts.

503. MIDDLE ENGLISH

Fall term. Credit four hours. Mr. Kaske.

Reading and critical analysis of major works, excluding Chaucer and the drama.

505. PHILOLOGICAL PROBLEMS IN THE STUDY OF ENGLISH LITERATURE

Fall term. Credit four hours. Mr. Robinson.

An examination of major developments in the English language from Middle English to the present and a consideration of the problems which these changes present in the reading of literary texts.

[507. THEORY OF PROSE]

Fall term. Credit four hours. Mr. Elledge. Not offered in 1966–67.

509. ELIZABETHAN-JACOBEAN DRAMA

Fall term. Credit four hours. Mr. McMillin.

In 1966–67, a study of dramatic form in four Jacobean playwrights: Jonson, Webster, the later Shakespeare, and Middleton.

511. EPIC AND ALLEGORY IN THE ENGLISH TRADITION

Fall term. Credit four hours. Miss Anderson.

Piers Plowman, The Faerie Queene, and *Paradise Lost:* the relation of satire to allegory, the development of characterization, the changing nature of the dream-world, and the function of the narrative voice. Emphasis will be on the poetry of Spenser.

515. STUDIES IN RENAISSANCE LITERATURE

Fall term. Credit four hours. Primarily for graduate students in Comparative Literature and English; a few qualified undergraduates may be admitted. Enrollment limited to 20. M W F 11. Mr. Robert Adams.

The elements of Neo-classic taste. Successive waves of inspiration from Greek and Roman antiquity will be studied through selected dramas, odes, satires, and imitations, from the Renaissance forward, in connection with illustrative material from the plastic arts.

517. STUDIES IN THE SEVENTEENTH CENTURY

Fall term. Credit four hours. Mr. Novarr.

Jonson and Dryden: drama, poetry, criticism.

*519. THE ROMANTIC PERIOD

Fall term. Credit four hours. Mr. Abrams.

Structure and imagery in the longer Romantic poems.

521. VICTORIAN PROSE

Fall term. Credit four hours. Mr. Mineka.

Major emphasis upon writers of non-fictional prose, but with some attention to the novel.

523. THE NEW ENGLAND MIND, 1620–1860.

Fall term. Credit four hours. Mr. Colacurcio.

The major texts of Puritanism studied in relation to the literary produc-

tions of Emerson, Hawthorne, and Melville. The emphasis will be on varieties of Puritan inheritance.

525. CLIMATES OF OPINION IN AMERICAN THOUGHT AND LITERATURE

Fall term. Credit four hours. Mr. Strout.

Tradition and revolt in Puritanism, the Enlightenment, and the Romantic movement.

[529. AMERICAN POETRY]

Fall term. Credit four hours. Mr. Elias. Not offered in 1966–67.

[531. DRAMATIC LITERATURE]

Fall term. Credit four hours. Mr. Caputi. Not offered in 1966–67.

[535. AMERICAN FICTION]

Fall term. Credit four hours. Mr. Mizener. Not offered in 1966–67.

539. STUDIES IN AMERICAN LITERATURE

Fall term. Credit four hours. Mr. Elias.

Naturalism in the United States: its social and cultural context, its European and American beginnings, its expression in the theory and practice of such writers as Hamlin Garland, Stephen Crane, Frank Norris, Theodore Dreiser, and Jack London, and its relation to the work of Henry Adams, Gertrude Stein, and Sherwood Anderson.

547. GRAMMATICAL ANALYSIS

Fall term. Credit four hours. Mr. Hathaway.

Study of the structures of English revealed in the transformation of the basic components of predications.

549–550. CREATIVE WRITING

Throughout the year. Credit four hours a term. Mr. Hathaway.

552. INTRODUCTION TO ADVANCED RESEARCH

Spring term. Credit four hours. Mr. Novarr.

A study of methods and materials relevant to the solution of problems in scholarly and critical interpretation. For candidates for the Ph.D. degree.

554. BEOWULF

Spring term. Credit four hours. Prerequisite, English 501. Mr. Robinson.

A reading of the poem in Old English and discussion of the literary problems which it presents.

556. CHAUCER

Spring term. Credit four hours. Mr. Kaske.

Reading and critical analysis, with emphasis on *Troilus* and *Canterbury Tales*.

* 558. STUDIES IN MEDIEVAL LITERATURE

Spring term. Credit four hours. Mr. Kaske.

Advanced research in English (or other) medieval literature.

560. MEDIEVAL DRAMA

Spring term. Credit four hours. Mr. Barry Adams.

Dramatic forms and traditions from the liturgical drama to the Elizabethan period.

* 562. SHAKESPEARE: THE ROMAN TRAGEDIES

Spring term. Credit four hours. Mr. Fogel.

Shakespeare's concepts of Rome and of tragic experience in a non-Christian context, as they are developed in *Julius Caesar, Antony and Cleopatra,* and *Coriolanus.* The Shakespearean plays will be compared with Roman tragedies by Daniel, Jonson, and other dramatists. Background readings in such historians as Plutarch, Suetonius, and Tacitus.

[564. SEVENTEENTH-CENTURY LITERATURE]

Spring term. Credit four hours. Not offered in 1966–67.

566. MILTON

Spring term. Credit four hours. Mr. Elledge.

Intensive study of Milton's poetry and selected prose with special reference to *Paradise Lost.*

568. EIGHTEENTH-CENTURY LITERATURE

Spring term. Credit four hours. Mr. Eddy.

In 1966–67 the emphasis will be on the writings of Jonathan Swift.

[570. THE LATER EIGHTEENTH CENTURY]

Spring term. Credit four hours. Mr. Hartman. Will be offered in 1967–68.

* 572. WORDSWORTH

Spring term. Credit four hours. Mr. Parrish.

Critical and textual studies based upon the Dove Cottage manuscript archive.

574. VICTORIAN POETRY

Spring term. Credit four hours. Mr. Mineka.

Major emphasis upon Tennyson, Browning, and Arnold, but with some study of other Victorian poets.

580. STUDIES IN ENGLISH FICTION

Spring term. Credit four hours. Mr. Slatoff.

The emphasis will be on the fiction of Joseph Conrad.

[582. CLIMATES OF OPINION IN AMERICAN THOUGHT AND LITERATURE]

Spring term. Credit four hours. Mr. Strout. Not offered in 1966–67.

584. TWENTIETH-CENTURY FICTION

Spring term. Credit four hours. Mr. Kleine.

The emphasis will be on the novella as a form.

588. FORMS OF THE NOVEL

Spring term. Credit four hours. Mrs. Blackall.

In 1966–67 the course will deal with the experimental novels of Henry James.

[590. LITERARY CRITICISM]

Spring term. Credit four hours. Not offered in 1966–67.

598. MASTER'S ESSAY

Spring term. Credit four hours. Members of the Department.

German

Faculty: Vilhjálmur T. Bjarnar, Eric A. Blackall, J Milton Cowan (Director, Division of Modern Languages), Joseph B. Dallett (Field Representative), Herbert Deinert (on leave, 1967–68), Paul de Man (Acting Chairman, Department of Comparative Literature), O. J. Matthijs Jolles (Chairman, Department of German Literature), Herbert L. Kufner, Pardee Lowe, Jr., James W. Marchand, Burton E. Pike (Chairman, Department of Comparative Literature; on leave, 1966–67), Joseph R. Puryear.

The Lector: Detlef Mahnke.

Visitors: Marianne U. Cowan, 1966–67; Else M. Fleissner (Wells College), 1966–67; Dennis H. Green (Cambridge University), 1965–66; Elizabeth M. Wilkinson (University College, London), 1966; Frans van Coetsem (Universities of Louvain and Leiden), 1965–66.

APPROPRIATE MAJOR SUBJECTS	APPROPRIATE MINOR SUBJECTS
German Literature	German Literature
Germanic Linguistics	Germanic Linguistics
	Old Norse

ADMISSION REQUIREMENTS. The Field requires applicants to submit scores of the Graduate Record Examination (both aptitude and advanced tests), though in special circumstances this requirement may be waived. For scores to be available by the time applications for fellowships and scholarships are reviewed, the examination must be taken *no later than December.*

Both M.A. and Ph.D. degrees are granted in German literature and in Germanic linguistics. Incoming graduate students in German will ordinarily be admitted first as candidates for the M.A. degree, except those who have already earned the M.A. degree in German at another accredited institution. Those who wish to acquire the Master's degree for teaching at the secondary-school level will be encouraged to apply to Cornell's Master of Arts in Teaching program rather than to the Field's M.A. program.

LANGUAGE REQUIREMENTS. For the M.A.: proficiency in German, as determined by the entrance examination in German administered by the Department of German Literature.

For the Ph.D.: besides proficiency in German, proficiency in French (required of all students majoring in German literature) or in Russian.

FIELD REQUIREMENTS FOR THE VARIOUS COMPREHENSIVE AND THESIS EXAMINATIONS. For details see the *Guide for Graduate Students in German at Cornell University,* available from the chairman of the Department of German Literature.

DESCRIPTION OF THE FIELD

In the Field of German the student may concentrate in either linguistics or literature. For each of these areas the staff is equally strong and the facilities are equally good. In the doctoral program, each area serves as a minor when the other is the major, so that a basis is established for a broad professional competence in the Field as a whole. In his free choice of a second minor, the Ph.D. candidate can, for example, avail himself of the wide offerings at Cornell in European medieval literature and philology, including Icelandic; another approach would be an interdepartmental program in the eighteenth century (also a period in which the offerings here are unusually attractive); an interest in comparative literature, history, music, philosophy, general linguistics, anthropology, or mathematics can similarly be developed within the student's program in German. The Master's program involves a major subject and a single minor of the student's own choice, together with a Master's essay.

GERMAN LITERATURE. In the Master's degree program, focus depends on the selection of courses in combination with the Master's essay. Together with his adviser the student works out a plan of study best designed to strengthen his knowledge of particular authors, genres, and periods, to deepen his understanding of the tenor and purpose of literary criticism, and to familiarize himself with the techniques and goals of scholarly research. German 415, an introduction to methods and bibliography, is specifically intended to acquaint the student beginning graduate work with procedures of research and to confirm his sense of direction towards a profession of scholarship and teaching.

In his doctoral work the student must see himself as making the transition to professional life. Supervised practice teaching in language and/or literature and directed research culminating in the dissertation represent two essential phases of his activity. He should strive, moreover, for a broadened but also intensified awareness of what has been achieved by German writers from the early Middle Ages to the present day. Important here are both the development of his historical sense and the cultivation of his critical ability. An opportunity to concentrate before the student begins his dissertation is provided by his selecting for special emphasis one of three partially overlapping periods: German literature before 1700, German literature from 1500 to 1832, or German literature from 1750 on.

The special interests of the staff in the area of literature are as follows: Medieval literature and philology: Professors Lowe, Marchand, and Puryear. The late Middle Ages through the seventeenth century: Professors Dallett and Deinert. The eighteenth century, the Classical Age: Professors Blackall, de Man, and Jolles. Romanticism and Realism: Professors Blackall, de Man, and Deinert. Twentieth-century literature: Professors de Man, Deinert, and Pike. Literary criticism and its theory: Professors de Man and Jolles.

GERMANIC LINGUISTICS. In the Master's degree program, the student aims at familiarizing himself with the basic tools of research in linguistics and philology (including descriptive techniques and a good grasp of the principles of historical linguistics). His selection of courses — in consultation with his adviser — will be designed to help him acquire this fundamental knowledge and develop a special area of interest, with which his Master's essay will normally be concerned. German 501, an introduction to Germanic linguistics, is specifically intended to acquaint the beginning student with the bibliography and the methods which sound scholarship in the field presupposes. The wide course offerings in the older Germanic languages allow the student

considerable choice in fulfilling the requirement that he be able to read two of them.

In his doctoral program the student seeks to mature as a scholar. His expected attainments will include a thorough knowledge of the structure of modern German, of the contrastive analysis of German and English, of the history of the German language, of four of the older Germanic languages, and of comparative Germanic linguistics. Reading courses are available for many aspects of study, along with seminars investigating such special topics as comparative Germanic cultures and Germanic codicology and palaeography. The faculty's wide range of scholarly concerns in the field of Germanic linguistics and philology — extending chronologically from Gothic to modern German dialects — insures that in writing his dissertation the student can count on interested guidance, whatever the subject of his investigation.

The special interests of the staff are as follows: Professors Bjarnar, Lowe, and Marchand: Old Icelandic. Professors Marchand and Puryear: Gothic, Old High German, Old Saxon, Middle High German, Early New High German. Professors Kufner and Lowe: history of the German language, modern German grammar. Professor Kufner: German dialects, applied linguistics, pedagogy. Professor Marchand: comparative culture, codicology and palaeography, computer-aided analysis of the older Germanic languages. Professor Cowan: general and applied linguistics, pedagogy. The above list is only approximate, since interests vary from time to time, and since each member of the staff is ultimately concerned with the entirety of the Field.

OLD NORSE. Although Old Norse can be taken only as a minor by students in the Field of German, the opportunities for studying it are exceptional. The University is especially favored with a collection of Old Icelandic materials (the Fiske collection) that is probably the most important of its kind in the world, and with a curator, Vilhjálmur Bjarnar, who is both a librarian and an Old Norse scholar. Two other faculty members, Professors Lowe and Marchand, have particular interest in the Old Icelandic field.

LIBRARY FACILITIES

The excellent opportunities for original research in the Field of German are suggested by the fact that the Cornell library ranks among the seven leading university libraries in this country. The John M. Olin Research Library has rich holdings in the area of German, including a comprehensive representation of the relevant series and periodicals. Among its rarities are contemporary editions of many sixteenth-, seventeenth-, and eighteenth-century German authors, as well as numerous incunabula from German presses, and the Fiske Old Icelandic collection mentioned above.

ACCREDITED STUDY IN EUROPE

Advanced students wishing to do research, or to supplement their training, at a European university but for credit at Cornell can qualify for the Cornell Program of Graduate Studies in Europe. This program is sponsored by the Cornell Department of Comparative Literature, one of whose professors serves as resident supervisor in Zurich and directs Cornell students enrolled there or at any other university on the Continent or in the British Isles.

SPECIAL FELLOWSHIPS

Incoming students can qualify for Cornell fellowships, foundation awards, and for NDEA Title IV and Title VI Fellowships (see page 14). Advanced

students can compete for the Schurman Fellowship (available annually to a Cornel student in any field for study at the University of Heidelberg), for one of several *Dank-Stipendien* given every year by the German Federal Republic for a year's work in any field in West Germany, or for the German Academic Exchange Service (DAAD) Fellowship which is similarly made available annually to Cornell students. While these special awards are not restricted to those in the Field of German, it is they who usually stand to profit the most from graduate study in the German Federal Republic.

GRADUATE COURSES

401. HISTORY OF THE GERMAN LANGUAGE I

Fall term in alternate years. Credit four hours. Prerequisites, German 204 or consent of the instructor and Linguistics 201 or 301 taken previously or concurrently. M W F 11. Mr. Lowe.

402. HISTORY OF THE GERMAN LANGUAGE II

Spring term in alternate years. Credit four hours. Prerequisite, German 401 or consent of the instructor. M W F 11. Mr. Lowe.

403. LINGUISTIC STRUCTURE OF GERMAN

Fall term. Credit four hours. Prerequisites, German 204 or consent of the instructor and Linguistics 201 or 301 taken previously or concurrently. M W F 10. Mr. Kufner.

A descriptive analysis of present-day German, with emphasis on its phonetics, phonemics, morphology, and syntax.

404. GERMAN FOR TEACHERS

Spring term. Credit four hours. Prerequisite, German 403. M W F 10. Mr. Kufner.

Methods of teaching the language based on a contrastive study of the structures of English and German. Extensive outside reading, reports on textbooks, discussion of various teaching aids and realia. Required for provisional New York State teacher certification.

405. INTRODUCTION TO MIDDLE HIGH GERMAN

Fall term. Credit four hours. Prerequisite, consent of the instructor. M W F 11. Mr. Puryear.

Intended for students with no previous knowledge of Middle High German; will begin with study of the Middle High German language and then proceed to the reading of selected texts.

406. MIDDLE HIGH GERMAN LITERATURE

Spring term. Credit four hours. Prerequisite, German 405. M W F 11. Mr. Puryear.

The main authors and literary trends of the Middle High German period will be discussed in connection with the reading of extensive selections from the works of the great epic and lyric poets between 1190 and 1230.

[407–408. TOPICS IN EARLIER GERMAN LITERATURE: 1300–1700]

Either term. Credit four hours. Prerequisite, consent of the instructor. T Th S 11. Mr. Dallett. Not offered in 1966–67.

409–410. TOPICS IN CLASSICISM AND ROMANTICISM

Fall term only. Credit four hours. Prerequisite, consent of the instructor. Th 11–1. Mr. Blackall.

Topic: Four novels of education: *Wilhelm Meisters Lehrjahre, Heinrich von Ofterdingen, Der Nachsommer, Der grüne Heinrich.*

413–414. TOPICS IN MODERN GERMAN LITERATURE

Fall term only. Credit four hours. Prerequisite, consent of the instructor. W 2–4. Mrs. Fleissner.

Topic: Naturalismus, Expressionismus, Symbolismus.

415. BIBLIOGRAPHY AND METHODS

Fall term. Credit four hours. Prerequisite, consent of the instructor. F 2–4. Mr. Marchand.

COURSES PRIMARILY FOR GRADUATE STUDENTS

500. SPRECH- UND SCHREIBÜBUNGEN

Throughout the year. No credit. Hours to be arranged. Mr. Mahnke. Required of all graduate students in German studies.

501. INTRODUCTION TO GERMANIC LINGUISTICS

Fall term in alternate years. Credit four hours. W 2–4. Mr. Puryear.

502. GOTHIC

Spring term in alternate years. Credit four hours. W 2–4. Mr. Puryear.

[503. OLD SAXON]

Fall term in alternate years. Credit four hours. M W F 2. Mr. Kufner. Not offered in 1966–67.

[504. OLD HIGH GERMAN]

Spring term in alternate years. Credit four hours. M W F 2. Mr. Marchand. Not offered in 1966–67.

509. OLD NORSE I

Fall term. Credit four hours. Hours to be arranged. Mr. Bjarnar.

510. OLD NORSE II

Spring term. Credit four hours. Hours to be arranged. Mr. Bjarnar.

[511. SAGAS]

Fall term. Credit four hours. Prerequisite, German 510 or consent of the instructor. Hours to be arranged. Mr. Lowe. Not offered in 1966–67.

[512. EDDA]

Spring term. Credit four hours. Prerequisite, German 510 or consent of the instructor. Hours to be arranged. Mr. Lowe. Not offered in 1966–67.

[521. MIDDLE HIGH GERMAN LITERATURE I]

Fall term. Credit four hours. Prerequisite, German 406 or consent of the instructor. M 2–4. Not offered in 1966–67.

522. MIDDLE HIGH GERMAN LITERATURE II

Spring term. Credit four hours. Prerequisite, German 406 or consent of the instructor. M 2–4. Mr. Marchand.

Topic: The Trivium: influence on MHG literature.

COMPARATIVE GERMANIC LINGUISTICS

(See Linguistics 541–542.)

[524. GERMAN POETRY OF THE LATE MIDDLE AGES]

Spring term. Credit four hours. F 3–5. Mr. Dallett. Not offered in 1966–67.

[526. SIXTEENTH-CENTURY GERMAN LITERATURE]

Spring term. Credit four hours. F 2–4. Mr. Dallett. Not offered in 1966–67.

528. SEVENTEENTH-CENTURY GERMAN LITERATURE

Spring term. Credit four hours. W 2–4. Mr. Dallett.

Topic: Forms of Baroque Fiction. A close study of von Zesen's *Adriatische Rosemund,* Grimmelshausen's *Simplicianische Schriften,* and Ziegler und Kliphausen's *Asiatische Banise;* the adaptation of their novelistic and non-fictional sources; the problem of the incorporation of encyclopaedic learning in fictional structures; numerological and other symbols of articulation, particularly as relating to ideas of terrestrial order and disorder.

[530. EIGHTEENTH-CENTURY LITERATURE OTHER THAN GOETHE]

Spring term. Credit four hours. W 2–4. Not offered in 1966–67.

531. GOETHE

Fall term. Credit four hours. T 2–4. Mr. Jolles.

Topic: Goethe als Kritiker und Naturwissenschaftler.

533–534. GERMAN ROMANTICISM

Spring term. Credit four hours. Th 2–4 Mr. Blackall.

Topic: The earlier Romantics: Jean Paul, the Schlegels, Tieck, Wackenroder, Novalis.

535–536. NINETEENTH-CENTURY GERMAN LITERATURE

Fall term only. Credit four hours. Th 2–4. Mr. Deinert.

Topic: Nineteenth-Century Drama: Grabbe, Büchner, Hebbel.

537–538. TWENTIETH-CENTURY GERMAN LITERATURE

Credit four hours a term. T 2–4.

Fall term topic: Roman und Novelle des 20. Jahrhunderts. Mrs. Fleissner. Spring term topic: Social Criticism in Twentieth-Century Drama: Hauptmann and Brecht. Mr. Deinert.

[540. HISTORY AND METHODS OF MODERN GERMAN LITERARY CRITICISM]

Spring term. Credit four hours. T 2–4. Mr. Jolles. Not offered in 1966–67.

GERMAN HISTORY

(See offerings in History.)

SEMINARS FOR GRADUATE STUDENTS

These seminars are intended for graduate students who are beyond the first year of their graduate study. Each seminar will deal with a specific topic in more detail than is possible in the graduate courses; the topics will vary from year to year.

[601. GERMAN DIALECTOLOGY]
Fall term. Four hours credit. Hours to be arranged. Not offered in 1966–67.

[602. EARLY NEW HIGH GERMAN]
Spring term. Four hours credit. Hours to be arranged. Not offered in 1966–67.

611. GERMANIC PALAEOGRAPHY AND CODICOLOGY
Fall term. Four hours credit. Hours to be arranged. Mr. Marchand.

612. COMPARATIVE GERMANIC CULTURES
Spring term. Four hours credit. Hours to be arranged. Mr. Marchand.

[651. SEMINAR IN GERMANIC LINGUISTICS I]
Fall term. Four hours credit. Th 2. Mr. Marchand. Not offered in 1966–67.

[652. SEMINAR IN GERMANIC LINGUISTICS II]
Spring term. Four hours credit. Th 2. Mr. Marchand. Not offered in 1966–67.

[653–654. SEMINAR IN GERMAN LITERATURE]
Throughout the year. Credit four hours a term. Not offered in 1966–67.

History

Faculty: Knight Biggerstaff, David B. Davis, Edward W. Fox, Paul W. Gates, Richard Graham, Henry Guerlac, James J. John, Donald Kagan, Michael Kammen, John R. Kirkland, Helmut G. Koenigsberger, Walter F. LeFeber, Frederick G. Marcham, Walter M. Pintner, Richard Polenberg, Joel H. Silbey, James M. Smith, Brian Tierney, Mack Walker, L. Pearce Williams, Oliver W. Wolters.

Field Representative: Richard Graham, 314 W. Sibley Hall.

APPROPRIATE MAJOR AND MINOR SUBJECTS

American History
Ancient History
Early Modern European History
English History
History of Science
Latin American History
Medieval History
Modern Chinese History
Modern European History
Russian History
Southeast Asian History

All applicants for admission to graduate study in the Field of History must include the scores of the Graduate Record Examination Aptitude Test with their other credentials.

Each major subject area of study within the department formulates its own foreign language requirement.

Candidates majoring in the Field of History may take minors in other history subjects or in other Fields of the Graduate School.

For available fellowships, see pages 14–16. Prospective students interested in

applying for assistantships, of which a number are available to students who have already completed at least one year of graduate study, should write directly to the chairman, Department of History, West Sibley Hall.

GRADUATE COURSES

431. THE ROMAN REPUBLIC, 133–30 B.C.

Fall term. Credit four hours. Prerequisite, History 302 or consent of the instructor. M W 3–4:30. Mr. Kagan.

432. GREEK HISTORY, 500–336 B.C.

Spring term. Credit four hours. Prerequisite, History 301 or consent of the instructor. M W 3–4:30. Mr. Kagan.

433. THE ROMAN EMPIRE, 30 B.C.–A.D. 180

Fall term. Credit four hours. Prerequisite, History 302 or consent of the instructor. M W 3–4:30. Mr. Kagan.

434. HELLENISTIC AGE

Spring term. Credit four hours. Prerequisite, History 301–302 or consent of the instructor. M W 3–4:30. Mr. Kagan.

335. MEDIEVAL CULTURE, 400–1150

Spring term. Credit four hours. Prerequisite, History 303–304 or consent of the instructor. T Th 2–3:30. Mr. John.

336. MEDIEVAL CULTURE, 1150–1300

Spring term. Credit four hours. Prerequisite, History 303–304 or consent of the instructor. T Th S 12. Mr. Tierney.

437. CHURCH AND STATE DURING THE MIDDLE AGES

Fall term. Credit four hours. Prerequisite, History 303–304 or consent of the instructor. T Th S 12. Mr. Tierney.

438. FRANCE IN THE HIGH MIDDLE AGES

Spring term. Credit four hours. Prerequisite, History 303–304 or consent of the instructor. T Th S 12. Mr. Tierney.

341–342. EUROPE IN THE AGE OF THE RENAISSANCE, REFORMATION, AND COUNTER-REFORMATION

Throughout the year. Credit four hours a term. Prerequisite, six hours in European history or consent of the instructor. T Th S 11. Mr. Koenigsberger.

442. THE SPANISH MONARCHY AND THE REVOLT OF THE NETHERLANDS

Spring term. Credit four hours. Prerequisite, six hours of European history and consent of the instructor. T Th S 9. Mr. Koenigsberger.

444. THE CENTURY OF ENLIGHTENMENT

Spring term. Credit four hours. A reading knowledge of French is required. Prerequisite, six hours in European history. M W F 10. Mr. Guerlac.

445. SOURCES OF EIGHTEENTH-CENTURY FRENCH HISTORY

Fall term. Credit four hours. Prerequisite, a reading knowledge of French and permission of the instructor. Th 2–4:30. Mr. Guerlac.

446. THE OLD REGIME IN FRANCE, 1660–1789

Spring term. Credit four hours. Prerequisite, a reading knowledge of French and six hours in European history. M W F 10. Mr. Guerlac.

347. ENGLISH CONSTITUTIONAL HISTORY I: TO 1485

Fall term. Credit four hours. Prerequisite, History 303–304, History 307, or consent of the instructor. T Th S 12. Mr. Tierney.

348. ENGLISH CONSTITUTIONAL HISTORY II: SINCE 1485

Spring term. Credit four hours a term. Prerequisite, History 307–308, History 347 or consent of the instructor. T Th S 9. Mr. Marcham.

450. HISTORY OF ENGLAND IN THE NINETEENTH AND TWENTIETH CENTURIES

Spring term. Credit four hours. Prerequisite, History 307–308 or consent of the instructor. T Th S 9. Mr. Marcham.

351. EUROPE IN THE NINETEENTH CENTURY

Fall term. Credit four hours. Prerequisite, History 106 or consent of the instructor. W F 3–4:30. Mr. Fox.

352. EUROPE IN THE TWENTIETH CENTURY

Spring term. Credit four hours. Prerequisite, History 106 or 351, or consent of the instructor. W F 3–4:30. Mr. Fox.

551. EVOLUTION OF THE FRENCH REPUBLIC

Spring term. Credit four hours. Open to upperclassmen and graduate students with the consent of the instructor. A reading knowledge of French is required. T Th 3–4:30. Mr. Fox.

553. THE EUROPEAN REVOLUTION, 1789–1848

Fall term. Credit four hours. Open to seniors and graduate students with the consent of the instructor. A reading knowledge of French is required. T Th 2–3:30. Mr. Fox.

554. THE MODERNIZATION OF EUROPE

Spring term. Credit four hours. Open to seniors and graduate students with the consent of the instructor. Mr. Fox.

356. HISTORY OF MODERN GERMANY

Spring term. Credit four hours. Prerequisite, six hours in European history. T Th S 10.

461. ECONOMIC AND SOCIAL HISTORY OF RUSSIA

Fall term. Credit four hours. Prerequisite, History 309–310, or permission of the instructor. M 2–3, W 2–4. Mr. Pintner.

462. HISTORY OF RUSSIAN FOREIGN RELATIONS FROM THE FIFTEENTH CENTURY

Spring term. Credit four hours. Prerequisite, History 309–310 or permission of the instructor. M 2–3, W 2–4. Mr. Pintner.

467. INTELLECTUAL CURRENTS OF THE SEVENTEENTH CENTURY
Spring term. Credit four hours. Prerequisite, History 311–312 or consent of the instructor. Th 2–4:30. Mr. Guerlac.

369–370. SCIENCE SINCE 1850
Throughout the year. Credit four hours a term. Prerequisite, either an intense interest in the history of modern science (see the instructor) or two years of college science. Course 369 is not prerequisite to 370. M W F 9. Mr. Williams.

371. COLONIZATION FROM ANTIQUITY UNTIL THE EIGHTEENTH CENTURY
Fall term. Credit four hours. M W F 9. Mr. Kammen.

372. THE COLONIAL PERIOD OF AMERICAN HISTORY, 1607–1763
Spring term. Credit four hours. M W F 9. Mr. Kammen.

473–474. AMERICAN HISTORY, 1763–1820
Throughout the year. Credit four hours a term. M W F 2. Mr. Smith.

376–377–378. AMERICAN CULTURAL AND INTELLECTUAL HISTORY
Credit four hours a term. History 376 covers the period to 1820; History 377 covers the period 1820–1890; History 378 covers the period 1890 to the present. The three terms form a sequence but each may be taken independently and without prerequisite. M W F 10. Mr. Davis.

379–380. RECENT AMERICAN HISTORY, 1890 TO THE PRESENT
Throughout the year. Credit four hours a term. T Th S 12. Mr. Polenberg.

481–482. AMERICAN HISTORY: HISTORY OF THE WEST
Throughout the year. Credit four hours a term. The first term is not prerequisite to the second. M W F 12. Mr. Gates.

487. MEXICO IN THE TWENTIETH CENTURY
Fall term. Credit four hours. Prerequisite, History 319–320 or consent of the instructor. M W F 11. Mr. Graham.

488. BRAZIL SINCE INDEPENDENCE
Spring term. Credit four hours. Prerequisite, History 319–320 or consent of the instructor. M W F 11. Mr. Graham.

495. SOUTHEAST ASIAN HISTORY TO THE FOURTEENTH CENTURY
Fall term. Credit four hours. T Th S 11. Mr. Wolters.

496. SOUTHEAST ASIAN HISTORY FROM THE FIFTEENTH CENTURY
Spring term. Credit four hours. Prerequisite, History 495 or consent of the instructor. T Th S 11. Mr. Wolters.

GRADUATE SEMINARS

501. INTRODUCTION TO HISTORICAL THEORY AND PRACTICE
Fall term. Credit four hours. Required of all entering graduate students in history (exemption may be granted by the instructor to students who have already completed a satisfactory equivalent). Not open to undergraduates. T Th 2–4. Mr. John.

Problems of historical thought, research, and writing as illustrated by historians representative of various cultures, periods and schools. Intensive supervision in the preparation of a term paper.

508. POLITICS AND THE SOCIETY IN COLONIAL AMERICA
Spring term. Credit four hours. Open to undergraduates with the permission of the instructor. Hours to be arranged. Mr. Kammen.

A topical seminar with emphasis upon the process of political socialization, factionalism, the development of party, and protest movements in relationship to social structure.

511–512. SUPERVISED READING
Throughout the year. Credit four hours a term. Hours to be arranged. For graduate students only. Staff.

591–592. MODERNIZATION OF CHINA
Throughout the year. Credit four hours a term. Prerequisite, History 324 with a grade of B or better or permission of the instructor. 591 prerequisite to 592. Conducted as a seminar. M 4–6. Mr. Biggerstaff.

Topical study of the impact of Western civilization upon traditional China and of the changes in China during the first half of the twentieth century.

631–632. SEMINAR IN ANCIENT HISTORY
One or two terms. Credit four hours a term. Hours to be arranged. Mr. Kagan.

635–636. SEMINAR IN MEDIEVAL HISTORY
One or two terms. Credit four hours a term. Hours to be arranged. Mr. John.

637–638. SEMINAR IN MEDIEVAL HISTORY
One or two terms. Credit four hours a term. Hours to be arranged. Mr. Tierney.

639–640. SEMINAR IN LATIN PALEOGRAPHY
Throughout the year. Credit four hours a term. First term prerequisite to the second. Hours to be arranged. Mr. John.

641–642. SEMINAR IN EUROPEAN HISTORY DURING THE ERA OF THE RENAISSANCE AND REFORMATION
One or two terms. Credit four hours a term. Hours to be arranged. Mr. Koenigsberger.

647–648. SEMINAR IN TUDOR AND STUART HISTORY
One or two terms. Credit four hours a term. Hours to be arranged. Mr. Marcham.

651–652. SEMINAR IN MODERN EUROPEAN HISTORY
One or two terms. Credit four hours a term. Hours to be arranged. Mr. Fox.

657–658. SEMINAR IN MODERN GERMAN HISTORY
One or two terms. Credit four hours a term. Hours to be arranged. Mr. Walker.

661–662. SEMINAR IN RUSSIAN HISTORY
One or two terms. Credit four hours a term. Hours to be arranged. Mr. Pintner.

665–666. SEMINAR IN THE HISTORY OF EARLY MODERN SCIENCE
One or two terms. Credit four hours a term. Hours to be arranged. Mr. Guerlac.

667–668. SEMINAR IN THE HISTORY OF SCIENCE DURING THE NINETEENTH AND TWENTIETH CENTURIES
One or two terms. Credit four hours a term. Hours to be arranged. Mr. Williams.

671–672. SEMINAR IN EARLY AMERICAN HISTORY
One or two terms. Credit four hours a term. Hours to be arranged. Mr. Smith.

673–674. SEMINAR IN AMERICAN POLITICAL HISTORY AND THE ANTE-BELLUM PERIOD
One or two terms. Credit four hours a term. Hours to be arranged. Mr. Silbey.

675–676. SEMINAR IN AMERICAN CULTURAL AND INTELLECTUAL HISTORY
One or two terms. Credit four hours a term. Hours to be arranged. Mr. Davis.

677–678. SEMINAR IN THE AMERICAN CIVIL WAR RECONSTRUCTION
One or two terms. Credit four hours a term. Hours to be arranged. Mr. Kirkland.

679–680. SEMINAR IN THE HISTORY OF THE AMERICAN WEST
One or two terms. Credit four hours a term. Hours to be arranged. Mr. Gates.

683–684. SEMINAR IN THE HISTORY OF AMERICAN FOREIGN RELATIONS
Throughout the year. Credit four hours a term. Hours to be arranged. Mr. LaFeber.

685–686. SEMINAR IN RECENT AMERICAN HISTORY
One or two terms. Credit four hours a term. Hours to be arranged. Mr. Polenberg.

687–688. SEMINAR IN LATIN AMERICAN HISTORY
One or two terms. Credit four hours a term. Hours to be arranged. Mr. Graham.

691–692. SEMINAR IN MODERN CHINESE HISTORY
One or two terms. Credit four hours a term. Hours to be arranged. Mr. Biggerstaff.

695–696. SEMINAR IN SOUTHEAST ASIAN HISTORY
One or two terms. Credit four hours a term. Hours to be arranged. Mr. Wolters.

Housing and Design

(See page 194.)

Medieval Studies

Faculty: Barry B. Adams, Vilhjalmur T. Bjarnar, Harry Caplan, Alice M. Colby, Robert A. Hall, Jr., James Hutton, James J. John, Robert E. Kaske, Norman Kretzmann, Pardee Lowe, Jr., James W. Marchand, Hugh Olmstead, Joseph Puryear, Isaac Rabinowitz, Felix Reichmann, Fred C. Robinson, Karl-Ludwig Selig, Brian Tierney, Abraham L. Udovitch.

Field Representative: James W. Marchand, 227 Morrill Hall.

APPROVED MAJOR AND MINOR SUBJECTS

Medieval History
Medieval Literature:
English, German, Latin, Norse, Romance
Medieval Philology:
Germanic, Romance, Slavic
Medieval Philosophy

The aim of this Field is to allow the student to concentrate more fully upon medieval studies, and to supplement his major interest with a greater number of courses in related disciplines than is possible within the programs of other Fields which include some medieval studies as part of their province.

Though certain requirements are absolute (e.g., a reading knowledge of Latin, and a course in palaeography and research methods), emphasis will be on the formulation of individual programs to fit the interests and needs of particular students, and on the meaningful combination of mutually relevant disciplines.

LANGUAGE REQUIREMENTS. For the M.A., a mastery of Latin and one other medieval language; for the Ph.D., a mastery of several medieval languages including Latin.

COURSES

For complete information on the following courses, consult the offerings in Classics, English, German, Romance Studies, History, and Philosophy.

Classics

369. MEDIEVAL LATIN LITERATURE. Mr. Caplan.

English

366. CHAUCER. Mr. Kaske.

406. THE EARLIEST ENGLISH LITERATURE. Mr. Robinson.

501. READINGS IN OLD ENGLISH. Mr. Robinson.

503. MIDDLE ENGLISH. Mr. Kaske.

554. BEOWULF. Mr. Robinson.

556. CHAUCER. Mr. Kaske.

558. STUDIES IN MEDIEVAL LITERATURE. Mr. Kaske.

560. MEDIEVAL DRAMA. Mr. B. Adams.

French

415–16. LITERATURE OF THE MIDDLE AGES. Miss Colby.

417. POETRY OF THE FIFTEENTH CENTURY. Mr. Brogyanyi.

518. GRADUATE SEMINAR IN MEDIEVAL LITERATURE. Miss Colby.

German

405. INTRODUCTION TO MIDDLE HIGH GERMAN. Mr. Puryear.

406. MIDDLE HIGH GERMAN LITERATURE. Mr. Puryear.

511. SAGAS. Mr. Lowe.

512. EDDAS. Mr. Lowe.

521. MIDDLE HIGH GERMAN LITERATURE I.

522. MIDDLE HIGH GERMAN LITERATURE II. Mr. Marchand.

524. GERMAN POETRY OF THE LATE MIDDLE AGES. Mr. Dallett.

Italian

313–314. DANTE.

433. OLD ITALIAN TEXTS. Mr. Hall.

513–514. SPECIAL TOPICS IN THE DIVINE COMEDY. Mr. Lanapoppi.

Spanish

411. INTRODUCTION TO MEDIEVAL LITERATURE. Mr. Selig.

432. LA CELESTINA. Mr. Selig.

History

303–304. MEDIEVAL HISTORY. Mr. Tierney.

335. MEDIEVAL CULTURE 400–1150. Mr. John.

336. MEDIEVAL CULTURE 1150–1300. Mr. Tierney.

437. CHURCH AND STATE DURING THE MIDDLE AGES. Mr. Tierney.

438. FRANCE IN THE HIGH MIDDLE AGES. Mr. Tierney.

637–638. SEMINAR IN MEDIEVAL HISTORY. Mr. Tierney.

639–640. SEMINAR IN LATIN PALEOGRAPHY. Mr. John.

Philosophy

303. MEDIEVAL PHILOSOPHY. Mr. Kretzmann.

580. SEMINAR IN MEDIEVAL PHILOSOPHY. Mr. Kretzmann.

Music

Faculty: William W. Austin, Donald J. Grout, William C. Holmes, John Hsu, Karel Husa, John Kirkpatrick, Robert M. Palmer, Harold E. Samuel, Thomas A. Sokol.

Field Representative: William C. Holmes, Lincoln Hall.

APPROPRIATE MAJOR AND MINOR SUBJECTS

Musical Composition, Musicology, Theory of Music

The Master of Arts degree is awarded in musical composition, musicology, and theory of music. The Doctor of Philosophy degree is conferred in musicology, and the Doctor of Musical Arts degree (A.Mus.D.) in musical composition. The Master's degree in theory of music may either be terminal or lead to doctoral studies in musical composition or musicology.

Applicants for admission are asked to submit scores for the Graduate Record Examination Aptitude Test. All applicants also must take a test of musical proficiency, including sight singing, melodic and harmonic dictation, score reading, and sight reading at the piano. Sample copies of this test and further information may be obtained from the Music Department office.

Minimum language requirements are: a reading knowledge of French and German for the M.A. and the Ph.D. in musicology; French or German for the M.A. in theory and composition and for the A.Mus.D. All students in the Field of Music are urged to acquire a more intimate knowledge of these languages (and others) and, upon recommendation of their Special Committee, may be required to do so. Applicants who are admitted with deficiencies either in language proficiency or in basic musicianship (as determined by the Music Proficiency Test) must make up these deficiencies within their first year of resident study at Cornell.

A student is admitted to doctoral candidacy after he has passed a Comprehensive Examination administered by his Special Committee. The passing of this Comprehensive Examination certifies that the student is eligible to present a thesis to the Graduate School Faculty. The examination may not be taken until two units of residence credit have been accumulated, and a minimum of two units of residence credit is required after passing this Comprehensive Examination before the Final (Thesis) Examination can be scheduled. In those cases in which the Master's degree candidate has fulfilled all the prerequisites for the examination for admission to doctoral candidacy, the Final Examination for the Master's degree may be combined with the examination for admission to candidacy.

Compositions of student composers are performed by members of the Music Faculty, including David Montagu, violinist, and Barbara Troxell, soprano, by ensembles conducted by Professors Husa, Sokol, and others, and by occasional visitors.

The Music Library, a part of the University Library System, is housed in the Music Department. It has an excellent collection of the standard research tools, including collected editions, *Denkmäler*, and periodicals. The Music Library's holdings consist of 40,000 books and scores and 13,000 records. Particularly noteworthy are the collections of opera scores from all periods, scores and records of music from the contemporary period, and a large microfilm collection of Renaissance sources, both theoretical and musical.

Donald J. Grout, the opera historian, heads the faculty in musicology. Both he and William W. Austin, the author of *Music in the Twentieth Century*, work closely with the students whose studies are mainly historical. John

Kirkpatrick, pianist and adviser for the Ives Collection at Yale University, specializes in the music of Charles Ives. Robert Palmer and Karel Husa are in charge of students in theory and composition. The former is also a pianist with wide-ranging interests in music of all periods, and the latter is an active conductor both in the United States and abroad. John Hsu, cellist and gambist, in addition to performing, is actively engaged in editing the largely unknown solo gamba repertoire of seventeenth- and eighteenth-century France. Choral activities are under the direction of Thomas A. Sokol, who specializes in vocal music of the Spanish Renaissance. The Music Librarian, Harold E. Samuel, editor of the journal of the Music Library Association, *Notes,* teaches Bibliography and works in early seventeenth-century German music. William C. Holmes is particularly interested in middle-17th century Italian opera.

APPROPRIATE COURSES

381–382. HISTORY OF MUSIC I

Throughout the year. Credit four hours a term. First term prerequisite to second. M 2–4, W 2–3. Mr. Holmes.

History of musical styles from the Middle Ages to Beethoven. Intensive study of musical scores, readings from theoretical sources (in translation), and written reports.

451. ADVANCED COUNTERPOINT AND ANALYSIS: EIGHTEENTH CENTURY

Fall term. Credit four hours. M W 12 and Th 2. Mr. Palmer.

Advanced problems of contrapuntal writing in three voices. An introduction to invertible counterpoint and fugal writing. Representative works employing the fugal principle will be analyzed with particular attention to those of J. S. Bach.

452. COMPOSITION (PROSEMINAR)

Spring term. Credit four hours. May be repeated for credit. M W 11. Mr. Husa.

Problems of writing in the smaller forms and in various media. Class discussion and performance, with analysis of contemporary works. The basic techniques of composition and their extensions in the twentieth century will be related to individual ability and needs. Students will be required to attend the Friday afternoon reading sessions of student compositions and occasionally to attend rehearsals of the Cornell musical organizations and ensembles.

453. ADVANCED COUNTERPOINT AND ANALYSIS: SIXTEENTH CENTURY

Fall term. Credit four hours. M W 12 and Th 2. Mr. Palmer.

Contrapuntal techniques of the sixteenth century, including analysis of works by Palestrina and his contemporaries.

455. ORCHESTRATION

Fall term. Credit four hours. M W 11. Mr. Husa.

A study of the instruments of the orchestra and their use in representative works from 1700 to the present. Scoring for various instrumental groups including large orchestra. Students will occasionally attend rehearsals of the Cornell musical organizations and ensembles.

481. HISTORY OF MUSIC II

Fall term. Credit four hours. Prerequisite, Music 382. M 2–4 and individual conferences. Mr. Grout.

History of musical styles from the time of Beethoven to the present.

482. MUSICOLOGY (PROSEMINAR)

Spring term. Credit four hours. Prerequisite, Music 481. M 2–4. Mr. Grout.

Principles of research. Introduction to notation, with exercises in transcription from sources and preparation of performing editions.

551–552. SEMINAR IN COMPOSITION

Throughout the year. Credit four hours a term. W 2–4. Mr. Palmer.

Intended to make the student acquainted with compositional practices in contemporary styles and to develop his creative abilities.

555. ANALYSIS

Fall term. Credit four hours. Required of all graduate students in composition. T 9–11, Th 9. Mr. Palmer.

An introduction to the systematic analysis of musical structure, melody, and harmony. Emphasis on the Viennese classic composers and Bach, with some consideration of later music.

580. INTRODUCTION TO CONTEMPORARY MUSIC

Spring term. Credit two hours. T 9. Mr. Palmer.

Approaches to the analysis of short works of representative composers, with emphasis on only one or two techniques in each composition.

581–582. INTRODUCTION TO BIBLIOGRAPHY AND RESEARCH

Throughout the year. Credit four hours a term. Prerequisites, a reading knowledge of French and German and an elementary knowledge of music theory and general music history. M 2–4. Mr. Samuel.

The basic materials and techniques of musicological research.

585–586. DEBUSSY TO BOULEZ

Throughout the year. Credit four hours a term. Prerequisites, Music 580 and 582 or equivalent. Th 2–4. Mr. Austin.

Historical studies in twentieth-century music. Each student will study many works of a single composer, in relation to that composer's life and thought and especially his knowledge of other music. Composers will be chosen in accordance with the students' abilities and interests.

680. CONTEMPORARY MUSIC (SEMINAR)

Spring term. Credit two hours. Prerequisite, Music 580. T 10. Mr. Palmer.

Detailed analysis of a limited number of larger works representative of main trends in twentieth-century music (different works chosen each year).

681–682. MUSICOLOGY (SEMINAR)

Throughout the year. Credit four hours a term. T 2–4. Mr. Grout.

683–684. PALAEOGRAPHY

Throughout the year. Credit four hours a term. Prerequisite, reading knowledge of French and German. Reading knowledge of Latin is desirable. Th 2–4. Mr. Holmes.

Studies in the history of musical notation from the tenth to the sixteenth centuries. Transcriptions and performance from original notation.

685–686. HISTORY OF OPERA (SEMINAR)

Throughout the year. Credit four hours a term. M 9–11. Mr. Grout.

Specialized independent studies.

Philosophy

Faculty: Max Black, Stuart M. Brown, Jr., John V. Canfield, Keith S. Donnellan, Bruce C. Goldberg, Norman Kretzmann, David B. Lyons, Norman Malcolm, Nelson C. Pike, David Sachs, Sydney S. Shoemaker, Richard R. K. Sorabji, Michael Stocker. Professor at Large: Georg Henrik von Wright, University of Helsinki.

Field Representative: David B. Lyons, 321 Goldwin Smith Hall.

APPROPRIATE MAJOR SUBJECTS	APPROPRIATE MINOR SUBJECTS
Aesthetics	Aesthetics
Epistemology	Epistemology
Ethics	Ethics
History of Philosophy	History of Philosophy
Logic	Logic
Metaphysics	Metaphysics
Philosophy of Religion	Philosophy
Philosophy of Science	Philosophy of Religion
	Philosophy of Science
	Political Philosophy

The Susan Linn Sage School of Philosophy, which comprises the Field of Philosophy in the Graduate School, was founded through the generosity of the late Henry W. Sage, who endowed the Susan Linn Sage Professorship and gave in addition $200,000 to provide permanently for instruction and research in philosophy.

The Philosophical Review, which is managed by the Sage School, is an international quarterly that publishes articles, reviews, and discussions in all branches of philosophy.

ADMISSION REQUIREMENTS. The instruction offered to graduate students presupposes such undergraduate courses in the subject as would be taken by a student in the College of Arts and Sciences of Cornell University who had elected philosophy as a major subject. Those who have not had equivalent preparation are expected to make up their deficiencies outside the work required for an advanced degree.

The Sage School provides opportunity for advanced study to two classes of graduate students: those whose major interest is in some branch of philosophy; and those whose chief branch of research is in allied fields but who desire to supplement this with a minor in philosophy.

1. Students whose major interest is in philosophy are required (a) to gain a general knowledge of the whole subject including its history, and (b) to select some aspect or subdivision of it for intensive study and research.

2. Students having a major interest in literature or the arts, in history or social studies, or in mathematics or a branch of experimental science are permitted to choose a minor in philosophy with such emphasis as best suits their needs. For such students the School endeavors to outline a plan of philosophical study (in courses or directed reading) which will form a natural supplement to their field of research.

The aim of the Field in graduate work is to devote its resources primarily to the instruction of students who expect to proceed to the Ph.D. with a major

in philosophy. It is not the normal policy of the Field to accept as graduate students those who have no intention of pursuing academic work beyond the M.A. degree. However, the Field will be prepared to accept as M.A. candidates those students who expect to continue advanced studies later, either in philosophy or in some other field, and those who, while not expecting to pursue graduate work beyond the M.A., nevertheless give satisfactory evidence of a serious interest in philosophy.

LANGUAGE REQUIREMENTS. For the M.A. degree: proficiency in French or German immediately upon admission to candidacy.

For the Ph.D. degree: proficiency in two languages chosen from among (1) French, (2) German, (3) Greek, (4) Latin or (5) Russian, including at least one modern language (i.e., not Greek or Latin). Languages other than the five mentioned may be used only upon special permission of the Field. A student not satisfying both language requirements upon admission to degree candidacy must give evidence to his Special Committee that he is actively preparing for the examinations in question. A student who has not satisfied both language requirements by the end of his second semester in residence must register for course work in the languages still outstanding. In the event that a student should fail a language examination, a second examination can be taken only after the student gives evidence of having undertaken substantial additional preparation. The oral defense of the Ph.D. thesis may not be scheduled until after both language requirements are satisfied.

EXAMINATIONS. (1) By the second week of the second semester the Special Committee of each new graduate student shall be informed by the student's instructors, either in writing or orally in a meeting of the Field, whether the evidence of the student's work in his courses in the first semester indicates that he is qualified to continue study for the Ph.D. The Special Committee will try to decide on this evidence whether the student is qualified. If the Special Committee wants more information it will give the student either an oral or a written examination based on his courses during the first term.

(2) Comprehensive Examination (Examination A): Examination A will consist of a written examination and an oral examination. The written examination will contain four parts: Logic, History of Philosophy, Moral Philosophy, Philosophical Problems. The oral examination will consist of a review by the Special Committee of the written parts.

(3) There will be an oral examination on the thesis by the Special Committee.

SPECIAL AREAS OF RESEARCH

Max Black: Philosophy of Mathematics, Philosophy of Science, Semantics, Philosophy of Logic.

Stuart M. Brown, Jr.: Ethics, Political Theory.

John V. Canfield: Philosophy of the Social Sciences, Epistemology.

Keith S. Donnellan: Metaphysics, Epistemology, Philosophy of Language.

Bruce C. Goldberg: History of Philosophy, Philosophy of Mind, Philosophy of Language.

Norman Kretzmann: Medieval Philosophy and Logic, Ancient Philosophy and Logic, History of Semantics.

David B. Lyons: Moral, Political, and Legal Philosophy.

Norman Malcolm: Epistemology, Philosophy of Mind, History of Philosophy, Metaphysics.

Nelson C. Pike: Philosophy of Religion, History of Philosophy.

David Sachs: Ancient Philosophy, Philosophy of Mind, Philosophy of Literature, Aesthetics.

Sydney S. Shoemaker: Metaphysics, Philosophy of Mind, History of Philosophy.
Richard R. K. Sorabji: Ancient Philosophy, Ancient Science.
Michael Stocker: Moral, Political, and Legal Philosophy.
Georg Henrik von Wright: Philosophy of Science, Modal Logic, Moral Philosophy.

COURSES OPEN TO GRADUATE STUDENTS:

403: PLATO AND ARISTOTLE

412: DEDUCTIVE LOGIC

413: DEDUCTIVE LOGIC

414: PHILOSOPHY OF LOGIC

415: PROBLEMS IN PHILOSOPHY OF LANGUAGE

416: METAPHYSICS

417: THEORY OF KNOWLEDGE

425: CONTEMPORARY ETHICAL THEORY

427: PROBLEMS IN PHILOSOPHY OF SCIENCE

433: PROBLEMS IN ETHICS AND PHILOSOPHY OF MIND

SEMINARS:

551: PHILOSOPHY OF RELIGION

576: PLATO

580: MEDIEVAL PHILOSOPHY

585: ETHICS AND VALUE THEORY

587 AESTHETICS

588: METAPHYSICS

589: METAPHYSICS

590: PHILOSOPHY OF LANGUAGE

594: THEORY OF KNOWLEDGE

595: SEMANTICS AND LOGIC

Romance Studies

Faculty: Frederick B. Agard, Claire Asselin, Cesáreo Bandera-Gómez, Jerome Bernstein, Gian-Paolo Biasin, Dalai Brenes, Alice M. Colby, Paul de Man, Jean-Jacques Demorest, Herbert Dieckmann, Charles L. Eastlack, David I. Grossvogel, Robert A. Hall, Jr., John Kronik, Edward P. Morris, Jean Parrish, Blanchard L. Rideout, Mario D. Saltarelli, Karl-Ludwig Selig, Alain Seznec, Donald F. Solà.

Visiting Assistant Professor: Hans-Jost Frey, University of Zurich.

Research Associate and Instructor in Italian Literature: Aleramo Lanapoppi.

Field Representative: Karl-Ludwig Selig, Goldwin Smith Hall.

APPROPRIATE MAJOR AND MINOR SUBJECTS

French Linguistics
French Literature
Italian Linguistics
Italian Literature
Romance Linguistics
Spanish Linguistics
Spanish Literature

The Field requires applicants to submit scores of the Graduate Record Examination (both Aptitude and Advanced Tests). For scores to be available by the time applications for fellowships and scholarships are reviewed, the examination must be taken *no later than December.*

In the Field of Romance Studies the student may concentrate either in linguistics or in literature.

LANGUAGE REQUIREMENT

The Field requires that the M.A. candidate pass a reading examination in French and the doctoral candidate pass reading examinations in both French and German. In certain cases Russian may be substituted for German. The doctoral candidate in the Field will be expected to pass one or the other of these examinations upon entrance. The Field further requires that both M.A. and Ph.D. candidates pass a Latin literature examination at respective and stated levels. The student also has the option of taking a one-semester course at either the 100 or 200 level in Latin literature, depending on the degree sought. The graduate student in Romance Literature must further take a one-semester course in the history of his major language or satisfy the chairman of his Special Committee that he has had the equivalent course elsewhere. All language requirements must be met before the candidate presents himself for the admission to candidacy examination.

FIELD REQUIREMENTS

ROMANCE LINGUISTICS. In Romance linguistics, the student is given training in four types of study and research: (1) general principles of linguistic analysis; (2) the description of the structure of the Romance language of his major interest; (3) the history, external and internal, of that language; and (4) the genetic and typological relationships of the Romance family of languages. Special emphasis is laid on the relation between linguistic history and cultural factors (literary, political, and social). A concomitant aim of this area is to afford instruction and practice in the application of linguistics to the teaching of one or more Romance languages.

Candidates in Romance linguistics may choose as their major subject either the linguistics (descriptive and historical) of a specific Romance language, or the comparative study of the Romance languages. Such candidates will normally have, as one of their minor subjects, the literature of the language in which their major interest lies. A prior knowledge of Latin is desirable; a candidate without prior knowledge of Latin will be expected to acquire a working acquaintance with its linguistic structure and history. Each candidate's program will be determined in individual consultation with his committee.

ROMANCE LITERATURE (French Literature, Italian Literature, and Spanish Literature). Graduate studies in Romance literature are designed to train students as scholars and as teachers of language and literature. The Field expects its candidates to acquire a certain fund of knowledge and certain skills. Under the heading of knowledge may well be included: direct knowledge of

literary texts; literary history; intellectual history; philology; social and political history; biography; and linguistic theory. The most important skills are the critical understanding of texts, the explication of texts, annotating and editing of texts, and identifying and developing critical and scholarly problems.

Students will be expected to teach at least one full year either in the Division of Modern Languages or in the Department of Romance Studies. Their teaching will be closely supervised and will form an integral part of the doctoral program. Ordinarily, students will not teach during their first year of residence.

Applicants who have had no prior graduate study may apply for direct admission to the doctoral program. Those with superior records and qualifications may be admitted directly; others may be admitted for the Master's program if their intent is clearly to go on to the doctorate. Later admission to the doctoral program can be assured by a distinguished record at the Master's level. Those who wish to acquire the Master's degree for teaching at the secondary school level will be encouraged to apply to Cornell's Master of Arts in Teaching program rather than to the Field's Master of Arts program.

There are relatively few requirements imposed by the Graduate School or by the Field. As a Master's candidate, the student will usually spend his time broadening his interests; as a Ph.D. candidate he will spend more time studying a given area in depth. It is hoped that the choice of the minor will be either a second Romance literature (French, Spanish, or Italian) or the history of the major language.

Graduate students are expected to meet certain standards at specified points in their training. Incoming students in French Literature will take both a written examination and an oral interview in their major language. The oral interview will be based on the reading list sent at the beginning of the summer preceding entrance. The written examination will determine the student's ability to write French, and most entering students will find it advisable to do at least one year's course work in that language.

Candidates for the Master's degree are expected to take five one-semester courses in their major and three in their minor. They will also take a course in the history of the language of their major. By the end of their third term of residence, students will be expected to demonstrate proficiency in the major language and in Latin. This requirement may be satisfied by examination or by a stylistics course, and a course in Latin. All first-year students will attend the proseminar in literary studies (credit two hours per semester).

A Master's thesis or essay will be written in the language of the major, except in cases where the major language is also the native language.

Candidates for the Ph.D. are expected to choose one major and one minor. They will be expected to take eight one-semester courses in their major, and a minor will be chosen from a related Romance language or literature and be studied in some depth. If the student and the chairman of his Special Committee agree, the doctoral candidate may elect two minors, in which case the first minor will be in a related Romance language or literature and one may be chosen outside the Field. The course program will be chosen in consultation with the candidate's Special Committee.

Further particulars will be found in the *Procedural Guide for Graduate Students in Romance Literature* furnished upon request.

FACULTY SPECIALIZATIONS

Cornell's Field of Romance Studies is particularly strong in Romance linguistics, in French literature of the eighteenth century, and in Spanish medieval literature. Professor Herbert Dieckmann, a Diderot specialist, along with such

distinguished professors as Professor Meyer H. Abrams (English), Professor Eric Blackall and Professor Matthijs Jolles (German literature), Professor Paul de Man (comparative literature) and Professor Henry Guerlac (history of science) offer unique opportunities to the graduate student interested in European eighteenth-century thought. The Field of Medieval Studies, with particular strengths in medieval history, English, German, French medieval literature (Professor Alice Colby) and medieval philosophy, offers another very strong area of specialization. A student wishing to work in twentieth-century French literature can study with Professor David I. Grossvogel, a specialist in drama. In seventeenth-century French literature Professors Jean-Jacques Demorest and Alain Seznec and in the nineteenth century Professors de Man and Demorest are prepared to direct research in these particular areas. Professor Edward P. Morris' interests lie in the sixteenth century and Professor Dieckmann is prepared to direct theses on Montaigne.

In Spanish, the contemporary Latin American Field is in the hands of Professor Jerome S. Bernstein. The Middle Ages and the literature of the Golden Age are areas of specialization for Professor Karl-Ludwig Selig, Hinchliff Professor of Spanish Literature. Professors Dalai Brenes and Cesáreo Bandera-Gómez specialize in Golden Age literature and in the Middle Ages, respectively. Professor John Kronik's specialty is Spanish Literature of the nineteenth and twentieth centuries.

In Romance linguistics Professor Robert A. Hall, Jr. specializes in French and Italian linguistics; Professors Frederick B. Agard, Donald F. Solá, and Mario D. Saltarelli are chiefly interested in Spanish linguistics; Professor Claire Asselin concentrates on French linguistics; Portuguese linguistics is represented by Professor Charles L. Eastlack.

COURSES

Students should check with the department as to additional offerings, times, places, etc.

FOR UPPERCLASSMEN AND GRADUATE STUDENTS

The Comparative Study of the Romance Languages

See Linguistics 441–442, 443–444, 445, 446, 449.

French

401–402. HISTORY OF THE FRENCH LANGUAGE

Throughout the year in alternate years. Credit four hours a term. Prerequisites, qualification in French and Linguistics 201 or 301. M W F 11. Miss Asselin.

Fall term: detailed study of the structural development of French from the origins to the Old French period. Spring term: selected readings in Old French texts, examination of structural changes from the Old French period to the present.

403. LINGUISTIC STRUCTURE OF FRENCH

Fall term. Credit four hours. Prerequisites, qualification in French and Linguistics 201 or 301. M W F 3. Miss Asselin.

A descriptive analysis of present-day French, with emphasis on its phonetics, phonemics, morphology, and syntax. Required of students seeking certification by New York State.

404. FRENCH FOR TEACHERS

Spring term. Credit four hours. Prerequisite, qualification in French. Hours to be arranged. Mr. Rideout.

Survey of current teaching methods, preparation of teaching materials, selection and use of textbooks and realia, further study of phonetics, syntax, and culture as needed. Required of students seeking certification by New York State.

415–416. LITERATURE OF THE MIDDLE AGES

Throughout the year. Credit four hours a term. Prerequisite, two terms of 300-level French literature courses or consent of the instructor. May be entered in the second term by students with some previous training in Old French or who have taken French 501. Fall term: T Th S 9. Spring term: F 2–4 plus one hour to be arranged for those students who are completing the sequence French 501–French 416 without previous training in Old French. Miss Colby.

Lectures in French, classroom discussion, written reports. Translation of Old French texts into English and modern French. The first term deals with the epic; the second term with the romance. Facility in reading Old French and appreciation of these two major genres are the primary goals of this course.

417. POETRY OF THE FIFTEENTH CENTURY

Fall term. Credit four hours. Prerequisite, two terms of 300-level French literature courses or consent of the instructor. F 2–4. Mr. Brogyanyi.

The poetry of François Villon and his contemporaries.

434. NOVELS OF THE SEVENTEENTH CENTURY

Spring term. Credit four hours. Prerequisite, two terms of 300-level French literature courses or consent of the instructor. F 2–4. Mr. Seznec.

Principal novels of the seventeenth century from *l'Astrée* to *la Princesse de Clèves,* including some semi-fictional *mémoires.*

441–442. FRENCH THOUGHT IN THE EIGHTEENTH CENTURY AND ITS ORIGINS

Throughout the year. Credit four hours a term. Prerequisite, French 201–202 or consent of the instructor. W 2–4. Mr. Dieckmann.

The origins: Descartes, Gassendi, Saint-Evremond, Bayle, Fontelle. The fundamental positions: Montesquieu, Voltaire, Diderot, Rousseau.

454. BAUDELAIRE AND MALLARMÉ

Spring term. Credit four hours. Prerequisite, at least one term of a 300-level French literature course. M 2–4. Mr. de Man.

481. THE WRITING OF EXPOSITORY PROSE

Fall term. Credit four hours. Primarily for graduate students. Limited to ten students. Some qualified undergraduate majors will be admitted, as space permits. Prerequisite: (undergraduates) French 304; (graduates) placement at the departmental French language examination. T Th 2–3:30. Mr. Seznec.

French 481 will normally be taken by all entering graduate students in French, with the exception of those exempted on the basis of the departmental examination, and those who, not being prepared to undertake work at the level of French 481, will be asked first to take French 303 or 304. French 481

is prerequisite to French 482. French 481 presupposes competence in the handling of French vocabulary, syntax, and idiom. The purpose is to teach the writing of French as a means of effective expression on literary and historical subjects. Review of advanced grammar; translations from and into literary French; lexical, stylistic, and methodological study of selected French critical works; literary *explication de textes;* study of French versification; analysis of literary topics, and composition of outlines. Short daily or weekly papers. Conducted in French.

482. STYLISTICS

Spring term. Credit four hours. Primarily for graduate students. Limited to ten students. Some qualified majors will be admitted as space permits. Prerequisite: French 481 or consent of instructor. T Th 2–3:30. Mr. Bérceaud.

A study of the stylistic significance of tenses and of sentence structure. Short daily or weekly papers. Conducted in French.

Italian

[431. STRUCTURE OF ITALIAN]

Fall term in alternate years. Credit four hours. Prerequisite, qualification in Italian. M W F 9. Not offered in 1966–67.

[432. ITALIAN DIALECTOLOGY]

Spring term in alternate years. Credit four hours. M W F 9. Not offered in 1966–67.

[433. OLD ITALIAN TEXTS]

Fall term in alternate years. Credit four hours. Prerequisite, consent of the instructor. M W F 9. Mr. Hall. Will be offered in fall of 1967.

[434. HISTORY OF THE ITALIAN LANGUAGE]

Spring term in alternate years. Credit four hours. Prerequisites, qualification in Italian and Linguistics 201 or 301. M W F 9. Mr. Hall. Will be offered in spring of 1968.

455. LATE NINETEENTH-CENTURY NOVEL

Fall term. Credit four hours. Prerequisite, consent of the instructor. W 2–4. Mr. Biasin.

Topic: Giovanni Verga and *Verismo.*

456. CONTEMPORARY POETRY

Spring term. Credit four hours. Prerequisite, consent of the instructor. W 2–4. Mr. Biasin.

Eugenio Montale from *Ossi di seppia* to *Farfalla di Dinard.*

Spanish

401–402. HISTORY OF THE SPANISH LANGUAGE

Throughout the year in alternate years. Credit four hours a term. Prerequisites, qualification in Spanish and Linguistics 201 or 301. M W F 2. Mr. Agard or Mr. Saltarelli or Mr. Solá.

Fall term: reading and analysis of progressively older Spanish texts, ending with the earliest monuments of Spanish literature. Spring term: the develop-

ment of Spanish phonology, grammar, and lexicon from its Latin origins to modern times.

403. THE GRAMMATICAL STRUCTURE OF SPANISH

Fall term. Credit four hours. Prerequisites, qualification in Spanish and Linguistics 201 or 301. M W F 2. Mr. Solá.

Descriptive analysis of the morphological and syntactical structure of present-day standard Spanish.

404. SPANISH FOR TEACHERS

Spring term. Credit four hours. Prerequisites, qualification in Spanish and Linguistics 201 or 301. M W F 2. Mr. Solá.

A course in methodology and applied linguistics for prospective teachers of the Spanish language. A survey of current attitudes, methods, materials, and techniques. The application of descriptive linguistics to the organization of lesson material, illustrated mainly through the contrastive study of Spanish and English phonology. Required for provisional New York State teacher certification.

411. INTRODUCTION TO MEDIEVAL LITERATURE

Fall term. Credit four hours. Prerequisite, a Spanish 300-level literature course or consent of the instructor. M W F 2. Mr. Selig.

Critical analysis of major texts of Spanish medieval literature: Poema de Mio Cid, Libro de buen amor, the works of Alfonso the Learned, and representative selections from early prose fiction.

432. *LA CELESTINA*

Spring term. Credit four hours. Prerequisite, a 300-level Spanish literature course or consent of the instructor. M W F 2. Mr. Selig.

A critical analysis of the text.

462. NINETEENTH-CENTURY REALISTIC NOVEL IN SPAIN

Spring term. Credit four hours. Prerequisite, a 300-level Spanish literature course or consent of the instructor. M W F 12. Mr. Kronik.

GRADUATE COURSES

French

501. INTRODUCTION TO FRENCH PHILOLOGY

Fall term. Credit four hours. Required of all graduate students in French literature. Th 4–6. Miss Colby.

A study of the phonological, morphological, syntactical, and etymological developments which most frequently create problems for the student of literature.

518. GRADUATE SEMINAR IN MEDIEVAL LITERATURE

Spring term. Credit four hours. Th 4–6. Miss Colby.

Topic: the theater of the Middle Ages.

522. GRADUATE SEMINAR IN RENAISSANCE LITERATURE

Spring term. Credit four hours. T 4–6. Mr. Morris.

Topic: Du Bellay.

535. GRADUATE SEMINAR IN SEVENTEENTH-CENTURY LITERATURE

Fall term. Credit four hours. W 4–6. Mr. Seznec.

Topic: Molière.

549. GRADUATE SEMINAR IN EIGHTEENTH-CENTURY LITERATURE

Fall term. Credit four hours. T 4–6. Mr. Dieckmann.

Topic: Diderot.

SEMINAR ON THE NOVEL

Spring term. Credit four hours. T 2–4. Mr. Dieckmann.

See Comparative Literature 526.

[554. GALLO-ROMANCE DIALECTOLOGY]

Spring term in alternate years. Credit four hours. Prerequisite, Linguistics 431–432 or 433–434 or consent of the instructor. T Th 2. Not offered in 1966–67.

[555. HISTORICAL PHONOLOGY OF FRENCH]

Fall term in alternate years. Credit four hours. Prerequisite, Linguistics 301 or consent of the instructor. T Th 2. Not offered in 1966–67.

[558. LINGUISTIC STRUCTURES OF OLD AND MIDDLE FRENCH]

Spring term in alternate years. Credit four hours. Prerequisite, French 403 or consent of the instructor. T Th 2. Not offered in 1966–67.

571–572. INTRODUCTION TO LITERARY STUDIES

Throughout the year. Credit two hours a term. Required of all first-year graduate students in Romance Studies. M W 11. Mrs. Parrish and staff.

595. GRADUATE SEMINAR IN TWENTIETH-CENTURY LITERATURE

Fall term. Credit four hours. M 2–4. Mr. Grossvogel.

Topic: the novel, existentialism, and existential fiction.

[600. SEMINAR IN FRENCH LINGUISTICS]

Offered in accordance with student needs. Credit four hours a term. Hours to be arranged. Not offered in 1966–67.

601—602. SPECIAL TOPICS IN FRENCH LITERATURE

Either term. Credit four hours per term. Hours to be arranged. Staff.

Italian

513–514. SPECIAL TOPICS IN THE DIVINE COMEDY

Throughout the year. Credit four hours a term. Prerequisite, consent of the instructor. Hours to be arranged. Mr. Lanapoppi.

521. CESARE PAVESE

Fall term. Credit four hours. Prerequisite, consent of the instructor. T 10–12. Mr. Biasin.

An examination of the writer's complete works.

[600. SEMINAR IN ITALIAN LINGUISTICS]

Offered in accordance with student needs. Credit four hours. Not offered in 1966–67.

601–602. SPECIAL TOPICS IN ITALIAN LITERATURE

Either term. Credit four hours per term. Hours to be arranged. Staff.

Spanish

517–518. GRADUATE SEMINAR IN HISPANIC LITERATURE

Throughout the year. Credit four hours. Th 2–4. Mr. Selig.

Topic: Historians and Humanists of the period of Charles V. Fall term: The Classical Tradition and the Discovery of the Past. Spring term: The Discovery of the New World.

525. GRADUATE SEMINAR: CERVANTES

Fall term. Credit four hours. Prerequisite, Spanish 425–426 or consent of the instructor. Hours to be arranged. Mr. Brenes.

Topic: Relation of *Don Quixote* to the romances of chivalry and the picaresque novel. Special study of *Amadís* and *Guzmán de Alfarache*.

533. SEMINAR IN GAUCHO LITERATURE

Fall term. Credit four hours. Prerequisite, two 300-level courses in Spanish or Spanish-American literature or consent of the instructor. Hours to be arranged. Mr. Bernstein.

A detailed reading of the major works of Hilario Ascasubi, Estanislao del Campo, and José Hernández.

588. SEMINAR IN MODERN SPANISH-AMERICAN LITERATURE

Spring term. Credit four hours. Prerequisite, two 300-level courses in Spanish or Spanish-American literature or consent of the instructor. Hours to be arranged. Mr. Bernstein.

Topic: Borges and Mallea.

600. SEMINAR IN IBERO-ROMANCE LINGUISTICS

Offered in accordance with student needs. Credit four hours. Hours to be arranged. Mr. Agard or Mr. Solá.

601–602. SPECIAL TOPICS IN SPANISH LITERATURE

Either term. Credit four hours per term. Hours to be arranged. Staff.

630. GRADUATE SEMINAR IN SPANISH-AMERICAN LITERATURE

Spring term. Credit four hours. Prerequisite, consent of the instructor. Hours to be arranged. Mr. Brenes.

Topic: Latin American *Pensadores*. A study of the Latin American essay in the nineteenth and twentieth centuries.

The student is further advised to consult listings under Comparative Literature.

Semitic Studies

Faculty: David Patterson, Isaac Rabinowitz, Abraham L. Udovitch.

Field Representative: I. Rabinowitz, 173 Goldwin Smith Hall.

APPROPRIATE MAJOR AND MINOR SUBJECTS

Arabic
Aramaic
Biblical Studies
Hebrew
Islamic Studies

Candidates for advanced degrees in any subject included in the Field of Semitic Studies will be expected to have had at least three years of undergraduate study of one Semitic language, or the equivalent, prior to admission to the Graduate School.

Candidates for the Ph.D. whose major subject is Biblical studies will be required to demonstrate ability to control the Scriptual texts both in their original languages and in those of the chief ancient versions: Hebrew, Aramaic, Greek, Latin, and Syriac.

Candidates for the Ph.D. whose major subject is Islamic Studies will be required to demonstrate proficiency in either Hebrew, Greek, or Persian, in addition to Arabic.

Language requirements for the Master's degree: proficiency in French, German, Russian, Italian, Greek, or Latin, to be demonstrated at least one term before the degree is awarded.

Graduate work in the Field of Semitic Studies is designed, through seminars and other means, to train the student for independent, critical scholarship and teaching in this Field. Master of Arts and Ph.D. candidates will be encouraged to complement their studies with work in some associated Field, e.g., Classics, Comparative Literature, History, and Philosophy.

More detailed information about graduate programs in Semitic Studies may be obtained by writing to the Field Representative.

COURSES

Hebrew and Aramaic

101–102. ELEMENTARY CLASSICAL HEBREW

Throughout the year. Credit three hours a term. The first term is prerequisite to the second term. M W F 11. Mr. Rabinowitz.

201. CLASSICAL HEBREW PROSE

Fall term. Credit three hours. Prerequisite, Hebrew 102 or consent of the instructor. Hours to be arranged. Mr. Rabinowitz.

Selected prose narratives of the Hebrew Old Testament.

204. POST-BIBLICAL HEBREW PROSE (1)

Spring term. Credit three hours. Prerequisites, Hebrew 201, or 3 units of entrance Hebrew and the consent of the instructor. Hours to be arranged. Mr. Patterson.

Rapid reading of narrative texts in rabbinic, medieval, and modern Hebrew.

302. CLASSICAL HEBREW POETRY

Spring term. Credit four hours. Prerequisite, Hebrew 201 or consent of the instructor. M W F 2. Mr. Rabinowitz.

Reading and interpretation of texts selected from the Psalter and the Prophets.

305. POST-BIBLICAL HEBREW PROSE (2)

Fall term. Credit four hours. Prerequisites, Hebrew 204, or four units of

entrance Hebrew and consent of the instructor. Hours to be arranged. Mr. Patterson.

Readings in the Mishnah, in medieval theological and philosophical texts, and in the modern essay.

[306. POST-BIBLICAL HEBREW POETRY]

Spring term. Credit four hours. Prerequisite, Hebrew 305. Not offered in 1966–67.

[421. MIDRASH]

Fall term. Credit four hours. Prerequisite, Hebrew 305 or consent of the instructor. Not offered in 1966–67.

[423. TALMUD]

Fall term. Credit four hours. Prerequisite, Hebrew 305 and Aramaic 452, or consent of the instructor. Not offered in 1966–67.

432. MEDIEVAL HEBREW LITERATURE

Spring term. Credit four hours. Prerequisite, Hebrew 305 or consent of the instructor. Hours to be arranged. Mr. Patterson.

Study of a group of texts illustrative of several of the main genres of medieval Hebrew literature: Biblical exegesis, liturgical poetry, ethics, philosophy, mysticism, science, etc.

441. MODERN HEBREW LITERATURE

Fall term. Credit four hours. Open to qualified undergraduate and graduate students. Hours to be arranged. Mr. Patterson.

The development of modern Hebrew letters, both fiction and non-fiction, traced in selected works of the best writers from "Mendele" (S. J. Abramowitz, 1836–1917) and " 'Ahad Ha-'Am" (Asher Ginsberg, 1856–1927) to the present.

[451. ARAMAIC]

Fall term. Credit four hours. Prerequisite, Hebrew 201, Arabic 208, or consent of the instructor. Hours to be arranged. Mr. Rabinowitz. Not offered in 1966–67.

452. TALMUDIC ARAMAIC

Spring term. Credit four hours. Prerequisite, Hebrew 305 or consent of the instructor. Hours to be arranged. Mr. Rabinowitz.

Accidence and syntax of Galilean and of Babylonian Talmudic Aramaic; reading of selected passages from the Palestinian and Babylonian Talmuds and from Midrash Bereshith Rabba.

[471–472. SEMINAR]

Throughout the year. Credit four hours a term. For qualified undergraduate and graduate students. Not offered in 1966–67.

401. INDEPENDENT STUDY

Either term. Credit two hours. For qualified students. Staff.

402. INDEPENDENT STUDY

Either term. Credit four hours. For qualified students. Staff.

Arabic

105–106. ELEMENTARY LITERARY ARABIC

Throughout the year. Credit three hours a term. The first term is prerequisite to the second term. Hours to be arranged. Mr. Udovitch.

207–208. INTERMEDIATE LITERARY ARABIC

Throughout the year. Credit three hours a term. Prerequisite, Arabic 106 or consent of the instructor. Hours to be arranged. Mr. Udovitch.

Rapid reading of selected texts in the main genres of Arabic literature.

[317. ISLAMIC TEXTS IN ARABIC]

Fall term. Credit four hours. Prerequisite, Arabic 208 or consent of the instructor. Not offered in 1966–67.

[318. ARABIC GEOGRAPHERS AND HISTORIANS]

Spring term. Credit four hours. Prerequisite, Arabic 208 or consent of the instructor. Not offered in 1966–67.

[461. ARABIC PHILOSOPHERS]

Fall term. Credit four hours. Prerequisite, Arabic 317 or 318, or consent of the instructor. Not offered in 1966–67.

[462. MEDIEVAL ARABIC *BELLES LETTERS ('ADAB)*]

Spring term. Credit four hours. Prerequisite, Arabic 317 or 318, or consent of the instructor. Not offered in 1966–67.

[481. MODERN ARABIC LITERATURE]

Fall term. Credit four hours. Prerequisite, Arabic 318, or consent of the instructor. Not offered in 1966–67.

[482. ARABIC POETRY]

Spring term. Credit four hours. Prerequisite, Arabic 318, 462, or consent of the instructor. Not offered in 1966–67.

491–492. SEMINAR IN THE HISTORY OF THE MEDIEVAL ISLAMIC WORLD

Throughout the year. Credit four hours a term. Otherwise qualified undergraduate and graduate students who cannot read Arabic texts may be admitted with the consent of the instructor. Hours to be arranged. Mr. Udovitch.

405. INDEPENDENT STUDY

Either term. Credit two hours. For qualified students. Staff.

406. INDEPENDENT STUDY

Either term. Credit four hours. For qualified students. Staff.

Honors Courses

370. HONORS COURSE

Spring term. Credit four hours. To be taken in the junior year. A program of readings and consultations devoted to an author or topic to be made known in advance of the term.

[371–372. SENIOR HONORS COURSE]
Throughout the year. Credit four hours a term. The first term is prerequisite to the second term. Not offered in 1966–67.

Other Courses

THE LITERATURE OF THE OLD TESTAMENT
(See Comparative Literature 301.)

THE LITERATURE OF POST-EXILIC ISRAEL
(See Comparative Literature 302.)

Slavic Studies

Faculty: Patricia Carden, Gordon H. Fairbanks, George Gibian, Walter S. Hanchett, Martin Horwitz, Richard L. Leed.

APPROPRIATE MAJOR AND MINOR SUBJECTS

Russian Literature	Slavic Linguistics

ADMISSION REQUIREMENTS. There are no special requirements for admission to the Field of Slavic Studies other than the general requirements for admission to the Graduate School. It is recommended, though not required, that applicants submit scores from the Graduate Record Examination.

LANGUAGE REQUIREMENTS. Candidates for the M.A. degree are required to demonstrate a reading knowledge of either French or German. Candidates for the Ph.D. degree are required to demonstrate a reading knowledge of both French and German.

EXAMINATIONS. Students for the Ph.D. degree in Slavic Studies take the two examinations required by the Graduate School: (1) the Admission to Candidacy Examination and (2) the Final Examination. The former is to be taken at the end of the second semester of study. However, if a student enters with the M.A. degree and transfers two units of residence credit, he may take this examination any time during his first year, at the discretion of his Special Committee. The Final Examination covers the field of the student's studies as well as the thesis. It is not necessary to take both parts of the Final Examination at one time. Normally, the first part is taken before the thesis is begun, the second part upon completion of the thesis.

Students for the M.A. degree are required to take an examination at the end of their second semester of study. If, on the basis of this examination, it is determined that no further course work is required, the student will be awarded the M.A. degree upon submission of a Master's Essay.

The student who enters with a good background in the Russian language and in his major subject (Russian literature or Slavic linguistics) can obtain the M.A. in one year and the Ph.D. in three years after the B.A. The student who enters without such a background will normally take two years for the M.A. and four years for the Ph.D. after the B.A. It is not necessary to obtain the M.A. degree on the way to a Ph.D. degree.

SPECIALIZATION WITHIN THE FIELD OF SLAVIC STUDIES. There are two subjects within the field which may be chosen either as a major or a minor subject: Russian literature and Slavic linguistics. If a student should choose either of these subjects as a major, he may choose the other for a

minor, or he may choose minor subjects from other fields in the University, e.g., other literatures, linguistics, history, government, economics, psychology, mathematics, computer science, philosophy, etc.

The scope of the Slavic studies program can be seen from the listings of faculty specializations and courses, although these listings do not exhaust the possibilities.

FACULTY AND SPECIALIZATIONS. Professors Patricia Carden (twentieth-century prose, Isaac Babel). George Gibian (nineteenth-century literature, Tolstoy, Dostoevsky, contemporary literature). Richard Leed (historical Slavic linguistics, Russian dialectology, intonation). Martin Horwitz (symbolism, Andrey Bely, Sholokhov).

Feld Representative: Professor Richard L. Leed, Division of Modern Languages, Morrill Hall.

COURSES

(This list excludes Russian language courses, which range from elementary to advanced, including special reading courses.)

367. Comparative Literature. THE RUSSIAN NOVEL
Fall term. Credit four hours. T Th S 9. Mr. Gibian.

Works by Turgenev, Dostoevsky, and Tolstoy.

368. Comparative Literature. SOVIET LITERATURE
Spring term. Credit four hours. M W F 10. Mr. Horwitz. Not offered in 1966–67.

An introduction to selected works of Russian literature, from 1917 to date, examined as social and historical documents and as works of art.

314. Russian. INTELLECTUAL TRENDS IN NINETEENTH-CENTURY RUSSIA

Spring term. Credit four hours. M W F 3. Miss Carden.

Emphasis on intellectual figures and literary criticism. Gogol and Tolstoy as publicists and reporters. Belinsky, Dobrolyubov, Chernyshevsky, Apollon Grigoriev, Annenkov, Aksakov, Kozma Prutkov, Rozanov. Dostoevsky as journalist. Literary groups and magazines. Most of the reading will be in English, but reading knowledge of Russian is strongly recommended.

331. Russian. RUSSIAN POETRY

Fall term. Credit four hours. Prerequisites, Russian 202 and consent of the instructor. T Th 3 and one hour to be arranged. Mr. Gibian.

332. Russian. RUSSIAN DRAMA
Credit four hours. Prerequisite, Russian 202 and consent of the instructor. Not offered in 1966–67.

334. Russian. THE RUSSIAN SHORT STORY
Spring term. Credit four hours. T Th 3 and one hour to be arranged. Prerequisite, Russian 202 and consent of the instructor. Mr. Horwitz.

Gogol, Turgenev, Chekhov, and others.

401–402. Russian. HISTORY OF THE RUSSIAN LANGUAGE

Throughout the year in alternate years. Credit four hours a term. Prerequisites, qualification in Russian and Linguistics 201–202. M W F 2. Mr. Leed.

403 Russian. LINGUISTIC STRUCTURE OF RUSSIAN

Fall term in alternate years. Credit four hours. Prerequisite, Qualification in Russian and Linguistics 201 or 301. M W F 2. Mr. Lipson Not offered in 1966–67.

A descriptive study and analysis of Russian linguistic structure. Russian phonetics, phonemics, morphology, and syntax.

404. Russian. RUSSIAN FOR TEACHERS

Spring term in alternate years. Credit four hours. Prerequisites, qualification in Russian, Linguistics 201 or 301, and Russian 403. M W F 2. Mr. Lipson. Not offered in 1966–67.

421. Russian. SUPERVISED READING AND RESEARCH

Either term. Variable credit. By permission of the department.

431. Russian. RUSSIAN PROSE FICTION

Fall term. Credit four hours. Prerequisites, Russian 332 or 334 or the equivalent, and consent of the instructor. T Th 2 and one hour to be arranged. Miss Carden.

Longer works by Tolstoy, Dostoevsky, and others.

432. Russian. PUSHKIN

Spring term. Credit four hours. Prerequisite, consent of the instructor. T Th 2, and one hour to be arranged. Mr. Gibian.

435. Russian. GOGOL

Fall term. Credit four hours. Prerequisites, Russian 332 or 334 or the equivalent, and consent of the instructor. M W F 10. Mr. Horwitz. Not offered in 1966–67.

Careful study of Gogol's literary works and his *Selections from Correspondence with Friends;* some treatment of the development of Russian prose of his time.

493. Russian. HONORS ESSAY TUTORIAL

Either term. Credit four hours.

501. Russian. OLD BULGARIAN

Fall term in alternate years. Credit four hours. Hours to be arranged. Mr. Lipson. Not offered in 1966–67.

502. Russian. OLD RUSSIAN

Spring term in alternate years. Credit four hours. Hours to be arranged. Mr. Leed. Not offered in 1966–67.

517–518. Russian. RUSSIAN STYLISTICS

Throughout the year. Credit four hours a term. Hours to be arranged. Miss Glasse.

Literary uses of the Russian language. Close examination of texts from various periods and genres. Practical exercises.

520. Russian. STUDIES IN RUSSIAN POETRY

Spring term. Credit four hours. Hours to be arranged.

Topic varies from year to year. Class conducted in Russian. Not offered in 1966–67.

521. Russian. RUSSIAN LITERATURE FROM THE BEGINNINGS TO 1700

Spring term. Credit four hours. Reading knowledge of Russian required. M W F 2.

Old Russian literature, with attention to the development of the Russian literary language.

522. Russian. EIGHTEENTH-CENTURY LITERATURE

Spring term. Credit four hours. Prerequisite, Russian 521 or consent of the instructor. M W F 2. Miss Glasse.

523. Russian EARLY NINETEENTH-CENTURY LITERATURE

Fall term. Credit four hours. Conducted partly in Russian. Hours to be arranged. Miss Glasse.

531. Russian. PROSE WRITERS, 1890–1917

Fall term. Credit four hours. M W F 3. Mr. Horwitz. Not offered in 1966–67.

534. Russian. STUDIES IN THE PROSE OF ANDREI BELY

Fall term. Credit four hours. M W 3 and one hour to be arranged. A study of Bely's major prose in relation to selected works of the period. Mr. Horwitz.

561–562. Linguistics. COMPARATIVE SLAVIC LINGUISTICS

Throughout the year in alternate years. Credit four hours a term. Prerequisite, consent of the instructor. Hours to be arranged. Mr. Foos.

600. Russian. SEMINAR IN SLAVIC LINGUISTICS

Offered in accordance with student needs. Credit four hours. Hours to be arranged. Mr. Leed, Mr. Lipson, or Mr. Foos.

601. Russian. INTRODUCTION TO GRADUATE STUDY

Fall term. Credit four hours. Hours to be arranged. Staff.

Required of all first-year graduate students majoring in Russian literature. Bibliography, methods of literary analysis, stylistics, topics in scholarship.

611. Russian. SEMINAR IN RUSSIAN DIALECT GEOGRAPHY

Fall term. Credit four hours. Prerequisite, consent of the instructor. Hours to be arranged. Mr. Leed.

671. Russian. SEMINAR IN TWENTIETH-CENTURY RUSSIAN LITERATURE

Fall term. Credit four hours. Th 4–6. Topic to be announced. May be taken repeatedly. Miss Carden. Not offered in 1966–67.

672. Russian. SEMINAR IN NINETEENTH-CENTURY RUSSIAN LITERATURE

Spring term. Credit four hours. Th 4–6. Topic varies from year to year. Topic to be announced. May be taken repeatedly. Mr. Gibian.

Serbo-Croatian 221–222. ELEMENTARY COURSE

Throughout the year. Offered according to demand. Credit three hours a term. Prerequisite, qualification in Russian and consent of the instructor. Hours to be arranged. Mr. Leed.

Czech 221–222. ELEMENTARY COURSE

Throughout the year. Offered according to demand. Credit three hours a term. Prerequisite, qualification in Russian and consent of the instructor. Hours to be arranged.

Speech and Drama

Faculty: H. Darkes Albright, Gordon E. Beck, Vincent M. Bevilacqua, Harry Caplan, Marvin A. Carlson, Ruth A. Clark, John F. Wilson.

Field Representative: Marvin A. Carlson, 108 Lincoln Hall.

APPROPRIATE MAJOR SUBJECTS	APPROPRIATE MINOR SUBJECTS
Drama and the Theatre	Dramatic Production
Dramatic Production (M.A. only)	Experimental Study of Oral Discourse
Rhetoric and Public Address	Principles of Public Address
	Rhetoric and Public Address

(a) ADMISSION REQUIREMENTS. Candidates are selected on the basis of undergraduate achievement, letters of recommendation, and Graduate Record Examination aptitude test scores. If these scores are to be available by the time applications for fellowships and scholarships are received, the examination must be taken by *mid-January*.

(b) LANGUAGE REQUIREMENTS. There is no M.A. language requirement, although students planning to work for a Ph.D. are encouraged to attain proficiency in one foreign language before gaining the M.A. The language requirement for the Ph.D. degree is proficiency in two foreign languages. Students majoring in the Division of Rhetoric and Public Address may select any two of the following: Latin, Greek, French, German, Russian. Those majoring in the Division of Dramatic Production may choose no more than one language from any of these four groups: (1) Russian; (2) Dutch, German; (3) French, Italian, Spanish, Portuguese; and (4) Arabic, Chinese, Hindi, Indonesian, Japanese.

(c) EXAMINATIONS. A final examination is required for the M.A. degree, which under certain conditions may be combined with the Qualifying Examination for the Ph.D. Three examinations are required for the Ph.D. degree: (1) a Qualifying Examination to determine the applicant's fitness for undertaking advanced studies and to aid his Special Committee in planning his program. This examination should be taken in the first term of Ph.D. residence. (2) The Examination for Admission to Candidacy given not earlier than the last month of the third term of Ph.D. residence, and at least four months before the thesis examination. (3) Final examination on thesis and related material.

(d) RESEARCH AND STUDY. The chief aim of graduate work in the Field of Speech and Drama is to develop competent investigators and teachers. In many cases, this development will require more than the minimum periods of residence. Ordinarily, residence at this University during at least two academic years will be necessary for the doctorate.

The Field of Speech and Drama offers opportunity for graduate study and research in many phases of the discipline, including dramatic literature; history, criticism, and aesthetics of the theatre and the cinema; most phases of dramatic production; American and British public address; rhetorical history, theory, and criticism; psychology of speech; and qualitative and experimental

studies and methods. Members of the staff are especially qualified to direct research in the subjects listed, but research need not be limited to these subjects. The research interests of the members of the staff are broad; in general, they may be summarized as follows: H. Darkes Albright, acting, theatre history, and aesthetics; Gordon E. Beck, theatre history and criticism, directing, cinema; Vincent M. Bevilacqua, history of rhetorical theory, British public address; Harry Caplan, classic and medieval rhetoric; Marvin A. Carlson, dramatic literature, theatre history, dramatic production; Ruth A. Clark, psychology of speech, quantitative and experimental studies and methods; John F. Wilson, rhetorical criticism, American public address.

COURSES

Speech

300. INDEPENDENT STUDY IN SPEECH AND DRAMA

Either term. Credit four hours. Open to upperclassmen prepared for independent study in speech or drama. Permission to register must be secured through the departmental office. Members of the Department.

Individual study of special topics. Students who plan to teach speech and drama are expected to complete certain advanced work in teaching methods through independent study under supervision of an appropriate adviser.

302. PERSUASION

Spring term. Credit four hours. Open to upperclassmen who have taken Speech and Drama 103, 105, or 201. M W F 9. Mr. Bakke.

Advanced study of the speech designed to affect attitudes and beliefs and to induce action. Study of the theories of persuasion with special attention to the logic, language, and structure of audience-centered persuasive discourse. Practice in the composition and delivery of persuasive speeches related to varied purposes, audiences, and propositions.

303. ARGUMENT

Either term. Credit four hours. Open to upperclassmen and to underclassmen who have taken Speech and Drama 103, 105, 107, or 201. M W F 9.

Study of the principles and motivation in persuasive oral discourse. Topics to be considered: investigation and analysis of issues, types and tests of evidence, and reasoning as applied in discussion of public questions, methods of proof, and refutation.

Practice in analysis of supporting materials, in speech composition, and in standard style and cross-examination debating.

304. SYSTEMS OF ARGUMENT

Spring term. Credit four hours. W F 2 and an hour to be arranged. Mr. Bakke.

Intensive study of argument as a means of inquiry and persuasion in rhetorical and dialetical discourse. Exploration of fundamental inference patterns, related to such contemporary forms of speech as oratory, discussion, and debate. Readings in Aristotle, Cicero, Kant, Whately, Mill, Dewey, Toulmin, Johnstone, Ehninger, and others. Not a performance course. Lectures, reports, papers.

345. BASES OF SPEECH BEHAVIOR

Fall term. Credit three hours. Open to upperclassmen and to underclassmen who have taken Speech and Drama 103, 105, or 201. M W F 11. Miss Clark.

Designed to afford a comprehensive and integrated view of speech as a human behavior. Study of intrapersonal and interpersonal purposes of speech and of elements of communicative process by means of speech.

400. FORM AND IDEA IN RHETORIC AND DRAMATIC ART

Spring term. Credit four hours. Hours to be arranged. Messrs. Albright and Wilson.

Rhetoric and dramatic art studied from their common base in public oral communication: their similarities, differences, and limitations. Readings in texts from Plato and Aristotle to the present; and in representative speeches and plays.

401. FORMS AND STYLES OF PUBLIC ADDRESS

Fall term. Credit four hours. T Th 11 and an hour to be arranged. Mr. Wilson.

Study of style in various forms of public address: legislative, legal, ceremonial, campaign, sermonic. Speeches illustrating the forms of address will be drawn from the works of Burke, Webster, Lincoln, F. D. Roosevelt, Churchill, and others. Some practice in speech composition, oral and written.

402. PSYCHOLOGY OF PERSUASIVE DISCOURSE

Spring term. Credit four hours. T Th 11, and an hour to be arranged. Miss Clark.

Study of implications, for persuasive discourse, of current theories on the nature of attitudes and attitude change. Topics considered will include persuasive paradigms, research relevant to selection of persuasive appeals and arguments, and the ethics of persuasion. Lectures, readings, and research reports.

411. AMERICAN PUBLIC ADDRESS

Spring term. Credit four hours. M W F 12. Mr. Wilson.

Critical and analytical study of American speeches as influences upon, and reflections of, our national history. Speeches to be studied will relate to such events as ratification of the Constitution, the Civil War, reconstruction, imperialism, the League of Nations, and World War II. Representative of orators considered are: Webster, Lincoln, Bryan, Wilson, and Franklin D. Roosevelt.

412. BRITISH PUBLIC ADDRESS

Fall term. Credit four hours. M W F 12. Mr. Bakke.

Analytic study of parliamentary and public speeches reflecting the evolution of British rhetorical practice. Speeches to be studied will relate to such movements as the American and French revolutions, Indian reform, parliamentary reform, free trade, imperialism, and World War II. Representative of the orators considered are: Cromwell, Chatham, Burke, Cobden, Gladstone, and Churchill.

501–502. SEMINAR IN RHETORICAL THEORY

Throughout the year. Credit four hours a term. M 2–4:30.

In the first term consideration will be given to theories of rhetorical practice; in the second term, to applications of rhetorical theory in the criticism of public address.

510. EXPERIMENTAL RESEARCH METHODS IN SPEECH

Spring term. Credit four hours. Open by consent of instructor. T 2–4:30. Miss Clark.

Introduction to quantitative measurements applicable to speech problems. Emphasis on the design and evaluation of experiments, illustrated by current research in speech.

620. THESES AND SPECIAL PROBLEMS IN RHETORIC AND PUBLIC ADDRESS

Either term. Credit and hours to be arranged. Messrs. Wilson, Bakke, Miss Clark.

Open to graduate candidates working on theses and to other graduates prepared for independent study of special topics in rhetoric and public address.

Drama

375. THE HISTORY OF THE MOTION PICTURE

Fall term. Credit four hours. T Th 11. Laboratory, T 2–4:30. Mr. Beck.

An introduction to the history and art of the film: its characteristic problems, devices, and development. Representative motion pictures, from *The Great Train Robbery* and Griffith's *The Birth of a Nation* or *Intolerance* to contemporary films of significance, will be studied. Lectures, discussions, and reports.

376. THE DOCUMENTARY AND EXPERIMENTAL FILM

Spring term. Credit four hours. T Th 11. Laboratory, T 2–4:30. Mr. Beck.

An examination of the non-fiction film and the experimental film. Attention is given to the film maker as artist, informant, propagandist, and recorder. Representative examples of film essays, American and foreign, will be studied. Lectures, demonstrations, discussions, and reports.

381. STAGECRAFT

Fall term. Credit four hours. No prerequisite but previous study of acting or play production recommended. M W 12. Laboratory, T 2–4:30. Miss Gibson.

The theory and practice of stage production and design; theatre structure and equipment, problems and practice in scene construction and painting, elements of lighting. Lectures, demonstrations, research reports.

382. STAGE LIGHTING AND DESIGN

Spring term. Credit four hours. Prerequisite, Speech and Drama 381 or consent of instructor. M W 12. Laboratory, T 2–4:30. Miss Gibson.

A consideration of the history, theory, and practice of lighting and design in the pictorial elements of dramatic production. Lectures, demonstrations, and special projects.

383–384. THEATRE PRACTICE

Throughout the year; may be entered either term. Credit two hours a term. Primarily for majors in drama but open by consent of the instructors to other students who have taken or who are taking Speech and Drama 104, 110, 283, or 285. Hours to be arranged. Mr. Carlson, Miss Gibson, and the Staff of the University Theatre.

Planning and execution of projects in the productions of the University Theatre.

385. ADVANCED DIRECTING

Spring term. Credit four hours. Prerequisite, Speech and Drama 285 or consent of instructor. W 2–4:30.

Readings, reports, and exercises; assignments in the direction and production of plays in the Studio program.

386. ADVANCED ACTING

Spring term. Credit four hours. Prerequisite, Speech and Drama 283 or consent of instructor. W 2–4:30. Mr. Albright.

Varied projects in acting and group rehearsal, correlated with public presentations; individual drills, pantomimes, and reading exercises.

388. PLAYWRITING

Fall term. Credit four hours. Previous study in play production recommended. F 2–4:30. Mr. Robertson.

A consideration of the art and craft of writing for the theatre; practice through the composition and testing of one-act plays.

393. HISTORY OF THE THEATRE I

Fall term. Credit four hours. M W F 10. Mr. Beck.

A survey of the characteristics of primitive theatre, and of theatrical styles and production modes in classic Greece, Rome, China, and India, medieval Europe, and renaissance England and Spain. Readings, lectures, and reports.

394. HISTORY OF THE THEATRE II

Spring term. Credit four hours. M W F 10. Mr. Carlson.

A survey of theatrical styles and production modes in Europe and the Orient since 1642. Among the areas considered will be Renaissance France, the English Restoration, the eighteenth and nineteenth centuries in England, France, Germany, and Japan, and the modern international stage. Readings, lectures, and reports.

396. AMERICAN DRAMA AND THEATRE

Spring term. Credit four hours. T Th S 9. Mr. Robertson.

A study of the American theatre and of representative American plays from the colonial period to the present, with emphasis on the drama as an expression of the national life and culture.

491. SEMINAR IN THEATRE HISTORY

Spring term. Credit four hours. Prerequisite, Speech and Drama 391 or consent of instructor. Th 2–4:30. Mr. Carlson.

Selected topics in the history of the theatre.

493. SEMINAR IN THE FILM

Spring term. Credit four hours. Prerequisite, Speech and Drama 375 or 376, or consent of the instructor. Th 2–4:30. Mr. Beck.

Selected topics in the history and aesthetics of the film.

495. THEATRE AESTHETICS

Fall term. Credit four hours. Prerequisites, Speech and Drama 285 plus two 300-level or 400-level courses in drama. W 2–4:30. Mr. Albright.

The chief theories of dramatic production in relation to aesthetic principles.

497. THEATRE CRITICISM

Spring term. Credit four hours. Prerequisite, consent of instructor. F 2–4:30. Mr. Beck.

Examination of contemporary critical theory, related primarily to plays in production.

595. SEMINAR IN THEATRE AESTHETICS

Spring term. Credit four hours. Prerequisite, Speech and Drama 495 or consent of the instructor. T 2–4:30. Mr. Carlson.

Selected topics in theatre aesthetics.

690. THESES AND SPECIAL PROBLEMS IN DRAMA AND THE THEATRE

Either term. Credit and hours to be arranged. Messrs. Albright, Carlson, and Beck.

Open to graduate candidates working on theses and to other graduates prepared for independent study of special topics in drama and theatre.

Honors

328–329. INDEPENDENT STUDY: HONORS

Throughout the year. Credit four hours a term. Prerequisite, acceptance as a candidate for Honors. Hours to be arranged. Members of the Department.

428. HONORS SEMINAR

Spring term. Credit four hours. Prerequisite, senior standing as a candidate for Honors. Hours to be arranged. Members of the Department.

429. HONORS RESEARCH

Fall term. Credit four hours. Prerequisite, senior standing as a candidate for Honors. Hours to be arranged. Members of the Department.

SOCIAL SCIENCES

Fields of: Agricultural Economics, Anthropology, Asian Studies, Business and Public Administration, Child Development and Family Relationships, Economics, Education, Government, Hotel Administration, Household Economics and Management, Housing and Design, Industrial and Labor Relations, Institution Management, International Agricultural Development, Latin American Studies, Law, Linguistics, Rural Sociology, Sociology, Statistics, and Textiles and Clothing.

Agricultural Economics

Faculty: David J. Allee, Richard D. Aplin, Randolph Barker, Solon L. Barraclough, C. Arthur Bratton, Earl H. Brown, Max E. Brunk, David L. Call, Kendall S. Carpenter, George L. Casler, Howard E. Conklin, Lowell C. Cunningham, Lawrence B. Darrah, Bennett A. Dominick, Jr., Wendell G. Earle, Olan D. Forker, Donald K. Freebairn, Dana C. Goodrich, Jr., Glenn W. Hedlund, R. Brian How, Robert J. Kalter, C. Del Mar Kearl, Clifton W. Loomis, Edward A. Lutz, John W. Mellor, Joseph F. Metz, Jr., Daniel I. Padberg,

Thomas T. Poleman, Kenneth L. Robinson, Daniel G. Sisler, Robert S. Smith, Bernard F. Stanton, Robert P. Story, William G. Tomek, Stanley W. Warren.

Field Representative: William G. Tomek, 40 Warren Hall.

APPROPRIATE MAJOR AND MINOR SUBJECTS

Agricultural Economics
Farm Management and Production Economics
International Economics and Development
Marketing and Food Distribution
Policy and Prices
Public Administration and Finance
Resource Economics

ADMISSION REQUIREMENTS. An undergraduate major in the Field of Agricultural Economics is not required for admission to the Field, but some knowledge of agriculture and training in economics is desirable. Applicants are urged to take the Graduate Record Examination Aptitude Test.

LANGUAGE REQUIREMENT. No foreign languages are required by the Field for either the M.S. or the Ph.D. degree. However, a knowledge of one or more foreign languages is sometimes a prerequisite to acceptable professional work. The student's Special Committee members may set such language requirements as they deem necessary.

EXAMINATIONS. The Field requires only the examinations required by the Graduate School. However, a written examination in agricultural economics is required of Ph.D. students as a part of their Admission to Candidacy examination.

MAJOR AND MINOR SUBJECTS. One major and one minor are required for the M.S. degree. A candidate for the Ph.D. degree must have one major and two minors, one of which must be taken outside the Field.

RESEARCH AND STUDY OPPORTUNITIES. The student may pursue research in any of the areas suggested by the major subjects. Other faculty interests include agricultural cooperatives, agricultural geography, farm finance, international trade, regional agricultural development, and quantitative methods as applied to problems in agricultural economics. Within the area of economic development, staff members have special interests in Latin America, South and Southeast Asia, and tropical agriculture.

The primary subject matter interests of the faculty are as follows: Farm management and production economics: Professors Barker, Bratton, Casler, Conklin, Cunningham, Kearl, Loomis, Smith, Stanton, Warren. International economics and development: Professors Barraclough, Freebairn, Mellor, Poleman. Marketing and food distribution: Professors Aplin, Brown, Brunk, Call, Carpenter, Darrah, Dominick, Earle, Forker, Goodrich, Hedlund, How, Metz, Padberg, Story. Policy and prices: Professors Robinson, Sisler, Tomek. Public administration and finance: Professor Lutz. Resource economics: Professors Allee and Kalter.

FINANCIAL ASSISTANCE. Assistantships are available that provide an opportunity for part-time employment in teaching, research, or extension. Thesis research is often conducted as a part of assistantship duties in connection with research projects supervised by the staff. Offers of assistantships are made by the head of the Department, Professor G. W. Hedlund. Students with exceptional academic records are urged to apply for fellowships offered by Cornell University and by the State of New York. The closing date for receipt of applications for New York State Regents fellowships is December 1 and for Cornell University fellowships is February 1.

COURSES

Graduate-level courses in the Field are listed below. Attention is also directed to offerings in Economics, Statistics, and other related Fields. Courses at the undergraduate level are open to graduate students, and descriptions of these courses may be found in the Announcements of the various colleges. The following list is for the general information of the applicant, and specific details are subject to change.

500. FARM ORGANIZATION IN THE UNITED STATES

Fall term. Credit three hours. Enrollment limited to graduate students from countries other than the United States and Canada. Lecture, W 10:10. Laboratory and field trips. W 1:30–5:30. Warren 101. Professor Warren.

A study of the organization and operation of farms in the United States, from the point of view of efficiency and continuous profit. Intended to acquaint students from other countries with farm organization in the United States in order to serve as a basis for deciding on the adaptation of United States ideas to the circumstances of other regions. Visits to representative farms and the analysis of their business records. Attention will be given to the uses of farm management research studies.

507. RESEARCH IN FARM MANAGEMENT

Fall term. Credit two hours. Open only to graduate students. F 1:25–3:20. Warren 31. Professor Stanton.

A discussion of problems and methods used in doing research. Topics covered include science and scientific method, formulation of hypotheses, the role of data in research, sampling procedures, and methods of analysis used by research workers in this field.

508. QUANTITATIVE METHODS IN PRODUCTION ECONOMICS

Fall term. Credit three hours. Open only to graduate students. Lectures, M W F 11:15. Warren 160. Professor Robinson.

A review of economic theory, statistical methods, and empirical studies applicable to resource allocation problems in agriculture. Topics discussed include production functions, linear programming, interindustry studies, and game theory.

515. APPLIED ECONOMETRICS IN AGRICULTURAL ECONOMICS

Spring term. Credit three hours. Prerequisite, preparation in economics and statistics at the level of Economics 311–312 and I. and L.R. 311 (Statistics II). T Th 1:25–2:45. Warren 37. Associate Professor Tomek.

A course in applied econmetrics with examples drawn from price-demand-supply structures for agricultural commodities. Topics covered include model specification, the identification problem, estimation techniques, and the use of results.

540. INTRODUCTION TO MARKETING RESEARCH

Spring term. Credit two hours. Limited to graduate students. M 1:25–3:20. Warren 201. Professor Brunk.

Objectives of marketing research, organization of research agencies, selecting and planning projects, preliminary investigation procedures, surveys, experimental designs, methods engineering, case studies, field and office supervision, preparation of reports, and application of results.

541. FOOD MERCHANDISING AND PROMOTION

Fall term. Credit two hours. Limited to graduate students. T 1:25–3:20. Warren 345. Professor Brunk.

A seminar course exploring alternative merchandising and promotional devices used in the foods industry with special attention given to identification and measurements of basic forces having an impact on buying behavior.

548. QUANTITATIVE METHODS IN AGRICULTURAL ECONOMICS

Spring term. Credit two or three hours. Open only to graduate students. T 8–9:55. The additional hour of credit and extra class sessions to be arranged will be required of students without prior knowledge of computer programming. Warren 448. Professor How.

The application of quantitative methods to the improvement of decisions in agricultural economics. An introduction to the use of Markov processes, queuing models, simulation, project evaluation and review technique, dynamic programming, replacement theory, and inventory models. Emphasis will be placed on the applications of each technique to the area of interest.

552. SPECIAL PROBLEMS IN LAND ECONOMICS

Fall or spring term. Credit one or more hours. Open only to graduate students. Prerequisite, Course 452 and permission of the instructor. Professor Conklin and Associate Professor Allee.

Special work on any subject in the field of land economics that is of particular interest to the student. The student normally is expected to prepare a report on his work that is suitable for mimeograph reproduction and distribution.

560. ECONOMIC ASPECTS OF THE WORLD'S FOOD

Spring term. Credit three hours. Given in odd-numbered years. Primarily for graduate students, but open to seniors with permission of the instructor. Prerequisite, basic economics and a course in economic development. Time to be arranged. Assistant Professor Poleman.

Designed for students in economics and agricultural economics who are interested in the problems associated with quantification of the "Malthusian dilemma." Briefly considered are human food requirements, the major food groups, and the geography of world food production and consumption. Also examined are national diets and historical trends in food consumption. Prime attention is devoted to techniques for data evaluation, including food balance sheets and consumption surveys and the interrelations between population, food, and economic progress.

626. SEMINAR IN AGRICULTURAL COOPERATION

Spring term. Credit two hours. Open only to graduate students. Time to be arranged. Warren 204. Professor Carpenter.

A discussion of the economic theory concerning farmer cooperatives. Special attention is given to problems of financing, management, control, and membership relations peculiar to farmer cooperatives.

637. ADMINISTRATION OF PUBLIC AGRICULTURAL PROGRAMS

Spring term. Credit two hours. Primarily for graduate students. Undergraduate registration by permission of the instructor. F 2:30–4:25. Warren 260. Professor Lutz.

An examination of government organizations for administering and financing public agricultural programs; a study of some problems of administration and finance, including organization of agencies, management of personnel, budgetary management, interagency relationships (national, state, and local), and relationships among national, state, and local levels of government. Course 330 or one or more courses in government and public administration are desirable before taking this course.

640. MARKET ORGANIZATION AND STRUCTURE

Fall term. Credit two hours. Open only to graduate students. Registration by permission. M 1:25–3:20. Warren 345. Professors Story and Brunk.

A seminar course exploring the relationship of market organization and structure to the combined efficiency of production and marketing processes. Alternative market structures will be examined with respect to supply arrangements, market outlets, business considerations, and environmental conditions.

644. SEMINAR IN AGRICULTURAL LOCATION THEORY

Spring term of even-numbered years. Credit two hours. Open only to graduate students. Time to be arranged. Warren 448. Professor How and Assistant Professor Sisler.

Theories of the location of agricultural production and marketing facilities and methods used in making regional location decisions. Contributions of economic theory and quantitative methods will be reviewed. Analysis will be made of selected studies of interregional competition and the location and scale of marketing facilities.

646. SPECIAL PROBLEMS IN MILK MARKETING

Spring term. Credit two hours. Open to graduate students and selected seniors. Time to be arranged. Professor Story and Associate Professor Aplin.

Special topics relating to the dairy industry will be selected for study.

651. SEMINAR IN AGRICULTURAL POLICY

Spring term. Credit two hours. Open only to graduate students. W 1:25–3:20. Warren 160. Professor Robinson.

An analysis of current agricultural policies and proposed programs in the United States and selected foreign countries.

652. PRINCIPLES OF RESEARCH IN AGRICULTURAL PRODUCTION ECONOMICS

Spring term. Credit three hours. Open only to Ph.D. candidates. S 9:05–12:00. Warren 260. When field trips are taken, S 9:05–6:00. Professor Conklin.

The general problem of acquiring knowledge; major philosophical patterns of thought including rationalism, empiricism, relativism, and experimentalism; the past research continuum in agricultural production economics; the incomplete forces that guide choices among research alternatives; current research and future possibilities. Field trips are designed to supplement discussions of actual and possible research efforts.

653. REGIONAL ECONOMIC ANALYSIS

Fall term. Credit two hours. Open only to graduate students with permission of the instructor. Time to be arranged. Associate Professor Allee.

The application of economic theory and analysis to sub-national areas with emphasis on their structure and growth. Techniques of evaluating public actions will be stressed. Topics will be varied to meet current interests.

664. SEMINAR ON THE AGRICULTURAL DEVELOPMENT OF SOUTH ASIA

Spring term. Credit two hours. Open only to graduate students who have completed Course 364 or its equivalent. Times to be arranged. Professor Mellor.

665. SEMINAR ON LATIN AMERICAN AGRICULTURAL POLICY

Fall term. Credit two hours. Prerequisite, basic economics, a course in economic development, and permission of the instructor. A knowledge of Spanish or Portuguese is highly desirable. Time to be arranged. Professor Barraclough and Associate Professor Freebairn.

An examination of policies for the development of agriculture in Latin America including treatment of land tenure, the planning process, and related topics.

667. SEMINAR ON THE ECONOMICS OF TROPICAL AGRICULTURE

Spring term. Credit three hours. Given in even-numbered years. Primarily for graduate students, but open to seniors with permission of the instructor. Prerequisite, basic economics and a course in economic development. F 2:30–4:00, plus a weekly meeting with the instructor. Assistant Professor Poleman.

An examination of the production, distribution, and consumption of agricultural commodities in tropical countries. Emphasis will be on statistical sources and methods for their appraisal. Student participation and the preparation of a research paper will be stressed.

668. SEMINAR IN THE ECONOMICS OF AGRICULTURAL DEVELOPMENT

Fall term. Credit two hours. Open only to graduate students with permission. Time to be arranged. Professors Barraclough, Call, Conklin, Freebairn, Mellor, Poleman, Sisler, and other staff.

A joint exploration by the departmental staff in international agriculture of current topics in economic development with respect to agriculture. Intended primarily to facilitate the exchange of ideas among staff members, the seminar will be open to a limited number of advanced graduate students. Each student participant will be expected to prepare and defend a paper on a topic associated with his dissertation research.

690. SEMINAR IN AGRICULTURAL ECONOMICS EXTENSION

Fall term. Credit two hours. Primarily for graduate students. M 1:25–3:20. Warren 448. Professor C. A. Bratton.

The scope and nature of agricultural economics extension work will be considered. This will include early development of extension work in agricultural economics, objectives of agricultural economics extension; how programs are developed; extension methods used; and the importance of coordinating research and extension projects.

Current economic extension programs will be examined in detail.

The seminar is designed to familiarize students with the extension phase of agricultural economics.

Anthropology

Faculty: Robert Ascher, Frank A. Cancian, Charles F. Hockett, Allan R. Holmberg, Kenneth A. R. Kennedy, Bernd Lambert, William W. Lambert, Morris E. Opler, John M. Roberts, Lauriston Sharp, Robert J. Smith, Judith Treistman, Victor W. Turner, Arthur P. Wolf, Frank W. Young.

Visiting Faculty, 1966–67: Abner Cohen (Manchester), Chandra Jayawardena (University of Sydney, Australia), Terence S. Turner (Harvard University).

Field Representative:

ADMISSION REQUIREMENTS. A faculty committee of the Field, with the Field Representative as Chairman, evaluates all applications for admission to advanced work and for awards. All applicants resident in the United States during the year preceding matriculation at Cornell must submit the scores of the Graduate Record Examination Aptitude Test with their other credentials. Those who are accepted, but who do not reside in the United States at the time of application, must submit scores by the close of their first year at Cornell.

The Field of Anthropology requires that a candidate for a higher degree demonstrate a thorough reading knowledge of one language other than his mother tongue. The foreign language offered in fulfillment of this requirement may be any one which, in the judgment of the candidate's Special Committee, will further his research and professional competence. In the case of a foreign student whose first language is not English, English may be offered as the foreign language in which he is to demonstrate competence. In such a case the language examination must be taken before the end of his first term of residence. This is the minimum language requirement of the Field; a student's Special Committee may require a mastery of additional languages or a greater degree of language competence.

The Field strongly recommends that candidates seeking a career in anthropology elect the Ph.D. program, but M.A. candidates are occasionally accepted. Because the faculty conceives of its discipline as a unified field, one major only, namely anthropology, is offered. Subdisciplinary specialization and area interests are indicated by minors (and also by the composition of the Special Committee, course concentrations, and research and thesis projects). The Field requires that an M.A. candidate take one minor and that the Ph.D. candidate select two minors. Subfields of anthropology such as archaeology, linguistics, physical anthropology, social anthropology, and applied anthropology may be chosen as minors. In addition candidates for higher degrees in anthropology have often incorporated minors in Asian studies, social psychology, Latin American studies, sociology, government, history, economics, and many other Fields of the Graduate School into their programs to meet their special professional aims.

RESEARCH AND STUDY OPPORTUNITIES

The special interests and competence of a large faculty permit a full and varied curriculum for graduate students. New, modern laboratory facilities have given impetus to instruction and research in archaeology and physical anthropology. Some of the lines of inquiry and training available and the faculty members primarily associated with them are as follows:

African Studies: Abner Cohen, Victor W. Turner.
American Indian: Frank A. Cancian, Charles F. Hockett, Allan R. Holmberg, Morris E. Opler, John M. Roberts.
Anthropological History and Theory: Kenneth A. R. Kennedy, Bernd Lambert, Morris E. Opler, Robert J. Smith, Victor W. Turner.
Applied Anthropology and Culture Change: Allan R. Holmberg, Lauriston Sharp, Robert J. Smith.
Archaeology: Robert Ascher, Judith Treistman, Thomas Lynch.
Chinese Studies: Judith Treistman, Arthur P. Wolf.
Comparative Religion: Morris E. Opler, Lauriston Sharp, James T. Siegel, Victor W. Turner.
Cross-Cultural Studies: William W. Lambert, John M. Roberts, Frank W. Young.
Expressive Culture (Art, Folklore, Literature, Games, Models): Morris E. Opler, John M. Roberts, Robert J. Smith, Victor W. Turner.
Japanese Studies: Robert J. Smith.
Latin American Studies: Frank A. Cancian, Allan R. Holmberg, Terence S. Turner, Frank W. Young.
Legal Anthropology: John M. Roberts, Victor W. Turner.
Linguistics: Charles Hockett.
Oceania: Bernd Lambert, Lauriston Sharp.
Physical Anthropology: Robert Ascher, Kenneth A. R. Kennedy.
Political Anthropology: John M. Roberts, Terence S. Turner, Victor W. Turner, Lauriston Sharp.
Primitive Economics: Frank A. Cancian, Allan R. Holmberg, James T. Siegel.
Psychological Anthropology: William W. Lambert, Morris E. Opler, John M. Roberts, Arthur P. Wolf.
Social Organization: Frank A. Cancian, Bernd Lambert, Victor W. Turner, Lauriston Sharp.
South Asian Studies: Chandra Jayawardena, Kenneth A. R. Kennedy, Morris E. Opler.
Southeast Asian Studies: Chandra Jayawardena, James T. Siegel, Lauriston Sharp.

COURSES

(Upper division courses of particular interest to graduate students, and Graduate Seminars)

415–416. SURVEY OF ANTHROPOLOGICAL THEORY

Throughout the year. May be taken either term or both terms. Credit four hours a term. M W F 3. Mr. Opler.

Anthropological theory to 1930, Fall term; contemporary theory, Spring term. A systematic treatment of schools of thought in anthropology (historical, structural-functional, evolutionary, etc.), of principal concepts developed by the discipline, and of important figures who have contributed to anthropological theory. The relation of concepts which appear in anthropological theory to the general history of thought is constantly probed in an effort to understand both how ideology in anthropology has been influenced by developments in other disciplines and what anthropology has contributed to the main stream of ideas since its emergence as a distinct field of inquiry.

420. COMPARATIVE SOCIAL SYSTEMS

Spring term. Credit four hours. M W F 3. Mr. V. Turner.

The topics dealt with will include the comparative study of systems of kinship, politics, religion and magic in preliterate societies, and the relationship between these types of system in particular societies. They will further include age and sex differentiation; age-sets and age-grades; division of labor, types of specialization, occupational associations; rank and occupation; social classes, caste, slavery, pawnship and serfdom; secret associations; social networks and social mobility. References will also be made to theories concerning them.

421. KINSHIP AND SOCIAL ORGANIZATION

Fall term. Credit four hours. M W F 2. Mr. B. Lambert.

The development of kinship studies, analysis of the family, unilineal and bilateral systems of kinship, marriage. The study of kinship terminology. Kinship in small-scale and complex societies. Political, economic, and religious aspects of kinship organization.

[424. FOLKLORE AND CULTURE]

Spring term. Credit four hours. M W F 3. Mr. V. Turner. Not offered in 1966–67.

426. THE CONTENT OF CULTURE

Spring term. Credit four hours. Hours to be arranged. Mr. Roberts.

Attention is given to the description and management of the informational resource known as culture with a view to developing a theory of culture content. Codes, models, and inventories are given specific attention.

427. CONSTANTS AND VARIABLES IN CULTURE

Fall term. Credit four hours. M W F 2. Mr. Roberts.

An examination of those similarities and differences in cultures throughout the world which have claimed the attention of behavioral scientists. Major cross-cultural studies are reviewed, and specific use is made of the Human Relations Area Files in Olin Library.

[431. ETHNOLOGY OF NORTH AMERICA]

Fall term. Credit four hours. Prerequisite, Anthropology 101 or 301, or consent of instructor. M W F 3. Mr. Roberts. Not offered in 1966–67.

432. SOUTH AMERICAN TRIBAL SOCIETIES

Spring term. Credit four hours. M W F 9. Mr. T. Turner.

A comparative survey of the social and political organization, ritual, and myth of contemporary tribal peoples of South America. The course will focus upon a group of societies selected for the high quality of the available ethnographic sources and the interest inherent in the problems they pose. No systematic attempt will be made to cover all cultural areas and types represented on the continent.

434. ETHNOLOGY OF MAINLAND SOUTHEAST ASIA

Spring term. Credit four hours. T Th 3–4:30. Mr. Sharp.

The development and distribution of major cultural systems in mainland Southeast Asia. Discussion of selected groups in southern China, Assam, Burma, Thailand, Laos, Cambodia, and Vietnam, and of the fate of traditional cultural characteristics following the expansion of Chinese, Indian, Moslem, and Western civilizations into these areas.

435. ETHNOLOGY OF ISLAND SOUTHEAST ASIA

Fall term. Credit four hours. T Th 3–4:30. Mr. Siegel.

A survey of cultures of Indonesia, Malaysia and the Philippines with attention focused on social organization, rituals, beliefs, and forms of cultural expression. Selected societies will be studied in some detail.

437. ETHNOLOGY OF AFRICA

Fall term. Credit four hours. T Th S 9. Mr. Cohen.

A social and cultural survey of representative African peoples. Stress is laid on the comparative study of political institutions and local descent groups. Ritual beliefs and practices are considered in relation to repetitive and radical change.

[439. ETHNOLOGY OF OCEANIA]

Fall term. Credit four hours. Prerequisite, Anthropology 101 or 301, or consent of instructor. M W F 2. Mr. B. Lambert. Not offered in 1966–67.

441. CULTURE AND SOCIETY IN SOUTH ASIA

Fall term. Credit four hours. M W F 10. Mr. Opler.

A survey of the social, economic, political, and religious institutions of the countries of South Asia. Both the traditional cultures and the changes which are taking place are considered.

443. CHINESE CULTURE AND SOCIETY

Fall term. Credit four hours. M W F 3. Mr. Wolf.

An analytical survey of the social structure and nonmaterial culture of late traditional China. Attention is given to cultural geography and population, family and kinship, stratification and mobility, religion and values, economic institutions, and the power structure.

[445. JAPANESE CULTURE AND SOCIETY]

Fall term. Credit four hours. M W F 9. Mr. Smith. Not offered in 1966–67.

451. ETHNOLINGUISTICS

Fall term. Credit four hours. W 2–4. Mr. Hockett.

A survey of problems and findings in the interrelations of language and culture.

[461. SCIENCE IN ARCHAEOLOGY]

Fall term. Credit four hours. Th 2–4; laboratory to be arranged. Mr. Ascher. Not offered in 1966–67.

[462. INTERPRETIVE ARCHAEOLOGY]

Spring term. Credit four hours. Prerequisite, Anthropology 102 or 303 or 364, or consent of instructor. Th 2–4; laboratory to be arranged. Mr. Ascher. Not offered in 1966–67.

471. PHYSICAL ANTHROPOLOGY LABORATORY

Fall term. Credit four hours. Prerequisite, Anthropology 102, 272, 372, or 304; Zoology 101–102, 103–104, 201, 365; or consent of instructor. W F 3–5. Mr. Kennedy.

Methodology of field and laboratory analyses of human biological variation. Practical exercises in the techniques of anthropometry, serology, comparative primate anatomy, growth studies, and the interpretation of the hominid fossil record.

497. TOPICS IN ANTHROPOLOGY

Either term. Credit two hours. Prerequisite, consent of instructor. Hours to be arranged. Staff.

498. TOPICS IN ANTHROPOLOGY

Either term. Credit four hours. Prerequisite, consent of instructor. Hours to be arranged. Staff.

Graduate Seminars

501. PROSEMINAR: THE SCOPE OF ANTHROPOLOGY

Fall term. Credit four hours. M 4–6. Mr. Sharp and Staff.

A survey of the several sub-fields of anthropology designed for all graduate students entering the field.

502. SEMINAR: FIELD RESEARCH

Spring term. Credit four hours. M 4–6. Mr. V. Turner and Staff.

Problems involved in the planning and execution of field investigations designed for graduate students preparing for or returning from field work.

507–508. SPECIAL PROBLEMS IN ANTHROPOLOGY

Throughout the year. Credit and hours to be arranged. Staff.

510. SOCIAL CHANGE AND ADAPTATION: A SOUTH ASIAN CASE

Spring term. Credit four hours. F 4–6. Mr. Jayawardena.

An analysis of social change and adaptation among groups of Indian emigrants in the West Indies, Africa, Southeast Asia, and Oceania.

523. RELIGIOUS SYSTEMS: ISLAM IN WEST AFRICA

Fall term. Credit four hours. T 4–6. Mr. Cohen.

524. RELIGIOUS SYSTEMS: MYTH, RITUAL, AND SYMBOL.

Spring Term. Credit four hours. Th 4–6. Messrs. Sharp, Siegel, Turner.

525. TOPIC IN KINSHIP AND SOCIAL ORGANIZATION

Fall term. Credit four hours. W 4–6. Mr. T. Turner.

Various lineally and bilaterally organized kinship systems will be examined with emphasis on the relationship between the structure of local groups and personal kin groups, on the one hand, and corporate groups based on kinship, such as moieties, clans, and marriage sections, on the other. Attention will be paid to relationship terminologies, formal behavior patterns, related ritual symbolism, and problems of statistical patterns of behavior as contrasted with ideal norms. Admission with consent of instructor.

526. TOPICS IN PRIMITIVE POLITICAL ORGANIZATION

Spring term. Credit four hours. W 4–6. Mr. T. Turner.

The political institutions of various primitive peoples will be examined in the light of sociological and anthropological concepts of the nature of power, authority, and social integration or solidarity. Admission with consent of instructor.

532. MIDDLE AND SOUTH AMERICA

Spring term. Credit four hours. Prerequisite, consent of instructor. T 4–6. Mr. Holmberg.

534–535. SOUTHEAST ASIA

Throughout the year. Credit and hours to be arranged. Prerequisite, consent of instructors. Messrs. Siegel and Sharp.

[537. AFRICA]

Fall term. Credit four hours. Mr. V. Turner. Not offered in 1966–67.

[538. SOUTH ASIA]

Spring term. Credit four hours. Mr. Opler. Not offered in 1966–67.

[542. CHINA]

Spring term. Credit four hours. Mr. Wolf. Not offered in 1966–67.

[543. JAPAN]

Fall term. Credit four hours. Mr. Smith. Not offered in 1966–67.

545. PALAEOANTHROPOLOGY OF SOUTH ASIA

Fall term. Credit four hours. T 4–6. Mr. Kennedy.

A survey of the prehistoric and proto-historic cultures of India, Pakistan, and Ceylon from the archaeological evidence. The physical anthropology of ancient and living populations associated with these ancient cultures.

565. ARCHAEOLOGY: AGRICULTURE AND CIVILIZATION

Fall term. Credit four hours. Th 4–6. Mr. Lynch.

The development of agriculturally based civilizations in the Americas.

[571. BIOCULTURAL EVOLUTION]

Fall term. Credit four hours. Hours to be arranged. Mr. Ascher. Not offered in 1966–67.

[575. PHYSICAL ANTHROPOLOGY: HISTORY AND THEORY]

Fall term. Credit four hours. T 4–6. Mr. Kennedy. Not offered in 1966–67.

601–602. FIELD RESEARCH

Throughout the year. Credit to be arranged. Staff.

Field research seminars may be conducted in the United States, Latin America, Africa, India, Southeast Asia, Taiwan, Japan, and other areas for a limited number of adequately prepared students.

Asian Studies

FACULTY

CHINA: Knight Biggerstaff (modern history), Nicholas C. Bodman (linguistics), Nai-ruenn Chen (economics), John W. Lewis (government: domestic politics), Ta-Chung Liu (economics), William John McCoy (linguistics and literature), David Mozingo (government: international relations), Harold Shadick (literature), Judith M. Treistman (archaeology), Arthur P. Wolf (anthropology), Martie W. Young (art history).

JAPAN: Robert J. Smith (anthropology).

SOUTH ASIA: L. P. Adams (labor relations), D. E. Ashford (government: public administration), H. R. Capener (sociology), Arch T. Dotson (govern-

ment: development planning), Gordon H. Fairbanks (linguistics), James W. Gair (linguistics), Gerald Kelley (linguistics), Kenneth A. R. Kennedy (anthropology), John W. Mellor (economics), Morris E. Opler (anthropology).

SOUTHEAST ASIA: John M. Echols (linguistics and literature), Frank H. Golay (economics), Robert B. Jones, Jr. (linguistics), George McT. Kahin (government), Stanley J. O'Connor (art history), Robert A. Polson (rural sociology), Lauriston Sharp (anthropology), James T. Siegel (anthropology), John U. Wolff (linguistics), O. W. Wolters (history).

VISITING PROFESSORS: *China:* Maurice Freedman (Prof. of Anthropology, London University – fall semester). *Southeast Asia:* Tom Harrisson (Curator, Sarawak Museum; fall semester), Selo Soemardjan (Professor of Sociology, University of Indonesia; spring semester), Alexander B. Griswold (Director, Breezewood Foundation).

Field Representative: Harold Shadick, 102 Franklin Hall.

APPROVED MAJOR AND MINOR SUBJECT: Chinese Literature

APPROVED MINOR SUBJECTS: Asian Studies, Chinese Linguistics, South Asian Linguistics, Southeast Asian Linguistics

Major and minor work is also offered in Oriental art (see History of Art) and in modern Chinese history and Southeast Asian history (see History).

THE MAJOR IN CHINESE LITERATURE

At least two years of Chinese language study are required prior to admission.

Preference is given to applicants who have taken several undergraduate courses in English or European literature.

Candidates for the Ph.D. whose undergraduate education was in a Chinese university are normally expected to have taken a degree in English or in a European literature before admission.

It is recommended that applicants submit Graduate Record Examination Aptitude Test scores.

Language requirements for the Master's degree: proficiency in French, German, Japanese, or Russian. For the Ph.D. degree: proficiency in two of these languages.

The comprehensive examination for admission to Ph.D. candidacy will test: (1) familiarity with representative works in classical and vernacular Chinese and with critical studies in Chinese; (2) broad knowledge of the available translations of Chinese literature and critical studies in other languages; (3) specialized knowledge of at least two subfields such as the Confucian or Taoist classics, poetry, drama, fiction, classical prose, or twentieth-century writings.

The requirements for the M.A. degree or for a minor in Chinese literature are roughly equivalent to (1) or (2) above.

Courses

Chinese 312. INTERMEDIATE CLASSICAL CHINESE

Spring term. Credit three hours. Prerequisite, Chinese 213 or 301. M W F 11. Mr. Shadick.

Study of texts in a variety of styles, ancient and modern.

Chinese 313. CHINESE HISTORICAL AND PHILOSOPHICAL TEXTS

Fall term. Credit four hours. Prerequisite, Chinese 302 or 312 or consent of the instructor. T Th 11 and one hour to be arranged. Mr. Shadick.

Selections from the standard histories, the classical philosophers, and early modern reformers.

Chinese 414. CLASSICAL CHINESE PROSE

Spring term. Credit four hours. Prerequisite, consent of the instructor. Hours to be arranged. Mr. Shadick.

Chinese 416. CLASSICAL CHINESE POETRY AND DRAMA

Fall term. Credit four hours. Prerequisite, consent of the instructor. Hours to be arranged. Instructor to be appointed.

Chinese 420. READINGS IN THE TRADITIONAL CHINESE NOVEL

Either spring or fall term, according to demand. Credit two or four hours. Prerequisite, consent of the instructor. Hours to be arranged. Mr. McCoy.

Chinese 411–412. ADVANCED READINGS IN MODERN CHINESE

Throughout the year. Credit four hours a term. Prerequisite, Chinese 302. Hours to be arranged. Mr. McCoy.

Chinese 521–522. ADVANCED READINGS IN CLASSICAL CHINESE

Throughout the year. Credit two or four hours a term. Prerequisite, consent of the instructor. Hours to be arranged. Instructor to be appointed.

Chinese 571–572. SEMINAR IN CHINESE LITERATURE

Fall term. Credit three hours. M W F 10. Mr. Shadick.

Chinese 402. HISTORY OF THE CHINESE LANGUAGE

Either term. Credit four hours. Prerequisite, consent of the instructor. Hours to be arranged. Mr. Bodman.

Chinese 403. LINGUISTIC STRUCTURE OF CHINESE

Either term. Credit four hours. Prerequisite, consent of the instructor. Hours to be arranged. Mr. Bodman.

Comparative Literature 371. CHINESE HISTORICAL AND PHILOSOPHICAL LITERATURE IN TRANSLATION

Fall term. Credit three hours. M W F 10. Mr. Shadick.

Philosophical and historical literature, including Confucian, Taoist, and Buddhist writings.

Comparative Literature 372. CHINESE IMAGINATIVE LITERATURE IN TRANSLATION

Fall term. Credit three hours. M W F 10. Mr. Shadick.

Imaginative literature, including poetry, classical prose, fiction, drama, and the new writing of the twentieth century.

THE MINOR IN ASIAN STUDIES

The Ph.D. candidate specializing in Asia (or with a serious interest in the area) may select a minor in the Field of Asian Studies consisting of either: (a) concentrated interdisciplinary study of one area of Asia, or (b) disciplinary or topical concentration which cuts across area boundaries. Details of the minor are to be worked out in consultation with the member of the candidate's Special Committee representing Asian Studies. Because specialization in

Asia usually involves the study of an Asian language, it is essential that the candidate discuss the problem of language work with the entire membership of his Committee, particularly with the member representing his major Field.

Courses

Asian Studies 501–502. SOUTHEAST ASIA

Throughout the year. F 4–6. Credit to be arranged. Staff.

A graduate-level survey of the cultures and history of Southeast Asia covering the pre-European, colonial, and postcolonial periods, but with particular emphasis on postwar developments and contemporary problems. Will occasionally focus on a problem common to the area as a whole, but usually deals with a different country of Southeast Asia each term.

Asian Studies 591–592. SEMINAR: FIELD RESEARCH

Throughout the year. Staff.

Field research seminars for selected advanced students are conducted in South Asia, Southeast Asia, Hong Kong, Taiwan, or Japan by staff members who are themselves working in these areas.

Asian Studies 676. SOUTHEAST ASIAN RESEARCH TRAINING SEMINAR

Spring term. Hours to be arranged. Credit to be arranged. Mr. Majul.

Open only to advanced graduate students preparing for field work in Southeast Asia.

Other courses relevant to the minor in Asian Studies are listed under various discipline fields in this Announcement. They are listed as a group under Asian Studies in the *Announcement of the College of Arts and Sciences.*

There are at Cornell three programs concerned with teaching and research on Asia — the China Program, South Asia Program, and Southeast Asia Program. (Selection of a minor in Asian Studies does not in all cases qualify the candidate for membership in one of these programs.) Requirements for membership in these programs will be found under their individual listings.

Several fellowships and research assistantships are available for which application should be made directly to the Director of the China Program, the Director of the Southeast Asia Program, or the Director of the South Asia Program. These are described more fully on pages 29, 33, and 34 of this Announcement.

The work of the Department of Asian Studies is recognized and supported by the United States Office of Education. Under the National Defense Education Act, Cornell has three Language and Area Centers: East Asia, South Asia, and Southeast Asia. Languages currently offered are Burmese, Cebuano, Chinese (Mandarin, Cantonese, and Hokkien), Dutch, Hindi, Indonesian, Japanese, Javanese, Malay, Pali, Sanskrit, Sinhalese, Thai, Urdu, and Vietnamese. Graduate students in Asian Studies are eligible for the National Defense Foreign Language Fellowships offered by the U.S. Office of Education. Application forms should be requested directly from the Graduate School and returned to it for forwarding to the U.S. Office of Education if approved.

Graduate students in Asian Studies are also eligible for the Foreign Area Training Fellowships administered by the Social Science Research Council for study in the United States and for research overseas. Fulbright teaching and research awards for Taiwan, Hong Kong, India, Japan, Malaya, Pakistan, Philippines, Singapore, and Thailand are available to qualified graduate students who are citizens of the United States.

For additional details, consult the Department of Asian Studies.

Business and Public Administration

Faculty: Douglas E. Ashford, Roy E. Baker, Roger M. Battistella, Fredrick T. Bent, Harold Bierman, Earl Brooks, William D. Carmichael, Melvin G. de Chazeau, Arch T. Dotson, Allan R. Drebin, Thomas R. Dyckman, Edward S. Flash, Frank F. Gilmore, Warren H. Hausman, A. Miller Hillhouse, G. David Hughes, John G. B. Hutchins, Thomas M. Lodahl, Alan K. McAdams, Arthur E. Nilsson, John M. Rathmell, Seymour Smidt, David A. Thomas, Paul P. Van Riper, Richard R. West, Rodney F. White, Leroy K. Young.
Visiting Professor, 1966–67: Jon G. Udell (University of Wisconsin).

Field Representative: John G. B. Hutchins, 518 Malott Hall.

APPROPRIATE MAJOR AND MINOR SUBJECTS.

Major or minor subjects:	Minor subjects only:
Business Administration	Development and Public Administration
Managerial Economics	Finance and Accounting
Organizational Behavior and Theory	Hospital Administration
Public Administration	Marketing
	Production
	Quantitative Methods for Administration

A student admitted to the program must select a major subject from the four listed above. He must also select two minor subjects. In most cases he is encouraged to select one minor from another Field, preferably in a subject which will supply strong disciplinary support for his major interest. In any case, he is encouraged to take appropriate graduate courses in such other Fields. Those from which minors are commonly selected are the Fields of City and Regional Planning, Economics, Government, Industrial and Labor Relations, Industrial Engineering and Operations Research, Psychology, and Sociology. Attention is called to the wide range of choice available at Cornell. It is necessary, however, for the student to have or to acquire adequate preparation for graduate work in such Fields.

The M.A. and M.S. degrees are not awarded in this Field. A student interested in a Masters' degree should examine the *Announcement of the Graduate School of Business and Public Administration,* which describes the program for the professional degrees of Master of Business Administration and Master of Public Administration. While some students enter the Ph.D. program after having taken a Master's degree, and many enter with a professional Master's degree, able candidates are often encouraged to begin doctoral work directly upon completion of the Bachelor's degree.

Candidates for advanced degrees with majors in other Fields may elect minors in this Field provided they have sufficient preparation to do the graduate work involved. Normally, from twelve to fifteen hours of work are required as a minimum for a minor, depending on the degree sought and the extent of a candidate's preparation.

BRIEF STATEMENT OF PROGRAM AND SUBJECT CONTENT

The Ph.D. program in the field of Business and Public Administration is designed to provide advanced education within this broad area for those seeking careers in teaching and research. A student majoring in the Field is expected to become well grounded in the theory, literature, and techniques of

professional management within the institutional setting appropriate to his interest, e.g., business or government. He will also be expected to acquire competence in research methodology through course work, the selection of a thesis topic, and the completion of an original investigation into this topic.

MAJOR SUBJECTS

Descriptions of the four major subjects, together with listings of staff members primarily concerned, are as follows:

BUSINESS ADMINISTRATION, as a major subject, requires the candidate to demonstrate his ability to analyze the relationships of business firms to their economic, political, and social environment, and to apply managerial decision-making concepts to the integrated operations of such firms, especially in the formulation of the over-all policies of the enterprise. The candidate is permitted to focus his attention primarily within one of the functional areas, such as marketing, finance, production, personnel, and control. This selection of an area of study determines the area in which the thesis is written and influences the selection of the faculty member under whom the work will be conducted. However, the thesis cannot ignore, and the major subject must comprehend, the viewpoint of top management toward the area of special study and its impact on the other functional areas.

Faculty: Messrs. Baker, Bierman, Brooks, Call, de Chazeau, Drebin, Dyckman, Gilmore, Hausman, Hughes, Hutchins, Lodahl, McAdams, Nilsson, Rathmell, Thomas, West, Udell.

MANAGERIAL ECONOMICS. This subject concentrates on economic analysis for decision making. In substance, the candidate may study the problems of the total economy, of industries, or of the firm, and may do so within the context of a selected special study area, such as international economic relations, economic development, business and government relations, money and banking, investment project analysis, or transportation. He will be expected to develop a thorough grasp of relevant economic theory and institutions and a basic understanding of both qualitative and quantitative methods of analysis.

Faculty: Messrs. Bierman, Carmichael, de Chazeau, Dyckman, Hausman, Hillhouse, Hutchins, McAdams, Smidt, West.

ORGANIZATIONAL THEORY AND BEHAVIOR. Work in this subject focuses on social- and behavioral-science approaches to the study of human activity in organizational settings. The major concern is with the regularities, differences, and relationships in human behavior directed toward purposive ends. Systematic observation, theoretical analyses, and empirical investigation are stressed. A fundamental grounding in at least one of the social sciences is expected of all majors. Students without grounding in the literature and practices of general administration in an institutional setting must take one minor in such an area.

Faculty: Messrs. Brooks, Flash, Lodahl, Summerskill, Van Riper, White.

PUBLIC ADMINISTRATION. A broad interdisciplinary approach to public administration will be required. Not only the study of governmental policies, policy formulation, power relationships, administrative behavior, basic management functions such as personnel and finance, and the broad environment of public affairs, but also competence in bureaucratic and organizational theory and in the methods of the social sciences will be expected.

Faculty: Messrs. Ashford, Bent, Carmichael, Dotson, Drebin, Flash, Hillhouse, Van Riper.

MINOR SUBJECTS

In like manner descriptions of the minor subjects, together with staff, are as follows:

DEVELOPMENT AND PUBLIC ADMINISTRATION focuses on the political, economic, and social problems of institution-building in developing countries, and on their significance for American business and public administrators.

Faculty: Messrs. Ashford, Bent, Carmichael, Dotson.

FINANCE AND ACCOUNTING comprehend the functions of financial institutions, organizations and capital markets and the provision of accounting data required for the management and appraisal of business firms and investment institutions.

Faculty: Messrs. Baker, Bierman, de Chazeau, Drebin, Dyckman, McAdams, Nilsson, Thomas, West.

HOSPITAL ADMINISTRATION provides for study of the economics and administrative problems of health programs, health agencies, and hospitals.

Faculty: Messrs. Baker, Battistella, White, Young.

MARKETING emphasizes the application of analytical tools derived from economics, psychology, sociology and operations research in the development of operational and policy aspects of the marketing function.

Faculty: Messrs. Call, Hughes, Rathmell, Udell.

PRODUCTION includes a critical study of the effectiveness and limitations of various quantitative methods of analysis, including computer simulation, in the solution of major economic decision problems of production and operations management.

Faculty: Messrs. Conway, Gilmore, Hausman.

QUANTITATIVE ANALYSIS FOR MANAGEMENT stresses modern developments in the uses of mathematical and statistical tools and computer technology for the solution of managerial problems, including decision making under uncertainty.

Faculty: Messrs. Bierman, Conway, Drebin, Dyckman, Hausman, McAdams, Smidt.

ADMISSIONS

Admission to the Ph.D. program is dependent on suitable preparation for the subjects to be selected. This may consist of a strong undergraduate work in such relevant fields as economics, government, sociology, psychology, mathematics, or engineering, or of a satisfactory record in a professional program leading to the degree of M.B.A. or M.P.A. A student having had neither work in a relevant discipline nor a professional Master's degree will be expected to complete substantial course work from the Master's degree program during his doctoral work. Narrowly focused undergraduate programs in business administration which do not provide strong foundations in the underlying disciplines are not regarded with favor as preparation.

Applicants, both foreign and domestic, are required to submit aptitude test scores for either the Admission Test for Graduate Study in Business or the Graduate Record Examination.

LANGUAGE REQUIREMENT. The language requirement for the Ph.D. degree is the demonstration of reading proficiency in one foreign language

chosen among the following: French, German, Russian, Spanish, Italian, Swedish. With the approval of a student's Special Committee, another language having either a substantial scholarly literature or significant utility in a student's research plans may be substituted. A student whose native language is not English may substitute reading, writing, and speaking competence in English. Any Special Committee may require more than one language or greater competence in one language.

EXAMINATIONS. In addition to the usual course work each student must pass three examinations, which will be scheduled and administered by his special committee. The first of these, the *Qualifying Examination,* is designed to be diagnostic. It serves as the basis for the special committee to assist the student in planning his future program and to assure the committee that the student is properly prepared to persevere in the subject areas he has selected. The examination will usually be both written and oral. If the student enters with a Master's degree, the qualifying examination will be given in the first term of residence; if he enters with a Bachelor's degree only, it will be given during the first year of residence. The *Comprehensive Examination* covers the major and minor subjects and is always given in two parts, a written and an oral examination. It is usually given upon substantial completion of course work, ordinarily after four units of residence have been accumulated. The *Thesis Examination* is scheduled after a manuscript has been approved in substance by the Special Committee, and it is always oral.

COURSES

Business Administration (see also specific functional subjects below)

*200. BUSINESS POLICY. First term, Credit four hours. Mr. Gilmore.

201. INTERNATIONAL BUSINESS POLICY. Second term. Credit four hours. Mr. Gilmore.

308. LAW OF BUSINESS ASSOCIATIONS. Second term. Credit four hours. Mr. Bugliari.

309. ADVANCED BUSINESS LAW. First term. Credit four hours. Mr. Bugliari.

325. SEMINAR IN MANAGEMENT OF AGRICULTURAL INDUSTRIES. Second term. Credit three hours. Mr. Call.

Managerial Economics

*124. ECONOMIC ANALYSIS FOR MANAGEMENT I. First term. Credit three hours. Messrs. de Chazeau and West.

*125. ECONOMIC ANALYSIS FOR MANAGEMENT II. Second term. Credit three hours. Messrs. Smidt and McAdams.

*202. BUSINESS ENTERPRISE AND PUBLIC POLICY. Second term. Credit three hours. Mr. Hutchins.

375. ECONOMIC AND BUSINESS HISTORY. First term. Credit three hours. Mr. Hutchins.

* Required courses for MBA and/or MPA candidates.

*376. BUSINESS POLICY AND ECONOMIC INSTABILITY. First term. Credit three hours. Mr. de Chazeau.

*377. COMPETITIVE BEHAVIOR AND PUBLIC POLICY. Second term. Credit three hours. Mr. de Chazeau.

379. ECONOMIC EVALUATION OF CAPITAL INVESTMENT PROJECTS. First term. Credit three hours. Mr. Smidt.

*575. TRANSPORTATION: RATES AND REGULATIONS. First term. Credit three hours. Mr. Hutchins.

576. TRANSPORTATION: STRUCTURES, OPERATIONS, AND POLICIES. Second term. Credit three hours. Mr. Hutchins.

Organizational Behavior and Theory

*120. ORGANIZATIONAL BEHAVIOR AND THEORY. First term (first seven weeks). Credit two hours. Messrs. Lodahl and Alderfer.

*121. PERSONNEL ADMINISTRATION AND HUMAN RELATIONS. First term (last seven weeks). Credit two hours. Mr. Brooks.

352. PUBLIC RELATIONS AND COMMUNICATIONS CASES AND PROBLEMS. (Industrial and Labor Relations, 628.) Second term. Credit three hours. Mr. Hodges.

500. HUMAN RELATIONS IN ADMINISTRATION. Second term. Credit three hours. Mr. Alderfer.

502. SEMINAR IN ORGANIZATIONAL BEHAVIOR AND ADMINISTRATION. First term. Credit three hours. Mr. Brooks.

503. SEMINAR IN BUSINESS AND INDUSTRIAL PERSONNEL. Second term. Credit three hours. Mr. Brooks.

505. PROBLEM SOLVING IN ADMINISTRATION. Second term. Credit three hours. Messrs. Lodahl and Shocker.

907. SPECIAL TOPICS IN ORGANIZATIONAL THEORY AND BEHAVIOR. Second term. Credit three hours. Mr. Alderfer.

Public Administration (See also specific functional subjects).

*130. MANAGEMENT OF PUBLIC AGENCIES I. First term. Credit three hours. Mr. Flash.

*131. MANAGEMENT OF PUBLIC AGENCIES II. Second term. Credit three hours. Messrs. Hillhouse, Flash, and Drebin.

428. GOVERNMENT FISCAL MANAGEMENT. First term. Credit three hours. Mr. Hillhouse.

---

* Required courses for MBA and/or MPA candidates.

*550. POLITICS AND POLITICAL POWER. Second term. Credit three hours. Mr. Bent.

553. THEORY AND PRACTICE OF MUNICIPAL FINANCE. First term. Credit three hours. Mr. Hillhouse.

554. SEMINAR IN URBAN GOVERNMENT AND ADMINISTRATION. Second term. Credit three hours. Mr. Flash.

*555. ISSUES OF PUBLIC POLICY AND ADMINISTRATION. Second term. Credit three hours. Mr. Flash.

556. SEMINAR IN PUBLIC ADMINISTRATION. First term. Credit three hours. Mr. Presthus.

558. SEMINAR IN THE POLITICS OF GOVERNMENT PLANNING (Government 523). First term. Credit four hours. Mr. Altshuler.

904. SEMINAR IN POLITICS AND ADMINISTRATION. First term. Credit three hours. Mr. Presthus.

Finance and Accounting

*122. MANAGERIAL ACCOUNTING. First term. Credit four hours. Messrs. Thomas and Drebin.

*128. FINANCE. Second term. Credit three hours. Messrs. Nilsson and West.

300. INTERMEDIATE ACCOUNTING. Second term. Credit three hours. Mr. Drebin.

301. ADVANCED ACCOUNTING. Second term. Credit three hours. Mr. Baker.

302. COST ACCOUNTING. Second term. Credit three hours. Mr. Dyckman.

303. SEMINAR IN MANAGERIAL ACCOUNTING. Second term. Credit three hours. Mr. Bierman.

304. FINANCIAL ACCOUNTING. First term. Credit three hours. Messrs. Bierman and Drebin.

305. FEDERAL TAXATION AND TAX ACCOUNTING. First term. Credit three hours. Mr. Bierman.

306. GOVERNMENTAL ACCOUNTING. Second term. Credit three hours. Mr. Hillhouse.

307. AUDITING. First term. Credit three hours. Mr. Baker.

310. MANAGERIAL ACCOUNTING IN HOSPITALS. Second term. Credit three hours. Mr. Baker.

381. MONETARY MANAGEMENT AND STABILIZATION. First term. Credit three hours. Mr. West.

* Required courses for MBA and/or MPA candidates.

424. ANALYSIS OF AMERICAN INDUSTRIES. Second term. Credit two hours. Mr. McAdams.

425. ANALYSIS OF THE FIRM. Second term. Credit two hours. Mr. McAdams.

426. FINANCIAL MANAGEMENT. First term. Credit three hours. Mr. Nilsson.

427. INVESTMENT MANAGEMENT. Second term. Credit three hours. Mr. Nilsson.

429. FINANCIAL INSTITUTIONS AND CAPITAL MARKETS. Second term. Credit three hours. Mr. West.

430. INVESTMENT IN GOVERNMENT SECURITIES. Second term. Credit three hours. Mr. Hillhouse.

432. CAPITAL FINANCING SEMINAR. First term. Credit three hours. Mr. Nilsson.

Hospital Administration

*140. INTRODUCTION TO HOSPITAL AND MEDICAL CARE ADMINISTRATION. First term. Credit four hours. Mr. Battistella.

*141. INTRODUCTION TO CLINICAL MEDICINE AND PUBLIC HEALTH PROGRAMS. Second term. Credit three hours. Dr. Samson.

142. HEALTH ECONOMICS. First term. Credit three hours. Messrs. Battistella and Berki.

450. ADMINISTRATIVE DEVELOPMENTS IN HOSPITALS. First term. Credit three hours. Mr. Brown.

453. LEGAL ASPECTS OF HOSPITAL ADMINISTRATION. First term. Credit two hours. Mr. Bugliari.

454. POLICY AND PLANNING IN HOSPITALS AND HEALTH AGENCIES. Second term. Credit three hours. Mr. Battistella.

Marketing

*126. MARKETING. First term (ten weeks). Credit two hours. Mr. Shocker.

476. MARKETING RESEARCH. First term. Credit three hours. Mr. Udell.

477. MARKETING MEASURES AND MODELS. Second term. Credit three hours. Mr. Shocker.

479. SEMINAR IN INTERNATIONAL MARKETING. Second term. Credit three hours. Mr. Rathmell.

480. MARKETING STRATEGY. Second term. Credit three hours. Mr. Rathmell.

481. SEMINAR IN MARKETING THEORY. First term. Credit three hours. Mr. Udell.

* Required courses for MBA and/or MPA candidates.

Production

*127. PRODUCTION. Second term (ten weeks). Credit two hours. Mr. Hausman.

525. PROBLEMS AND TECHNIQUES IN PRODUCTION MANAGEMENT. First term. Credit three hours. Mr. Hausman.

526. CASE STUDIES IN PRODUCTION AND OPERATIONS. Second term. Credit three hours. Mr. Hausman.

Quantitative Analysis

*123. QUANTITATIVE METHODS FOR MANAGEMENT I. First term. Credit three hours. Messrs. Smidt and Dyckman.

402. QUANTITATIVE APPROACHES TO MANAGEMENT DECISIONS. Second term. Credit three hours.

456. QUANTITATIVE METHODS FOR MANAGEMENT II. Second term. Credit three hours. Mr. Dyckman.

601. INTRODUCTION TO STATISTICAL THEORY (Industrial Engineering 9470). Second term. Credit four hours.

602. OPERATIONS RESEARCH I (Industrial Engineering 9522). Second term. Credit three hours.

604. OPERATIONS RESEARCH II (Industrial Engineering 9523). First term. Credit three hours.

605. DATA PROCESSING SYSTEMS (Industrial Engineering 9582). First term. Credit four hours.

901. DATA PROCESSING SYSTEMS (Computer Science 431). Second term. Credit three hours. Mr. Conway.

Development and Public Administration

551. AMERICAN OPERATIONS ABROAD. First term. Credit three hours. Mr. Bent.

561. SEMINAR IN CONTEMPORARY NATIONALISM (Government 545). First term. Credit four hours. Mr. Ashford.

661. SEMINAR IN THE DEVELOPMENT PROCESS IN NEW NATIONS. First term. Credit four hours. Mr. Ashford.

662. SEMINAR IN ADMINISTRATIVE PROBLEMS OF DEVELOPING NATIONS. Second term. Credit three hours. Mr. Ashford.

Research

905. SEMINAR IN RESEARCH METHODS. Second term. Credit three hours. Messrs. Lodahl and Dyckman.

* Required courses for MBA and/or MPA candidates.

Child Development and Family Relationships

Faculty: Helen T. McMullen Bayer, W. Lambert Brittain, Urie Bronfenbrenner, Robert H. Dalton, Edward C. Devereux, Jr., John Doris, Harold Feldman, Mary Ford, Herbert Ginsburg, John S. Harding, Laurel Hodgden, Harry Levin, Margaret Parkman, Henry N. Ricciuti, Aletha Stein, George J. Suci.

Field Representative: John Doris, Martha Van Rensselaer Hall.

APPROPRIATE MAJOR SUBJECT	APPROPRIATE MINOR SUBJECTS
Child Development and Family Relationships	Child Development Family Relationships

Applicants resident in the United States during the year before entering Graduate School are required to submit their scores on the Graduate Record Examination Aptitude Test when applying for admission.

There is no language requirement for the Master's degree. The language requirement for the Ph.D. consists of reading proficiency in one foreign language, either French, German, Russian, or Spanish. Another language may be substituted for one of the preceding only if in the unanimous opinion of the student's Special Committee, it is an appropriate choice for that student's particular course of studies. A student whose native language is other than English will be exempt from the language requirement.

The graduate program is concerned primarily with the preparation of students for careers in research and college teaching dealing with the scientific study of children and families. All students are expected to acquire a basic background in the behavioral sciences, and to master a broad base of knowledge of human development and of the family as a social system. Individual programs can be planned so as to provide for major concentration in the study of child development, the family, or child and family psychopathology.

A substantial number of research projects conducted by faculty members in the Field provide varied research experiences for graduate students either as research assistants or through participation in research practice which are an integral part of the academic program. Some of the areas of special interest represented in our department and among the associated faculty members are as follows:

Cognitive development: Professors Ginsburg, Levin, Ricciuti, Suci.
Creativity: Professor Brittain.
Family Interaction: Professors Bayer, Devereux, Feldman, and Parkman.
Infancy: Professors Doris and Ricciuti.
Language development: Professors Levin and Suci.
Nursery School education: Professors Hodgden and Ford.
Personality development: Professors Bronfenbrenner, Dalton, Hodgden, and Stein.
Child and Family Psychopathology: Professors Devereux, Doris, Dalton, Ford, Ricciuti, and Stein.
Social behavior: Professors Bronfenbrenner, Harding, and Stein.

Masters' degree programs ordinarily require one and one-half to two years for completion; Ph.D. programs about four years. Students with relatively little preparation in the behavioral sciences should plan on additional time to complete degree requirements. Admission to graduate study is based primarily on evidence of the student's competence to do advanced work in a research-and-theory-oriented program, and on broad preparation as a basis for specialization. Both the Master's and Ph.D. degrees require the completion of a

research thesis. All degree candidates must develop some competence in statistical methods, usually by taking one or more appropriate courses.

Approximately 22 teaching and research assistantships are ordinarily available, along with nine National Institute of Mental Health Traineeships and one National Science Foundation Traineeship.

For further details concerning graduate work in the Field, write to the Department of Child Development and Family Relationships for the brochure *Graduate Training in the Scientific Study of Children and Families.* Since the subject matter in Child Development and Family Relationships draws on several major disciplines, students are encouraged to supplement their work in the Field with studies in related Fields. For courses in these related disciplines, see the appropriate Field listings in this Announcement.

COURSES

414 (315). SEMINAR IN LANGUAGE DEVELOPMENT

Fall. Credit three hours. Open to juniors, seniors, and graduate students. Mr. Levin. Hours to be arranged.

The development of language during infancy and early childhood will be considered. The topics to be covered include theories of acquisition of language, the learning of sounds, grammar, meanings, and pathologies which involve language.

416 (317). SOCIAL AND PERSONALITY DEVELOPMENT IN CHILDHOOD

Spring. Credit three hours. Prerequisite, C.D. & F.R. 115 and 360 or equivalents. Mr. Ginsberg. M W F 12. Room 117.

An examination of selected topics in the area of personality development and social behavior of the child. Emphasis will be on the experimental and observational approaches to these problems. Some topics which will be considered are: dependency, imitation, social reinforcement; cooperation and competition; achievement; small groups; and person-perception.

500 (403). SPECIAL PROBLEMS FOR GRADUATE STUDENTS

Fall and spring. Credit and hours to be arranged. Department faculty. For graduate students recommended by their chairmen and approved by the head of the department and the instructor in charge for independent, advanced work.

504–505 (404–405). RESEARCH PROBLEMS AND METHODS IN CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS

Fall and spring. Credit three hours each semester. Mr. Harding and Mrs. Parkman. Th 1:30–4. Fall, Room 124. Spring, Room G-106.

504. Fall. Prerequisite, one course in statistics which may be taken concurrently.

The focus will be on methods of data collection including basic considerations in the evaluation, selection, and development of techniques useful in research.

505. Spring. Prerequisite, a course in statistics covering analysis of variance (ordinarily a second course in statistics) which may be taken concurrently.

The focus will be on problems of research design and analysis. The goal is to enable students to make critical evaluation of published research reports and to design sound studies of their own. Included will be discussions of factor analysis and analysis of variance designs with more than one criterion of classification, the relative power of statistical tests of significance made with quantitative variables and categorical variables, the problems of estimating size of sample needed, and the problem of multiple comparisons.

Though the two semesters are integrated, neither is a prerequisite for the other.

514 (414). CLINICAL DEVIATIONS IN INTELLECTUAL AND SENSORY-MOTOR DEVELOPMENT

Spring. Credit three hours. Mr. Doris. W 9–12. Room 124.

Designed to acquaint students with the clinical and research literature on mental retardation, cerebral palsy, and sensory defects. Attention will be focused upon research problems in the etiology, diagnosis, and treatment of these disorders.

517 (417). SEMINAR IN NURSERY SCHOOL PROCEDURES

Fall. Credit three hours. Hours to be arranged. Miss Margosian.

Exploration of research relative to the nursery school, study of methods of working with parents and supervision of students and administrative procedures in the nursery school.

522 (422). SEMINAR IN PIAGET

Fall. Credit three hours. Admission by permission of the instructor. Mr. Ginsburg. T 2–4:30. Room 124.

A critical review and evaluation of selected aspects of Piaget's work on cognitive development. Relevant research and theory by workers other than Piaget will be considered.

523 (423). SEMINAR IN COGNITIVE PROCESSES

Fall. Credit four hours. Admission by permission of the instructor. Mr. Suci. M W F 9. Room 124. Discussion, F 10.

Introduction to problems in cognition at the graduate level. The discussion will explore in detail some of the issues raised in the lecture material and will provide time for presentation of reports and critical reviews of selected literature by graduate students.

[532 (432). RESEARCH PRACTICUM: ADULT-CHILD INTERACTION IN INDIVIDUAL AND GROUP SETTINGS]

Fall. Credit three hours. Admission by permission of the instructor. Hours to be arranged.

Opportunities are available for a limited number of graduate students to observe and carry through some familiar research techniques, such as doll play, with individual subjects and to conduct experimental procedures in children's groups. In addition the student gains experience in interacting with children in free play in the laboratory nursery school.

The purpose is for the student to gain supervised experience in the techniques involved in establishing rapport, eliciting and evaluating information, and dealing with individual differences among children in standardized situations. Not offered in 1966–67.

560A (460A). SEMINAR IN PSYCHODYNAMICS: NORMAL AND PSYCHOPATHOLOGICAL

Fall. Credit three hours. Mr. Dalton. Th 10–12:30. Room 124.

Primary emphasis will be upon theory and empirical findings with respect to normal personality development and functioning.

560B (460B). SEMINAR IN PSYCHODYNAMICS: NORMAL AND PSYCHOPATHOLOGICAL

Spring. Credit three hours. Mrs. Stein. Th 10–12:30. Room 124.

Primary emphasis will be upon theory and empirical findings with respect to the origin, functioning, and treatment of psychopathological personalities.

568 (468). SOCIOLOGICAL FACTORS IN PSYCHOPATHOLOGY

Fall. Credit three hours. Admission by permission of instructor. Mr. Devereux. Th 2–4:30. Room 3-M-11.

This seminar will explore the research literature which deals with various sociological factors in the family, the community, the institution, and the broader society which are relevant for an understanding of the courses and treatments of deviant behavior and pathological personality organizations.

574. SEMINAR ON INFANT BEHAVIOR AND DEVELOPMENT

Fall. Credit three hours. Mr. Ricciuti. F 1–3:30. Room 3-M-11.

The seminar will deal with selected topics of current importance as research issues in the field of infant behavior and development. While principal emphasis will be on studies of human infancy, relevant ethological and comparative literature will also be considered. In 1966–67 major focus will be on the nature and stimulus determinants of affective responses in the first two years of life. The work of the seminar will be oriented primarily towards formulation of empirical research questions and strategies.

599 (407). MASTER'S THESIS AND RESEARCH

Fall and spring. Credit hours to be arranged. Registration with permission of the instructor. Miss Ford, Mrs. Hodgden, Mrs. Stein, Mrs. Parkman; Messrs. Brittain, Bronfenbrenner, Dalton, Devereux, Doris, Feldman, Ginsburg, Harding, Levin, Ricciuti, and Suci.

606 (406). RESEARCH PRACTICUM: FAMILY STRUCTURE AND PERSONALITY DEVELOPMENT

Spring. Credit three hours. Messrs. Bronfenbrenner, Devereux, Rodgers, and Suci. W 1:30–4. Room 225, M.V.R. Annex.

A practicum utilizing the resources of an on-going program of research. Members of the seminar participate in design, critical analysis, and execution of research studies. May be taken more than once for credit.

611 (411). EVALUATION PRACTICUM: STUDY OF THE INDIVIDUAL PERSONALITY, DEVIANT AND NORMAL

Spring. Credit three hours. Admission by permission of the instructors. Prerequisites, C.D. & F.R. 613, 560A and B or equivalents. Messrs. Doris, Ricciuti and Mrs. Stein. T 2–4 and additional hours to be arranged. Room 124.

Provides experience in the description and evaluation of the psychological function of individual children, both deviant and normal, in the context of relevant social and familial factors. Involves selection and utilization of a variety of testing, interviewing, and observational techniques for obtaining

most relevant data; evaluation and interpretation of such data in order to arrive at a fuller understanding of the child's behavior, and in the case of deviant children, to identify and appraise the nature of the clinical problem.

613 (413). INDIVIDUAL INTELLIGENCE TEST PROCEDURES

Fall. Credit four hours. Admission by permission of the instructor. Mr. Doris. W 1–4. Additional hours for testing and supervision to be arranged. Room 301.

The primary purpose of this course is to prepare a student for participation in C.D. & F.R. 611, and it is a prerequisite for that practicum. The student is introduced to the literature on intelligence testing dealing with the construction, reliability, and validity of individual test instruments and with the historical development of the concept of intelligence as this relates to techniques and problems of measurement. Problems of test administration and interpretation in the clinical use of test instruments are emphasized, and the student is required to administer both the Stanford-Binet and the WISC to a number of children.

615 (415). SEMINAR IN THE DEVELOPMENT OF HUMAN BEHAVIOR

Fall. Credit three hours. Mr. Bronfenbrenner. M W F 11. Bailey Hall. W 2:30–4:30.

An introduction to theory and research in developmental psychology at the graduate level. The seminar utilizes the lecture and reading of C.D. & F.R. 115 as a basis for supplementary reading and content discussion of central issues in contemporary developmental psychology.

620 (420). RESEARCH PRACTICUM: EXPERIMENTAL STUDIES OF CHILD BEHAVIOR

Spring. Credit three hours. Permission of the instructor required. Mr. Levin. Hours to be arranged.

Advanced graduate students will design and carry out laboratory-type experiments. The practicum is offered in relation to an on-going research program and will concern children's language and verbal learning.

623. ADVANCED SEMINAR IN COGNITIVE PROCESSES

Spring. Credit three hours. Prerequisite, C.D. & F.R. 523. Mr. Suci. T 10–12. Room 124.

The student will explore in depth a problem of his own choosing. The problem should be selected in the previous semester while attending C.D. & F.R. 523. The semester's work should lead to a research design aimed at filling some gap in our knowledge about cognition and/or at some methodological problem in cognitive research.

662 (462). SEMINAR IN THE FAMILY AND SOCIETY

Spring. Credit four hours. Mr. Devereux. M W F 11. An additional meeting to be arranged. Graduate section of C.D. & F.R. 162.

In addition to covering the lectures and readings of that course, students will do additional readings, meet as a separate group for discussion, and prepare a term paper.

663. SEMINAR ON EXPERIMENTAL STUDY OF THE FAMILY

Spring. Credit three hours. Admission by permission of the instructor. Mrs. Parkman. Hours to be arranged.

This course focuses on observational studies of interpersonal relations in the family. It is both a reading course, including an examination of relevant

social psychological theories — small group theory, balance theory and exchange theory — and a methodological course. Detailed attention will be given to the development of new methods of observation of family interaction, particularly the systematization of dinner hour observations.

699 (407). DOCTOR'S THESIS AND RESEARCH

Fall and spring. Credit hours to be arranged. Registration with permission of the instructor. Miss Ford, Mrs. Hodgden, Mrs. Stein, Mrs. Parkman, Messrs. Brittain, Bronfenbrenner, Dalton, Devereux, Doris, Feldman, Ginsburg, Harding, Levin, Ricciuti, and Suci.

City and Regional Planning

(Please see pages 59–70).

Economics

Faculty: George P. Adams, Jr., Nai-Ruenn Chen, M. Gardner Clark, Tom E. Davis, Melvin G. de Chazeau, Douglas F. Dowd, W. Duane Evans, Louis M. Falkson, John C. H. Fei, Frank H. Golay, George H. Hildebrand, John G. B. Hutchins, Alfred E. Kahn, Robert W. Kilpatrick, Ta-Chung Liu, Chandler Morse, Paul M. O'Leary, Richard T. Selden, George J. Staller, Bernt P. Stigum, Jaroslav Vanek.

Visiting Professors: Alpha Chiang, Professor of Economics, University of Connecticut; Walter Galenson, Professor of Economics, University of California (Berkeley).

Field Representative: Richard T. Selden, 263 Goldwin Smith Hall.

All subjects listed below may be taken as majors or minors:

Econometrics and Economic Statistics	Industrial Organization and Control
Economic Development and Planning	International Economics
Economic History	Labor Economics
Economic Theory	Monetary and Financial Economics
History of Economic Thought	Public Finance and Fiscal Policy

All candidates resident in the United States during the year preceding matriculation at Cornell must take the Graduate Record Examination Aptitude Test. There are no fixed admission requirements. However, grades, class standing, GRE scores, and letters of recommendation, considered collectively, must indicate superior scholastic ability and motivation.

A Program on Comparative Economic Development has been established in the Department to do research on developing economies, using a combination of theoretical, historical, quantitative, and institutional approaches. Assistantships and opportunities for field work will be available to qualified graduate students. Further information may be obtained by writing to the Director of the Program on Comparative Economic Development, the Department of Economics.

Students majoring in this Field should consult the descriptions in this Announcement of the Fields of Agricultural Economics, Business and Public Administration, and Industrial and Labor Relations for other subjects related to the work in economics.

In addition to their major and two minors, doctoral candidates will be required to demonstrate competence in economic theory, its history, and its

methodology, the latter including economic statistics, social accounting, and (except when the major adviser explicitly approves an exemption) mathematical economics. A student who elects as a major or minor any of these required subjects must broaden his program by taking work in "outside subjects" approved by his Special Committee.

All candidates for advanced degrees who elect a minor in economics will be held for work in economic theory and its history.

Candidates for the Ph.D. degree with a major in Economics are encouraged to elect one minor subject in another Field.

Applications for fellowships and scholarships in Economics should be filed with the Dean of the Graduate School prior to the deadline date (see Calendar). Applications for teaching assistantships, however, should be made directly to the Chairman of the Department of Economics.

The Field of Economics requires that every graduate student possess a professionally usable reading or speaking command of at least one language in addition to his native language.

Within his first year of residence each Ph.D. candidate in the Field of Economics must pass an oral qualifying examination administered by his Special Committee. The purpose of the qualifying examination is to determine the student's qualification to pursue all aspects of a Ph.D. program. A member of the Special Committee who is satisfied with the student's qualifications in the subject which the member represents may pass him in that subject without formal testing. On the basis of the qualifying examination the Special Committee will work out with the student his graduate program.

FACULTY SPECIALIZATIONS

Evans, Liu, Stigum, Chiang: econometrics and economic statistics.

Clark, Staller, Davis, Golay, Morse, Fei, Vanek: economic development and planning.

Dowd, Hutchins: economic history.

Adams, Falkson, Fei, Hildebrand, Selden, Stigum, Vanek, Chiang: economic theory.

Adams, Hildebrand, Sowell: history of economic thought.

de Chazeau, Kahn, O'Leary: industrial organization.

Staller, Vanek, Davis, Golay, Morse: international economics.

Hildebrand, Galenson, Sowell: labor economics.

Selden, Davis, La Pittus, O'Leary: monetary and financial economics.

Kilpatrick, O'Leary: public finance and fiscal policy.

GRADUATE COURSES AND SEMINARS

The following course listings are tentative, intended for the student's information. The Department's office should be contacted for definite course offerings, times, places, etc.

SEMINAR IN THE WELFARE ECONOMICS OF HEALTH SERVICES (Business and Public Administration 452)

Spring term. Credit three hours. Prerequisite, consent of the instructor. Hours to be arranged. Mr. Berki.

511. PRICE AND ALLOCATION THEORY

Fall term. Credit four hours. Prerequisite, consent of the instructor. Hours to be arranged. Messrs. Chiang and Hildebrand.

Theories of utility, demand, production, and pricing, with special emphasis on recent developments.

512. MACROECONOMIC THEORY
Spring term. Credit four hours. Prerequisite, consent of the instructor. Hours to be arranged. Messrs. Selden and Vanek.

Analysis of the determination of national income, the price level, and economic growth.

521–522. EUROPEAN ECONOMIC HISTORY
Throughout the year. Credit four hours a term. Hours to be arranged. Mr. Dill.

523–524. AMERICAN ECONOMIC HISTORY
Throughout the year. Credit four hours a term. Hours to be arranged. Mr. Fleisig.

561–562. INTERNATIONAL ECONOMIC THEORY AND POLICY
Throughout the year. Credit four hours a term. Hours to be arranged. Messrs. von Furstenberg and La Pittus.

565. ECONOMIC PROBLEMS OF LATIN AMERICA
Spring term. Credit four hours. Hours to be arranged. Mr. Davis.

571–572. ECONOMIC GROWTH AND DEVELOPMENT
Throughout the year. Credit four hours a term. Hours to be arranged. Messrs. Golay and Morse.

610. ADVANCED MICROECONOMIC THEORY
Spring term. Mr. Chiang.

612. ADVANCED MACROECONOMIC THEORY
Fall term. Mr. Vanek.

613–614. HISTORY OF ECONOMIC THOUGHT
Throughout the year. M 2–4. Mr. Adams.

[615. BUSINESS CYCLES AND GROWTH]
Fall term. Mr. Selden. Not offered in 1966–67.

616. INTERMEDIATE MATHEMATICAL ECONOMICS
Spring term. M W 2–3:15. Mr. Evans.

617–618. MATHEMATICAL ECONOMICS
Throughout the year. Mr. Stigum.

619–620. ECONOMETRICS
Throughout the year. Mr. Stigum.

SEMINAR IN ECONOMIC STATISTICS (Industrial and Labor Relations 610)
Fall term. Mr. Evans.

[621–622. EUROPEAN ECONOMIC HISTORY]
Throughout the year. Mr. Dowd. Not offered in 1966–67.

[623. AMERICAN ECONOMIC HISTORY]
Fall term. Mr. Fleisig. Not offered in 1966–67.

631–632. MONETARY THEORY AND POLICY
Throughout the year. Messrs. Selden and La Pittus.

634. FINANCIAL THEORY, HISTORY, AND POLICY
Spring term. Th 2–4. Mr. O'Leary.

635–636. PUBLIC FINANCE: THEORY AND POLICY
Throughout the year. Messrs. Kilpatrick and von Furstenberg.

637–638. ECONOMICS OF WATER RESOURCE DEVELOPMENT
Throughout the year. Mr. Falkson.

639–640. WATER RESOURCE PLANNING
Throughout the year. Mr. Falkson.

641–642. LABOR ECONOMICS
Throughout the year. Messrs. Galenson and Hildebrand.

651–652. INDUSTRIAL ORGANIZATION AND REGULATION
Throughout the year. Mr. Kahn. Offered only in fall term, 1966–67.

[661–662. INTERNATIONAL ECONOMICS]
Throughout the year. Mr. Vanek. Not offered in 1966–67.

663–664. ADVANCED INTERNATIONAL ECONOMICS
Throughout the year. Mr. Vanek.

671–672. ECONOMICS OF DEVELOPMENT
Throughout the year. Messrs. Golay and Morse.

673–674. ECONOMIC PLANNING
Throughout the year. Mr. Staller. Offered only in spring term, 1966–67.

675. ECONOMIC GROWTH MODELS
Fall term. Mr. Fei.

676. THE ECONOMY OF CHINA
Spring term. Instructor to be announced.

[678. ECONOMIC GROWTH IN SOUTHEAST ASIA]
Spring term. Mr. Golay. Not offered in 1966–67.

679. THEORY OF ECONOMIC DEVELOPMENT
Spring term. Prerequisite, Economics 675. Mr. Fei.

Education

Faculty: Howard G. Andrus, Joe P. Bail, Sara E. Blackwell, Matthew H. Bruce, Jr., Robert L. Bruce, Ralph N. Campbell, Harold R. Cushman, Stanley W. Davis, Robert E. Doherty, William E. Drake, Arthur E. Durfee, Joan R. Egner, Robert H. Ennis, Jean Failing, Richard B. Fischer, Felician F. Foltman, Harrison A. Geiselmann, Marvin D. Glock, D. Bob Gowin, Charles W. Hill, Lawrence B. Hixon, Mauritz Johnson, Jr., Philip G. Johnson, J. Paul Leagans, Harry Levin, Stanley R. Levy, William T. Lowe, Donald J. McCarty, George W. McConkie, Jason Millman, A. Gordon Nelson, Helen Y. Nelson, Walter J. Pauk, Isabel J. Peard, Kathleen Rhodes, Richard E. Ripple, Verne N. Rockcastle, Frederick H. Stutz, Wayne E. Thompson, Frederick K. T. Tom, Helen L. Wardeberg.

Field Representative: Charles W. Hill, 100 Stone Hall.

APPROPRIATE MAJOR SUBJECTS

Agricultural Education
Curriculum and Instruction
Development of Human Resources
Educational Administration and Supervision
Educational Psychology and Measurement
Extension and Adult Education
Guidance and Student Personnel Administration
History, Philosophy, and Sociology of Education
Home Economics Education
Science and Nature Education

APPROPRIATE MINOR SUBJECTS

Agricultural Education
Curriculum and Instruction
Development of Human Resources
Education
Educational Administration and Supervision
Educational Psychology and Measurement
Extension and Adult Education
Guidance and Student Personnel Administration
History, Philosophy, and Sociology of Education
Home Economics Education
Science and Nature Education

The Graduate Field of Education is engaged in both the study of education and the preparation of professional practitioners. Its concern includes educational aims, objectives, learning theory, curriculum, instruction, educational organization, and administration.

ENTRANCE REQUIREMENTS. All applicants for candidacy to advanced degrees with majors in education — M.A., M.S., M.A.T., Ed.D., Ph.D. — residing in the United States or Canada, whose native language is English, are required to submit a score from the Miller Analogies Test and/or Graduate Record Examination (the Aptitude Test) before admission to candidacy. This applies to both the general and professional degrees. An applicant who needs information concerning the location of a center where he may conveniently go for testing should write to the Field Representative in Education, Stone Hall.

LANGUAGE REQUIREMENT. In the Field of Education, a candidate for the degree of Ph.D. must demonstrate reading ability in one language (in addition to his native language) selected in consultation with the chairman of the candidate's Special Committee.

GRADUATE DEGREES. Students majoring in the Field of Education may be admitted to candidacy for either of two types of advanced degree. Requirements for the *general degrees* of M.A., M.S., and Ph.D., administered by the Graduate School, are stated in this Announcement as are requirements for the professional degrees administered by the Field of Education of the Graduate School. (See also pages 458–459 of this Announcement.

PROFESSIONAL DEGREES

Advanced professional degrees in education are designed as preparation for the professions in education. The admissions processes, requirements, and curricula for such degrees, as approved by the Graduate Faculty, are announced and administered by the faculty of the School of Education, acting as a Field of the Graduate School. Degrees are awarded upon recommendation of the School of Education to the Graduate Faculty. Two professional degrees, Master of Arts in Teaching and Doctor of Education, are awarded.

It is the responsibility of the candidate to become familiar with the various regulations which apply to his degree candidacy and to satisfy them in the proper manner. Most of the regulations are contained in the *Code of Legislation of the Graduate Faculty, Cornell University;* they are supplemented in the *Announcement of the School of Education.*

RESIDENCE. Each candidate for an advanced degree is expected to complete his residence with reasonable continuity. Under any circumstances, a candidate who fails to register during any period of four or more years may continue only after the General Committee of the Graduate School has stipulated the amount of additional residence to be required. The Committee will be guided in its decision by an estimate, written by the candidate's Special Committee, of the period of study necessary to recover lost ground. A candidate must complete all requirements for a Master's degree within seven years, and for a doctoral degree within ten years of the time of first registration in the Graduate School.

Residence credit earned during candidacy for professional Master's degrees at Cornell or elsewhere may be transferred toward meeting the residence requirements for a doctoral degree in an amount not exceeding two units. The amount transferable is dependent upon an evaluation of the candidate's program and the manner in which the residence was earned.

The Degree of Master of Arts in Teaching (M.A.T.)

The degree of Master of Arts in Teaching (M.A.T.) is designed for those with a baccalaureate degree, planning to undertake professional preparation in the fifth year. Teaching fields for this degree include agriculture, English, French, German, home economics, Latin, mathematics, Russian, the sciences, history and social sciences, Spanish, and speech in the secondary schools, and grades 1–6 of the elementary schools.

ADMISSION TO CANDIDACY. Applicants must have considerable depth of preparation in their intended teaching field and give evidence of ability necessary for successful progress in graduate study. They also must give evidence of a serious career interest in teaching.

RESIDENCE. A minimum of two regular semesters and one summer of full-time study or two and two-fifths residence units is required. Residence units may be earned as follows:

1. Regular terms of full-time or part-time registration during the academic year.
2. Summer registration.
3. Extramural registration. (Not more than one unit of residence earned extramurally may be counted.)

Full-time study will be required in all but exceptional cases.

SPECIAL COMMITTEE. A candidate will select a Special Committee of two or more members of the Graduate Faculty, one of whom will represent the

Field of Education and serve as chairman. The chairman normally will belong to one of the teacher preparation specializations. Other members of the Committee are to be selected with the advice of the chairman to give adequate representation of the candidate's program. For a candidate preparing for secondary school teaching, the teaching field will be represented.

PROGRAM OF STUDIES. The program will be determined by the candidate and his Special Committee. It will include those courses, seminars, and other experiences in the professional area and in the teaching field or fields which are deemed most appropriate for developing competence as a teacher. Each candidate will be required to demonstrate teaching skill in a supervised field experience.

FINAL EXAMINATION. A candidate must pass a final examination conducted by the Special Committee. The examination may be written or oral or both. It shall be comprehensive in nature and designed to evaluate the candidate's knowledge in the teaching field as well as in the theory and practice of teaching.

The Degree of Doctor of Education (Ed.D.)

Programs for this degree are designed to prepare the candidate for positions of leadership in the educational profession. Positions for which such preparation is available are administrator, coordinator, curriculum specialist, extension specialist, student services specialist, supervisor, and teacher.

ADMISSION TO CANDIDACY. Applicants must have completed a minimum of three years of successful experience appropriate to their proposed field of professional service. They also must show evidence, based on previous training, of scholastic ability and other qualifications necessary for successful progress in graduate study, field experience, and professional work.

RESIDENCE. A minimum of five units of residence is required beyond the Bachelor's degree, of which at least three units must be earned in residence at Cornell. Two units of residence beyond the Master's degree or its equivalent must be earned at Cornell in regular terms, consecutive except on petition.

The maximum number of residence units which may be earned through Extramural registration or in Summer Sessions at Cornell or in similar manner at other centers of graduate study is two.

In addition to meeting residence requirements, a candidate must complete successfully one year of participation in Directed Field Experience as described in subsequent statements.

PROGRAM OF STUDIES. The program of studies, designed to develop competence in a field of professional service and in the general field of professional education, must include a minimum of sixty-five credit hours in courses and seminars beyond the Bachelors' degree, of which thirty-five hours shall be completed beyond the Master's degree or its equivalent.

The program must include advanced work in each of these subjects: educational psychology, history and philosophy of education, educational measurement and statistics, and research in education. At least fifteen hours of credit must be earned in courses other than those in professional education.

The transfer of credit earned in institutions other than Cornell University must be recommended by the Special Committee and approved by the Dean of the Graduate School.

DIRECTED FIELD EXPERIENCE. In keeping with the primary emphasis in the program for the Ed.D. degree, a minimum of two consecutive academic

terms of full-time experience appropriate to the candidate's field of professional service is required. This period of participation, known as Directed Field Experience, will follow completion of a minimum of two units of residence at Cornell beyond the Master's degree or its equivalent.

The opportunity for the Field Experience is to be sought by the candidate with the advice and assistance of the Special Committee. The proposed plan for experience must be approved by the Committee. The opportunity sought must afford those practical experiences which the candidate and his Committee have identified to be needed in acquiring competence in the field of professional service for which the degree program has been designed.

Successful completion of the Directed Field Experience is prerequisite to recommendation of the candidate for the degree.

THESIS. The candidate is required to present a thesis which will give evidence of his ability to apply knowledge to a professional problem. The thesis must satisfy the Special Committee in respect to both professional proficiency and literary quality.

EXAMINATIONS. Two examinations are required for the degree in addition to the entrance examination required of all candidates. These are (1) a qualifying examination and (2) a final examination. Although other members of the faculty may be invited to participate in these examinations, the Special Committee alone decides whether the candidate has passed or failed.

QUALIFYING EXAMINATION. This examination is both written and oral and is given before or during the third unit of residence. It has the double purpose of determining the ability of the candidate to pursue further studies and of allowing the Special Committee and the candidate to plan a satisfactory program for completion of candidacy.

FINAL EXAMINATION. The candidate is required to pass a final examination given by the Special Committee and other members of the faculty who may be invited to attend. The examination must be given in two parts — one part on the field of professional service and core studies in education (Examination A), which may be taken at the end of the fourth unit of residence; the second part on the thesis (Examination B), is taken after the thesis is approved by the Special Committee. Examination A may be written or oral or both. Examination A and B may precede or follow the period of Directed Field Experience.

The differences between the general degree programs and those of the professional degrees relate to the manner of meeting residence requirements, the emphasis on research, the specification of hours of credit required, the selection of major and minor subjects, the program of studies, and language requirements.

THE SUBJECTS IN EDUCATION

The Field of Education includes several subjects. The information below briefly presents the professional opportunities, areas of study and research, and the courses for each subject.

Educational Administration and Supervision

Mrs. Joan R. Egner, Lawrence B. Hixon, Donald J. McCarty, Miss Helen L. Wardeberg.

For a major in this subject, the candidate must (1) demonstrate proficiency

in the following areas of knowledge: (a) theoretical concepts of administration and supervision, (b) understanding of the basic disciplines undergirding the relationships between individuals and groups within an organization and between organizations, (c) identification and conduct of research in educational administration, (d) environmental factors which influence the educational enterprise; and (2) have had a field experience in the functional areas of educational administration, e.g., school finance, school law, school personnel, and the like. Research interests of members of the Division include statistical models of conformity deviance, educational leadership, and environmental influences on organizational behavior.

R.E. 561. THEORY AND PRACTICE OF ADMINISTRATION

Fall term. Credit three hours. Mr. McCarty.

The goal is to give the student understanding and practice in the use of behavioral science concepts for analyzing human behavior in formal organizations. Students will be required to apply course concepts to the analysis and discussion of cases. The course provides explicit instruction and practice in defining administrative problems, evaluating various kinds of evidence, exploring possible courses of action, making definite decisions, and setting forth programs of action to implement these decisions.

R.E. 562. THE SECONDARY SCHOOL PRINCIPALSHIP

Spring term. Credit three hours. Mr. Hixon.

Critical analysis of problems of the secondary school principalship as related to function of the secondary school, its curriculum appraisal of teaching and learning, pupil characteristics, and patterns of organization of personnel and resources.

[R.E. 563. ELEMENTARY SCHOOL ADMINISTRATION]

Spring term. Credit three hours. Given in alternate years. Mrs. Egner. Not given in 1967–68.

Organized to enable recognition and cognition of the administrative functions essential to an effective elementary school. Analysis will include the elementary school as a unique institution, innovation in organization and curriculum, administration of instructional and non-instructional personnel, and community relationships.

R.E. 564. SCHOOL FINANCE AND FACILITIES

Spring term. Credit three hours. Prerequisite, R.E. 561 or equivalent. Mr. McCarty.

The role of the administrator in providing leadership in the provision and maintenance of funds and facilities. Marshaling personnel and material for school operation. Sources of school support. Estimation, interpretation, and management of expenditures. Planning, constructing, and financing a school building. Utilization, operation, and management of the school plant. Records, accounts, reports, and audits.

R.E. 565. EDUCATIONAL SUPERVISION

Spring term. Credit three hours. Miss Wardeberg.

A basic course in the nature and scope of supervision; fundamental principles and various procedures will be considered. Open to those already in supervisory positions, either in school work or elsewhere, and experienced persons aspiring to become supervisors.

Ed. 567. SCHOOL LAW FOR ADMINISTRATORS AND TEACHERS

Fall term. Credit three hours. Mr. Hixon.

A study of school law with particular emphasis on New York State legislation, court decisions, opinions, and regulations which affect the schools of the state.

R.E. 569. PERSONNEL ADMINISTRATION IN EDUCATIONAL INSTITUTIONS

Fall term. Credit three hours. Mrs. Egner.

Designed to provide an introduction to modern psychological and sociological perspectives of personnel administration. Three purposes are paramount: (1) to acquaint the student with a variety of ways of conceiving the problems of personnel administration, (2) to acquaint the student with relevant research, and (3) to develop some facility in the analysis of conceptual schemes and research projects.

R.E. 668. SEMINAR IN EDUCATIONAL ADMINISTRATION

Spring term. Credit three hours. Prerequisites, R.E. 561 or R.E. 569 or consent of instructor. Mr. McCarty.

Planned for advanced students in administration. Major emphasis to be placed on the analysis of administrative theory and research from business, public, hospital, and industrial, as well as educational administration.

Agricultural Education

Joe P. Bail, Harold R. Cushman, William E. Drake, Charles W. Hill, Frederick K. T. Tom.

Candidates for any advanced degree are expected to have extensive undergraduate preparation in agriculture. Teaching experience is desirable for all candidates and required for candidacy at the doctoral level.

The graduate program in agricultural education prepares the student for positions in teaching, research, supervision, and administration in public schools, technical schools, and colleges and universities. Graduates may also follow careers in state and federal educational agencies or in overseas educational programs.

Current research projects include the areas of curriculum, occupational work experience, adult education, job analysis and opportunities, learning systems, and teacher education.

R.E. 332. METHODS, MATERIALS, AND DIRECTED PRACTICE IN TEACHING AGRICULTURE IN THE SECONDARY SCHOOL

Fall term. Credit nine hours. Staff in agricultural education.

Directed participation in off-campus centers in the specific and related problems of teaching agriculture on the junior and senior high school levels which includes adjustment in the school and community, evaluation of area resources, materials of instruction, and school facilities; organization and development of local courses of study; launching and directing supervised farming programs; planning for and teaching all-day classes; advising Future Farmers chapters; and other problems relating to development of a balanced program for vocational education in agriculture in a local area.

R.E. 433. SPECIAL PROBLEMS IN AGRICULTURAL EDUCATION

Fall or spring term. Credit one or two hours. Graduate and undergraduate. Mr. Bail and staff.

The purpose is to provide students an opportunity to study individually or as a group selected problems in agricultural education to meet the particular needs of the students.

R.E. 434. ORGANIZATION AND DIRECTION OF YOUNG FARMER PROGRAMS

Fall term. Credit three hours. Mr. Cushman.

Emphasis will be placed on solving the problems encountered by teachers of agriculture in such phases of the young farmer program as making arrangements to have a program, determining instructional needs and planning programs of instruction, teaching young farmers in groups, giving individual on-farm instruction, organizing and advising the local young farmer association, and evaluating the young farmer program.

R.E. 531. SUPERVISION IN AGRICULTURAL EDUCATION

Fall term. Credit two hours. Given in alternate years. Open to students with experience in teaching agriculture, or by permission. Mr. Bail.

The function of supervision, program planning, and supervisory techniques as applied to state programs in agricultural education.

R.E. 532. ADVANCED METHODS AND MATERIALS OF TEACHING AGRICULTURE

Fall term. Credit two or three hours. Mr. Tom.

Consideration is given to an analysis of selected teaching techniques and to the selection, preparation, and use of instructional materials in agriculture.

R.E. 533. PLANNING COURSES OF STUDY AND AGRICULTURAL EXPERIENCE PROGRAMS

Spring term. Credit three hours. Mr. Hill.

Guiding principles, objectives, and sources of information will be developed for planning the courses of study and teaching calendar. Consideration will be given to principles, meanings, and functions of agricultural experience programs and how they are planned, developed, and used as a means of instruction.

R.E. 534. EDUCATION FOR LEADERSHIP OF YOUTH AND ADULT GROUPS

Fall term. Credit two hours. Mr. Cushman.

Designed for leaders in the field of agricultural education who are responsible for organizing programs. A consideration of the principles involved in organizing and conducting out-of-school programs for young and adult farmers.

[R.E. 535. PLANNING AND CONDUCTING PROGRAMS OF TEACHER PREPARATION IN AGRICULTURE]

Fall term. Credit two hours. Offered in alternate years. Mr. Hill. Not given in 1967–68.

Open to persons with teaching experience in agriculture who are preparing for or engaged in the preparation of teachers or in related educational service.

[R.E. 536. THE ORGANIZATION AND ADMINISTRATION OF AGRICULTURAL EDUCATION]

Spring term. Credit two hours. Given in alternate years. Mr. Cushman. Not given in 1967–68.

Designed for teachers, high school principals, teacher trainers, supervisors, and others who are responsible for the administration of agricultural programs or who wish to qualify for this responsibility. Emphasis will be placed on interpreting the vocational acts and on problems of administration at the local and state level.

R.E. 538. TEACHING GENERAL AGRICULTURE IN THE SECONDARY SCHOOL

Spring term. Credit two hours. Mr. Tom.

The organization, purpose, and content of courses in agriculture in junior and senior high schools to serve those who elect to study agriculture for its general educational values in preparation for rural living.

R.E. 539. EVALUATING PROGRAMS OF AGRICULTURAL EDUCATION

Spring term. Credit two hours. Given in alternate years. Open to students with experience in teaching agriculture or by permission. Mr. Drake.

Students will study objectives and evaluative criteria and develop criteria and procedures for evaluation of programs of agricultural education in the secondary schools.

R.E. 600. SEMINAR IN AGRICULTURAL EDUCATION

Spring term. Credit one hour. Mr. Tom.

Recommended for Masters' degree candidates who have had teaching experience and doctoral candidates with majors and minors in agricultural education. The seminar will be primarily centered in current problems and research in the field not included in other course work.

Curriculum and Instruction

Matthew H. Bruce, Jr., Harrison A. Geiselmann, Mauritz Johnson, Jr., Philip G. Johnson, William T. Lowe, Walter J. Pauk, Miss Isabel J. Peard, Verne N. Rockcastle, Miss Helen L. Wardeberg.

The Master of Arts in Teaching degree is offered for liberal arts graduates with appropriate disciplinary concentrations who desire supervised teaching practice and the related professional studies required for permanent certification as elementary school teachers or teachers of academic subjects at the secondary school level. The Master of Arts degree is intended for experienced teachers who seek advanced study in education and in their teaching fields. Doctoral candidates will find opportunities for research in scholarship, in teacher education, supervision and evaluation of teaching, instructional methodology and media, curriculum theory, and curriculum development in reading, social studies, mathematics, and the humanities. All degree programs include continuing work in academic disciplines in addition to professional study.

Ed. 440A. OBSERVATION AND STUDENT TEACHING

Fall or spring term. Credit six hours. Hours to be arranged. Mr. Lowe, Mrs. Greenberg, Mrs. Ocvirk, Mr. Pfaff and Mr. Teetor.

For students preparing to teach English, languages, mathematics, social studies, or speech in the secondary schools. (Prospective science teachers, see R.E. 429, Page 177). Opportunities to observe the work of experienced teachers and to do directed teaching in a secondary school are provided.

Seminars and student teaching conferences arranged with emphasis on discussion of teaching problems. Students should also enroll in the appropriate special methods course which follows.

Ed. 440E. TEACHING ENGLISH IN SECONDARY SCHOOLS

Fall and spring terms. Credit four hours. Hours to be arranged. Miss Peard and Mr. Novarr.

Taught jointly by the Department of English and the School of Education. Emphasis on the teaching of reading, writing, and language. Undergraduates accepted for the English-teaching program should register in the term immediately prior to that in which their practice teaching is scheduled; all others should see Miss Peard before registering.

Ed. 440L. TEACHING LANGUAGES IN SECONDARY SCHOOLS

Fall or spring term. Credit three hours. Hours to be arranged. Mr. Teetor.

Ed. 440M. TEACHING MATHEMATICS IN SECONDARY SCHOOLS

Fall term. Credit three hours. Hours to be arranged. Mrs. Greenberg.

Ed. 440S. TEACHING SOCIAL STUDIES IN SECONDARY SCHOOLS

Fall or spring term. Credit two or three hours. Mr. Lowe.

R.E. 444. SEMINAR IN THE TEACHING OF SECONDARY MATHEMATICS

Spring term. Credit three hours. Mr. Geiselmann.

Useful materials and practical methods for effective teaching of mathematics in the junior and senior high school. Attention will be given to research in mathematics education, and to recent proposals for curriculum revision. Special interests of the students will serve as a guide for the further selection of topics.

Ed. 445. TEACHING READING AND STUDY SKILLS IN SECONDARY SCHOOLS

Spring term. Limited to seniors and graduate students. Credit two or three hours. Mr. Pauk.

For teachers, administrators, guidance counselors, and supervisors. Pertinent research as well as the psychology and philosophy of developmental reading and study skills will be examined. Teaching methods and sample materials for classroom use will be demonstrated and discussed.

R.E. 447. JUNIOR HIGH SCHOOL EDUCATION

Fall and spring terms. Credit two or three hours. Limited to seniors and graduate students. Instructor to be appointed.

Examines educational programs for young adolescents in the light of the history, status, and philosophy of the junior high school. Includes guidance, articulation, exploration, general education programs such as block-time and core, and such recent developments as programed instruction and team teaching.

R.E. 540. THE ART OF TEACHING

Fall or spring term. Credit and hours arranged. Students may register only with consent of appropriate supervisor. Messrs. M. Bruce, Geiselmann, Lowe; Miss Peard and Miss Wardeberg.

For students enrolled in fifth-year teacher education programs. Students will be assigned to elementary and secondary schools for directed field experiences. Seminars will be scheduled concurrently.

R.E. 541. INTERNSHIP IN JUNIOR HIGH SCHOOL TEACHING

Fall or spring term. Credit six hours. R.E. 543 must be taken concurrently. Messrs. M. Bruce, Geiselmann, and Lowe.

Full time directed teaching experience in a public school throughout the school's fall or spring semester.

R.E. 542. SECONDARY EDUCATION IN THE UNITED STATES

Fall term. Credit three hours. Mr. M. Johnson. Prerequisite, courses in educational psychology and social foundations of education, or permission of instructor.

Historical background and theoretical considerations relating to curriculum and instruction in American secondary schools.

R.E. 543. SEMINAR IN JUNIOR HIGH SCHOOL TEACHING

Fall or spring terms. Credit two hours. Hours and places to be arranged. Messrs. M. Bruce, Geiselmann, M. Johnson, and Lowe.

Problems arising in the course of intern teaching will be discussed.

R.E. 545. THE CURRICULUM OF AMERICAN SCHOOLS

Fall term. Credit three hours. Limited to graduate students. Mr. Lowe.

A survey of the basic elements involved in making curriculum decisions, and an examination of contemporary curriculum developments in elementary and secondary schools.

R.E. 546. TEACHING READING AND LANGUAGE SKILLS

Fall term. Credit three hours. Miss Wardeberg.

Materials and techniques in teaching the language arts in the elementary school; special emphasis on the teaching of reading.

R.E. 547. SEMINAR IN ELEMENTARY EDUCATION

Fall and spring terms. Credit as arranged. Miss Wardeberg.

A problems seminar. For students enrolled in the Art of Teaching.

R.E. 645. SEMINAR IN CURRICULUM THEORY AND RESEARCH

Spring term. Credit three hours. Registration by permission of instructor. Mr. M. Johnson.

Educational Psychology and Measurement

Howard G. Andrus, Marvin D. Glock, Harry Levin, George W. McConkie, Jason Millman, A. Gordon Nelson, Richard E. Ripple.

Educational psychology is a behavioral science. Its concepts and principles comprise the body of knowledge relevant to the improvement of classroom learning. Many disciplines — including anthropology, child development, psychology, and sociology — contribute to educational psychology through their

research findings on the nature of growth and development, cognition, motivation, social interaction, and personality. Students who major in this subject may specialize in any of the traditional aspects of psychology as they apply to human behavior or statistics. Research in progress is in the field of human learning and literacy. Previous preparation in professional education or in psychology is not prerequisite. Any deficiencies must be satisfied during candidacy for the particular degree.

R.E. 411. EDUCATIONAL PSYCHOLOGY

Fall or spring term. Credit three hours. Prerequisite, an introductory course in psychology. Fall term limited to students in teaching programs, or, in exceptional cases, by special permission of the instructor. Spring term is organized for special block-time teacher preparation program. Special permission of the instructor is required for students not in this program. Mr. Glock.

Consideration of the outstanding facts and principles of psychology bearing upon classroom problems.

Ed. 411H. EDUCATIONAL PSYCHOLOGY

Fall or spring term. Credit three hours. Open only to selected undergraduate or graduate honors students. Permission must be granted by the professor in charge. Mr. Ripple and staff.

Through a program of independent study, reading, research activities, and seminars, the students will pursue study of human development, the learning process, motivation, retention and forgetting, transfer, higher mental process, personal-social organization, individual differences, the social psychology of the classroom, technological and other innovations, evaluation and measurement, and research methodology as these apply to the task of managing and organizing learning experiences for students so as to bring about desirable behavioral changes. Work may be arranged to satisfy state certification requirements.

R.E. 417. PSYCHOLOGY OF ADOLESCENCE

Spring term. Credit two hours. Freshmen and sophomores not admitted. Prerequisite, a course in general psychology. Mr. McConkie.

A survey of the nature of adolescent growth and development with emphasis on some of the causal factors pertaining to adolescent behavior.

R.E. 451. EDUCATIONAL MEASUREMENT

Spring term. Credit three hours. Permission of the instructor required. Mr. Millman. Not offered every year.

A study of the construction of achievement tests and the use of aptitude tests, achievement tests, and other measuring instruments in the classification and guidance of pupils and improvement of instruction.

R.E. 453. INTRODUCTION TO EDUCATIONAL STATISTICS

Fall and/or spring terms. Permission of instructor required. Credit three hours. Mr. Millman.

A study of common statistical procedures encountered in educational literature and research. Includes the computation and interpretation of descriptive measures and tests of significance.

R.E. 454. STATISTICAL INSTRUMENTS IN EDUCATION

Spring term. Credit three hours. Prerequisite, R.E. 453 or permission of the instructor. Mr. Millman. Not offered every year.

A study of the multiple regression, factor analysis, analysis of variance and covariance, and other statistical procedures useful in educational research.

R.E. 511. EDUCATIONAL PSYCHOLOGY

Fall term. Credit three hours. Permission of the instructor required. Mr. Glock.

A basic course in educational psychology for graduate students.

Ed. 555. USE AND INTERPRETATION OF TESTS IN GUIDANCE AND PERSONNEL ADMINISTRATION

Fall term. Credit three hours. Mr. Andrus.

Open to students in guidance or personnel administration and to classroom teachers who expect to work with standardized group tests. Deals with the historical development, use, and interpretation of aptitude tests as a basis for guidance and selection in public schools, colleges, and/or industry. Designed to meet the New York State certification for guidance counselors.

Ed. 614. SEMINAR IN THE BEHAVIORAL SCIENCE: BASES OF EDUCATIONAL RESEARCH

Fall term. Credit three hours. Mr. Levin.

Current issues in educational research will be treated in terms of related behavioral science theory and findings. For example, topics to be covered are classroom interaction and small group theory, science and mathematics curricula and cognitive development, reading research and language acquisition. Each student will present a research proposal.

Ed. 618. SEMINAR IN EDUCATIONAL PSYCHOLOGY

Fall and spring terms. Credit three hours. Mr. Ripple and staff.

Emphasis on theoretical considerations of various areas in educational psychology. Primarily for doctoral students.

See courses listed in psychology, child development and family relations, anthropology, sociology, and industrial and labor relations for related offerings.

Extension and Adult Education

Robert L. Bruce, Arthur E. Durfee, J. Paul Leagans.

The program leads to both the M.S. and Ph.D. degree. It is designed to prepare administrators, supervisors, trainers, and other specialists for leadership positions in extension and adult education and community development agencies. The central objective is to develop creative, professional leaders who can initiate, organize, and effectively execute such programs in different environments, both in the United State and abroad. The curriculum is interdisciplinary. Individual study plans are developed through personal counseling. Theory, technology, principles, and methodology central to the extension-adult education process are covered in divisional courses and seminars. Concepts gained from these studies form a nucleus around which students integrate study in a number of supporting disciplines.

Faculty and student research focuses on the structure of organizations, the design of programs and the communications process. Graduates typically

accept or return to positions of leadership in cooperative extension or agriculture colleges in the United States or in similar agencies in other countries. For further information, write to the chairman of the Division.

R.E. 512. THE COOPERATIVE EXTENSION SERVICE
Spring term. Credit three hours. Open to juniors and seniors by consent. Mr. R. Bruce.

An examination of the role and function of cooperative extension as an educational institution.

R.E. 523. ADMINISTATION AND SUPERVISION OF COOPERATIVE EXTENSION PROGRAMS
Fall term. Credit three hours. Mr. R. Bruce.

An application of principles of administration and supervision to the problems of organizing and operating the Cooperative Extension Service.

R.E. 524. PRINCIPLES OF EXTENSION EDUCATION PROGRAMING AND TEACHING
Fall term. Credit three hours. For graduate students interested in the principles and procedures basic to the development and execution of extension, adult, and community development programs, Mr. Leagans.

A study of the problems, principles, and general procedures commonly involved in developing and carrying out successful educational programs to promote economic and social change.

R.E. 525. COMMUNICATION IN EXTENSION AND COMMUNITY DEVELOPMENT PROGRAMS
Spring term. Credit three hours. For graduate students interested in a comprehensive understanding of theory, principles, procedures, and techniques of communication as applied in extension education-community development programs. Mr. Leagans.

Analysis of basic elements in the communications process with emphasis on the nature and role of the communicator, audience, message channels, message treatment, and audience response.

R.E. 621. SPECIAL STUDIES IN EXTENSION EDUCATION
Fall term. Credit two hours. Lectures, individual time to be arranged. Messrs. Leagans and R. Bruce.

The objective is to provide assistance in thesis preparation to graduate students in extension education. The course consists of three parts: (1) exploration of potential fields and specific delineation of thesis areas; (2) setting up a plan of thesis organization including establishment of objectives or hypotheses, preparation of questionnaires or other research instruments, collection, analysis, and interpretation of data in line with objectives; and (3) preparation of the thesis, its writing, editing, revising, and styling.

R.E. 626. SEMINAR: COMPARATIVE EXTENSION EDUCATION SYSTEMS
Fall term. Credit two hours. Open to graduate students and advanced undergraduates. Mr. Leagans.

A comparative analysis of the objectives, organization, procedures, achievements, and problems of selected extension education and community development agencies and programs in different circumstances of economic, social,

and political development and in different agricultural resource environments. Country programs for major consideration are selected in line with the interests of seminar members.

R.E. 627. SEMINAR: IMPLEMENTING EXTENSION AND COMMUNITY DEVELOPMENT PROGRAMS IN DEVELOPING COUNTRIES

Spring term. Credit two hours. Open to advanced students with experience in rural development programs by permission of the instructor. Mr. Leagans.

Analysis of major problems of implementing programs for economic and social change in non-western cultures. Key problems including administrative organization and policy, selection and training of personnel, setting objectives and goals, financing programs, communication, and evaluation will be considered along with others suggested by seminar members.

R.E. 628. SEMINAR: CURRENT PROBLEMS AND ISSUES IN EXTENSION EDUCATION

Spring term. Credit two hours. Open by permission of instructor to graduate students in extension education or other fields with special relevance to the seminar topic. Mr. R. Bruce.

A major area of concern to extension education will be selected for intensive study by participating students and faculty.

Guidance and Student Personnel Administration

Howard G. Andrus, Stanley W. Davis, Stanley R. Levy, A. Gordon Nelson.

A major in this subject area is appropriate for students who wish to prepare for positions in counseling, personnel administration in higher education, and counselor education. A candidate who intends to become a public school counselor must include in his program the courses specified for certification in the state where he expects to work. A doctoral candidate is required to complete one minor in some branch of psychology, and a second minor chosen in consultation with the chairman of his Special Committee.

Ed. 580. STUDENT CULTURE IN THE AMERICAN COLLEGE

Spring term. Prerequisite, consent of the instructor. Credit three hours. Mr. Levy.

Study of the student culture in the American college with emphasis on current research.

Ed. 581. STUDENT PERSONNEL ADMINISTRATION

Fall term. Prerequisite, consent of the instructor. Credit three hours. Mr. Levy.

The functions and organization of student personnel administration in higher education with emphasis on the historical and philosophical development of the area.

R.E. 582. EDUCATIONAL AND VOCATIONAL GUIDANCE

Fall term. Credit two hours. For graduate students only. Mr. Nelson.

Principles and practices of educational and vocational guidance. Historical and theoretical background of the guidance movement; educational, vocational, and community information needed; the study of the individual; group methods; counseling; placement and follow-up; and the organization, administration, and appraisal of guidance programs.

R.E. 583. COUNSELING

Spring term. Credit two hours. For graduate students only. Prerequisite, Ed. 555 and R.E. 582 or their equivalents. Mr. Nelson.

Principles and techniques of counseling with individuals concerning various types of educational, vocational, and social adjustment problems. Case studies.

R.E. 584. GROUP TECHNIQUES IN GUIDANCE

Spring term. Credit two hours. Prerequisite, permission of the instructor. Mr. Nelson.

Methods and materials for presenting educational and occupational information to students. Theory and practice of group guidance, and counseling in a group setting.

R.E. 585. OCCUPATIONAL AND EDUCATIONAL INFORMATION

Fall term. Credit four hours. Prerequisite, permission of the instructor. Mr. Nelson.

Survey and appraisal of occupations and training opportunities; study of sources of educational and vocational information; job analysis; vocational trends. Field trips to places of employment.

Ed. 602. FIELD LABORATORY IN STUDENT PERSONNEL ADMINISTRATION

Either term. Credit and hours to be arranged. Prerequisite, consent of instructor. Mr. Levy.

Directed field project in student personnel administration.

Ed. 681. SEMINAR IN STUDENT PERSONNEL ADMINISTRATION

Spring term. Prerequisite, Education 580 and 581. Credit two hours. Mr. Davis.

An analysis of problems in student personnel administration.

The following courses are not ordinarily offered on campus during the academic year, but they *are* offered in alternate Summer Sessions, along with most of the courses listed above.

R.E. 586. ORGANIZATION AND ADMINISTRATION OF GUIDANCE PROGRAMS. Credit two hours.

R.E. 587. PRACTICUM IN MEASUREMENT AND APPRAISAL FOR COUNSELORS. Credit two hours.

R.E. 588. CASE STUDIES IN COUNSELING. Credit two hours.

History, Philosophy, and Sociology of Education

Robert H. Ennis, D. Bob Gowin, Miss Isabel J. Peard, Frederick H. Stutz, Wayne E. Thompson.

All doctoral students will be expected to have or develop an acquaintance with the following four branches of this subject and to choose one for an area of specialization: history of education, philosophy of education, educational sociology, and comparative education. A candidate who chooses comparative education will also be expected to become a specialist in one of the other three branches.

Ordinarily about half of a candidate's program will include study in one or more of the following disciplines: history, philosophy, sociology, government,

and economics. At least one minor for the doctorate will be outside the Field of Education.

Areas of faculty and student study and research interests include structure of subject matter, analysis of educational concepts, fundamental assumptions in educational research, critical thinking, relation of philosophy and education, curriculum, logic in teaching, nature of theory in education, role of philosophy in teacher education, school-community relations, social roles of teachers, student climate, educational leadership, and educational aims.

R.E. 470. SOCIAL AND PHILOSOPHICAL FOUNDATIONS OF EDUCATION

Either term. Credit three hours. Open to juniors by consent, seniors, and graduate students. Registration in morning sections limited to 50 students; afternoon sections, 25 students. Fall term, Mr. Gowin and instructor to be announced. Spring term, Mr. Ennis and Miss Peard.

A study of the persistent problems of education in a democracy.

R.E. 471. LOGIC IN TEACHING

Fall term. Credit three hours. Open to graduates and advanced undergraduates. Mr. Ennis.

A consideration of definition, explanation, proof, problem solving, and the structure of subject matter as they bear upon the work of the classroom teacher.

Ed. 472. PHILOSOPHERS ON EDUCATION

Fall term. Credit three hours. For graduates and advanced undergraduates. Admission by consent only. Miss Peard.

Selected writings by such philosophers as Plato, Descartes, Rousseau, and Dewey will be examined in their own right and for the light they throw on the persistent problems in education.

Ed. 473. CONTEMPORARY PHILOSOPHY OF EDUCATION

Spring term. Credit three hours. Mr. Gowin.

The ideas of pragmatists, humanists, analysts, and existentialists will be examined in relation to the bearing of the ideas on educational thought and practice.

R.E. 571. SEMINAR: ANALYSIS OF EDUCATIONAL CONCEPTS

Spring term. Credit three hours. Admission by consent. Mr. Ennis.

Topic for 1967–68: To be announced.

R.E. 574. HISTORY OF EDUCATION IN THE MODERN PERIOD

Spring term. Credit three hours. For graduate students. Seniors admitted with permission of the instructor. Mr. Stutz.

An examination of educational thought and practice from the seventeenth century to the present in the setting of general developments in Western Europe and the United States. Principal attention will be given to the educational purposes and systems of France, Germany, the United Kingdom, the USSR, and the United States. A special paper will be required.

R.E. 578. COMPARATIVE EDUCATION

Spring term. Credit three hours.

A comparative treatment of several national systems of education from a historical perspective.

Ed. 672. SEMINAR IN EDUCATIONAL CLASSICS

Spring term. Credit three hours. Admission by consent. Miss Peard.

Topic for 1967–68: To be announced.

Ed. 673. SEMINAR IN JOHN DEWEY'S PHILOSOPHY OF EDUCATION

Fall term. Credit three hours. For graduate students. Consent of instructor required. Prerequisite, prior course in philosophy or philosophy of education. Mr. Gowin.

Dewey's conceptions of the nature of experience, knowledge, value, and metaphysics will be analyzed, as well as his method of philosophizing. Students will be expected to read widely in Dewey's writings and in the writings of his critics and disciples. Primary aim is a mature, critical understanding and appraisal of Dewey's philosophy, especially as it centers upon education.

Ed. 674. SEMINAR IN HISTORY OF EDUCATION

Spring term. Credit three hours. Admission by consent.

Topic for 1967–68: To be announced.

Home Economics Education

Miss Sara E. Blackwell, Mrs. Helen Y. Nelson, Miss Kathleen Rhodes.

Candidates are expected to have an undergraduate major in home economics. Previous courses in education as well as teaching experience in formal or informal situations are recommended.

Students' programs emphasize concepts and methods of inquiry of those social sciences which have relevance for dealing with problems of curriculum planning, teaching and learning, and evaluation. Concentration in one of these problem areas or in a related social science is expected of doctoral candidates.

Specialization is possible in adult and informal education, teacher education, administration, research, and, for selected students, international home economics.

Current research areas include: evaluation of cognitive and affective objectives of home economics; evaluation of student teaching; characteristics of adolescents related to vocational planning; developmental and experimental studies in occupational home economics; and studies in teacher education in developing countries.

H.E.Ed. 410. THE HOME ECONOMIST AS A TEACHER

Fall term. Credit three hours. Open to upperclassmen and graduate students. Miss Rhodes.

Designed for students who plan to be extension agents, dietitians, social workers, or home service representatives, or to undertake other work which will involve teaching in a non-school situation. Consideration will be given to social-psychological factors affecting the teaching-learning process, approach to different age and ability levels, use of appropriate media for different purposes, and various instructional techniques applicable to different groups of learners. Opportunity will be provided for observation and participation in educational programs according to students' individual needs.

H.E.Ed. 500. SPECIAL PROBLEMS FOR GRADUATE STUDENTS

Fall and spring term. Credit and hours to be arranged. Department faculty.

For students recommended by their chairmen and approved by the instructor in charge for independent advanced work.

H.E.Ed. 537. ADULT EDUCATION

Fall term. Credit two or three hours. Seniors admitted by permission of the instructor.

An introductory course planned for teachers, administrators, directors of adult education, extension agents, parent educators, and others. Focused on educational needs, program planning suited to adult learners, choosing teaching procedures and materials for adults, promotion of programs, and philosophy and evaluation in adult education. A wide variety of adult education activities in the Ithaca area provides opportunity for students to observe the application of principles to local programs. Students taking the course for three credits either observe or assist in teaching adults in local programs or choose some other suitable program.

[H.E.Ed. 538. SEMINAR IN ADULT HOME ECONOMICS EDUCATION]

Spring term. Credit two hours. Given in alternate years. Not given in 1967–68.

Planned for students specializing in adult education. It usually follows Home Economics Education 537; however, experienced students may register by permission of the instructor without 537. Attention is given to various aspects of organizing and conducting adult programs. Special interests of the students will serve as a guide in the choice of topics and of the relative emphasis to be placed on methods and materials for teaching adults, research in adult education, evaluation of instruction, or supervision of programs.

H.E.Ed. 549. CURRICULUM PLANNING IN HOME ECONOMICS

Spring term. Credit two or three hours. Miss Rhodes.

For high school and college teachers, administrators, and extension personnel. Attention is given to the social-cultural foundations of the home economics curriculum, social-psychological needs of learners, the influence of educational philosophy on curriculum planning, and curriculum planning for different age and ability levels. Opportunity is given for students to relate curriculum principles to individual situations.

H.E.Ed. 559. EVALUATION

Fall term. Credit three hours. Mrs. Nelson.

For high school and college teachers, administrators, extension agents, and educational research workers; students without experience in any of these professional positions are admitted by permission of the instructor. Basic principles of evaluation studied in relation to specific methods of appraising educational programs or individual achievement. Opportunities will be given for construction and use of evaluation instruments.

[H.E.Ed. 560. SEMINAR IN EVALUATION]

Spring term. Credit two hours. Prerequisites, H.E.Ed. 559 and R.E. 453 or equivalent. Given in alternate years. Miss Blackwell. Not given in 1967–68.

Opportunity for intensive study of the literature concerning educational evaluation, for refinement of appraisal techniques, and for analysis and interpretation of data from current research.

H.E.Ed. 575. READINGS IN EDUCATION

Spring term. Credit two hours. Given in alternate years.

Open to all graduate students interested in a critical analysis of current literature in the field of education, and the consideration of major issues. Students are expected to read widely, and to prepare and present an analysis of various current issues.

H.E.Ed. 580. SEMINAR IN HOME ECONOMICS EDUCATION

Fall and spring terms. No credit. Department staff.

An informal seminar planned for majors and minors in home economics education and for others who are interested. Plan for seminar is announced at opening meeting each term.

H.E.Ed. 590. TEACHING HOME ECONOMICS IN HIGHER EDUCATION

Fall term. Credit two hours. Given in alternate years.

For students interested in preparing to teach in colleges, junior colleges, or institutes. Opportunities are provided for students to observe and analyze the teaching of college classes.

Application of the principles of teaching to aspects of home economics to be taught, for example, food and nutrition, housing, textiles and clothing, family relations, or management. Deals with (a) the contributions of home economics at the college level, (b) the philosophy involved in cooperatively planned programs, (c) the characteristics of college-age youths, (d) factors affecting student learning, (e) principles influencing the choice of teaching procedures and materials for college teaching, (f) the educative values of group teaching, and (g) evaluation of teaching.

H.E.Ed. 661–662. THE TEACHER EDUCATOR IN HOME ECONOMICS

For graduate students preparing for teacher education positions involving supervision of student teachers. Permission of the instructors is required. Previous experience in teaching home economics at the secondary level is required for H.E.Ed. 662.

661. Fall term. Credit three hours. Mrs. Nelson.

Opportunity is provided for students to develop understanding of teacher education practices by observing and participating in H.E.Ed. 440. Participation involves teaching one or two lessons, and individual work with students. Additional experiences include observation of student teachers and of supervisory conferences in student teaching centers.

662. Spring term. Credit four hours. Mrs. Nelson and instructor to be announced.

Seminar is concerned with basic principles of supervision and their application to the preservice education of home economics teachers. Opportunity is provided for observation and participation in H.E.Ed. 441 and 442, including some teaching in the courses and the supervision of a student teacher.

H.E.Ed. 663. INTERNSHIP AND FIELD WORK IN TEACHER EDUCATION

Fall term. Credit two hours. Prerequisites, H.E.Ed. 661 and 662. Instructor to be announced, and Mrs. Nelson.

Interns will supervise three student teachers, make a follow-up visit to a first-year teacher, confer with college supervisor and cooperating teachers in the public schools.

[H.E.Ed. 670. ADMINISTRATION AND SUPERVISION IN HOME ECONOMICS]

Spring term. Credit three hours. Given in alternate years. Miss Rhodes. Not given in 1967–68.

Common elements of administrative and supervisory functions, the role of human relations and communication skills, theories of leadership, the charac-

teristics of effective administration and supervision in relation to program planning and evaluation, curriculum construction, in-service education, personnel, and public relations. Opportunity is provided for directed observation related to the student's area of special interest; e.g., administration of college programs, supervision of state and city public school programs, supervision of cooperative extension programs. Estimated cost of transportation to visit programs, $15.

Science and Nature Education

Matthew H. Bruce, Jr., Richard B. Fischer, Philip G. Johnson, Verne N. Rockcastle.

Persons with an interest in science, natural history, nature study and conservation of natural resources will find programs arranged to meet requirements for Master's or doctoral degrees in either of two areas:

(1) Science teaching, science supervision, science curriculum development, teacher preparation and research at elementary, secondary, and college levels. Programs may meet requirements for permanent certificates or broaden and deepen preparation in the sciences. The science departments offer the subject matter preparation, while the School of Education offers many helpful professional courses and seminars;

(2) Conservation education and the scientific study of nature leading to positions in college teaching, in conservation work, and in agencies dedicated to the development of public understanding and enjoyment of natural resources. There are opportunities for free-lance work as writers, illustrators, and lecturers. Often included are science content courses, natural history literature, natural history writing, journalism, fine arts, scientific illustrating, speech and other communication skills.

R.E. 402. NATURAL HISTORY LITERATURE

Fall term. Credit two hours. Open to juniors, seniors, and graduate students interested in nature, science, and conservation education. Mr. Fischer,

A survey of writings in the nature, science, and conservation education fields, with special attention to outstanding writers and their works, designed for teaching and for leisure time reading.

R.E. 403. NATURAL HISTORY WRITING

Spring term. Credit two hours. Open to juniors, seniors, and graduate students interested in nature, science, and conservation education, Mr. Fischer.

Designed to improve natural history, science, and conservation writing. Subject matter, sources of information, types of articles, use of illustrations, and outlets for students' articles are covered.

R.E. 407. THE TEACHING OF ELEMENTARY SCHOOL SCIENCE

Fall term. Credit three hours. Open to juniors, seniors, and graduate students by permission. Mr. Rockcastle.

The content and methods of elementary-school science and nature study, with field work and laboratory experience useful in classroom and camp. Designed particularly for those who are preparing to teach or supervise elementary science or nature study.

R.E. 409. OUR PHYSICAL ENVIRONMENT

Spring term. Credit three hours. Open to juniors, seniors, and graduate students primarily interested in public school teaching. Mr. Rockcastle.

A study of the commonplace machines and materials in our physical environment, and their effectiveness in demonstrating basic scientific principles. Frequent field trips and first-hand examination will be used in studying air, water, soil, light, and sound, as well as some elementary mechanical and electrical devices. Emphasis will be placed on the physical environment as an aid to teaching the physical sciences in the public secondary schools.

R.E. 424–425. FIELD NATURAL HISTORY

Fall or spring term. Credit three hours. Open to juniors, seniors, and graduate students, and to sophomores with instructor's permission. Limited to twenty students a section. Friday section primarily for those experienced in field biology. Mr. Fischer.

Devoted to studies of local plants and animals, their ecology and their relations to humans. Applications to teaching science and conservation are emphasized. May be taken either term or both terms.

R.E. 428. METHODS OF TEACHING SCIENCE IN SECONDARY SCHOOLS

Fall or spring term. Credit three hours. Prerequisite, Educational Psychology R.E. 411 or the equivalent, or concurrent registration. For juniors, seniors, and graduate students without teaching experience. Messrs. Johnson, Bruce, and assistants.

A consideration of methods and materials useful in teaching science in secondary schools. Observation of the work of experienced teachers constitutes an important part of the course.

R.E. 429. PRACTICE IN TEACHING SCIENCE IN SECONDARY SCHOOLS

Fall or spring term. Credit six or twelve hours. Prerequisite, R.E. 507 or R.E. 428 and permission of the instructor. For seniors and graduate students. Hours to be arranged. Mr. Bruce and assistant.

Supervised practice in teaching science in secondary schools, with frequent conferences on teaching plans and problems.

R.E. 505. THE TEACHING OF CONSERVATION

Fall term. Credit two hours. Mr. Fischer.

Consideration of the principles, materials, and methods of conservation education useful to teachers and others engaged in teaching wise use of the resources of the nation.

R.E. 507. THE TEACHING OF SCIENCE IN SECONDARY SCHOOLS

Fall term. Credit three hours. For graduate students with teaching experience and others by permission only. Mr. Johnson and assistants.

A consideration of problems of selection and organization of subject matter, of choice and use of materials, and of methods of teaching sciences at the secondary school level.

R.E. 509. THE DEVELOPMENT OF NATURE AND SCIENCE EDUCATION IN THE UNITED STATES

Spring term. Credit two hours. For graduate students. Messrs. M. Bruce, Fischer, Johnson, and Rockcastle.

Studies of the historical development of science teaching, the major personalities and their ideas, and current influences on science course content and methods of teaching.

R.E. 606. RESEARCH IN NATURE STUDY, SCIENCE, AND CONSERVATION EDUCATION

Fall and/or spring term. Credit one hour. Required of graduate students who major or minor in science education. Messrs. Johnson, Rockcastle, Fischer, and M. Bruce.

A seminar dealing with special problems.

General Courses

R.E. 499. INFORMAL STUDY IN EDUCATION

Maximum credit, three hours each term. Members of the staff.

This privilege is granted to a qualified junior, senior, or graduate student when approved by an adviser from the Education staff who is personally responsible for the study. Two purposes are sanctioned: (1) to engage in a study of a problem or topic not covered in a regular course; or (2) to undertake tutorial or honors study of an independent nature in the area of the student's research interests. The program is not designed for study supplementary to a regular course for the purpose of increasing the content and credit allocation of the course.

Ed. 499H. SEMINAR IN EDUCATION

Fall term. Credit and hours to be arranged. Miss Peard, Coordinator.

Open by permission only to students enrolled in regular programs for the preparation of teachers of English. Reading, lectures, and discussions of philosophical and psychological import for education.

Ed. 499S. INFORMAL STUDY IN EDUCATION

Maximum credit, three hours each term. Members of the staff. For students with majors in the endowed colleges.

This privilege is granted to a qualified junior, senior, or graduate student when approved by an adviser from the Education staff who is personally responsible for the study. Two purposes are sanctioned: (1) to engage in a study of a problem or topic not covered in a regular course; or (2) to undertake tutorial or honors study of an independent nature in the area of the student's research interests. The program is not designed for study supplementary to a regular course for the purpose of increasing the content and credit allocation of the course.

R.E. 500. SPECIAL STUDIES

Credit as arranged. Members of the staff. Limited to graduate students working on theses or other research projects. Each registration must be approved by a staff member who will assume responsibility for the work.

Ed. 500S. SPECIAL STUDIES

Credit as arranged. Members of the staff. Limited to graduate students with majors in the endowed divisions working on theses or other research projects. Each registration must be approved by a staff member who will assume responsibility for the work.

Ed. 594. COLLEGE TEACHING

Spring term. Without credit. Members of the University staff.

Designed for those who plan to teach in colleges and universities. Concepts and methods of teaching, organization of subject matter, motivation, learning, testing, grading, and similar problems are treated.

R.E. 599. INTRODUCTION TO EDUCATIONAL INQUIRY

Fall term. Credit four hours. Mr. Millman and staff.

An introduction to the processes that underlie the conduct of significant research in education. The central objective of the course is to prepare the student to produce better educational research and to be a more intelligent consumer of research already reported. The course is designed for the graduate student beginning work on a general degree or on the Ed.D. It is not intended for professional Master's degree candidates.

R.E. 600. INTERNSHIP IN EDUCATION

Fall and spring terms. Credit two to six hours as arranged. Members of the faculty.

Opportunity for apprentice or similar practical experience on the graduate level in administration, agricultural education, guidance, personnel administration, supervision, and other types of professional service in education.

H.E.Ed. 500. SPECIAL PROBLEMS FOR GRADUATE STUDENTS

Fall and spring terms. Credit and hours to be arranged. Department staff.

For graduate students recommended by their chairmen and approved by the instructor in charge for independent advanced work.

H.E.Ed. 599. THESIS AND RESEARCH

Fall and spring terms. Credit and hours to be arranged. Registration with permission of the chairman of the graduate committee and the instructor. Miss Blackwell, Mrs. Nelson, Miss Rhodes.

Interdepartmental Courses

ILR 524. PUBLIC POLICY AND DEVELOPMENT OF HUMAN RESOURCES

Credit three hours. Fall term.

Analysis of the need for development of human resources, trends in work force requirements and implications for public policy, the role of government and of educational institutions in providing development programs, and the effectiveness of such programs. Attention to the rationale, organization, and administration of specific programs such as apprenticeship, vocational and technical schools, technical institutes, university programs for development of technical, scientific, and managerial skills, and the foreign technical assistance program. Implications and problems of public support for the development of human resources.

ILR 527. MANAGEMENT AND LEADERSHIP DEVELOPMENT

Credit three hours. Fall term.

Study of the factors affecting the growth and development of managers and leaders in industrial and other organizations. Consideration is given to the organizational environment, formal and informal development programs, leadership theory, and individual attitudes and beliefs. Special emphasis is given to analysis of specific case studies of actual practice.

ILR 627. CURRENT ISSUES AND RESEARCH IN HUMAN RESOURCES DEVELOPMENT

Credit three hours. Fall and spring terms.

A graduate seminar centering on selected issues and relevant research involved in the development of managerial and work force skills (particular

emphasis for the seminar to be determined with the seminar group). Seminar papers and class discussions might concentrate on such topics as management development, impact of technological change on training programs, development of scientific and professional personnel, or labor union education.

Interdept. 404. COMPUTER METHODS IN BEHAVIORAL SCIENCES

Spring term. Credit four hours. Prerequisite, an intermediate statistics course (may be taken concurrently). Mr. Rudan.

Importance of digital computers in behavioral research. Issues that arise in design of research instruments. The use of unit record equipment in data analysis and reduction. Programing with the FORTRAN language. Outline of programs available for analysis and reduction of data. Information on the theory and use of such programs.

Soc. 441. STRUCTURE AND FUNCTIONING OF AMERICAN SOCIETY — I

Fall term. Credit four hours. Prerequisite, Sociology and Anthropology 101 or consent of instructor. Mr. Williams.

Systematic analysis of the major institutions of kinship, stratification, economic activity, political structure, education, and religion. Special attention is given to values and their interrelations in the modern social order. Includes a survey of the more important types of groups and associations making up a pluralistic nation.

Soc. 442. STRUCTURE AND FUNCTIONING OF AMERICAN SOCIETY — II

Spring term. Credit four hours. Prerequisite, Sociology and Anthropology 401 or consent of instructor. Mr. Williams.

Primary attention is directed to the study of interrelations of institutions, including analysis of the regulation of economic and political systems. Group cooperation and conflict are surveyed. Analysis of important processes of change in institutions, values, and social organization.

Geography

Physical Geography is a branch of Geological Sciences. See page 401.

Government

Faculty: Douglas E. Ashford, Walter F. Berns, Allan D. Bloom, Herbert W. Briggs, Arch T. Dotson, Mario Einaudi, Andrew Hacker, George McT. Kahin, Eldon Kenworthy, John W. Lewis, David Mozingo, Steven Muller, Clinton Rossiter, Arthur Rovine, Myron Rush, Allan P. Sindler.

Director of Graduate Studies and Field Representative: Arch T. Dotson, 305 West Sibley Hall.

ADMISSION REQUIREMENTS. All applicants for admission to graduate study in the Field of Government must submit the scores of the Graduate Record Examination Aptitude and Advanced Tests with their other credentials. Applicants for financial assistance should take these tests before January 15.

LANGUAGE REQUIREMENTS. The Field of Government requires candidates for the Ph.D. degree to be proficient in at least one foreign language.

That language may be French, German, or Russian: with the consent of his Special Committee, a candidate may substitute Burmese, Chinese, Hindi, Indonesian, Spanish, Thai, or Vietnamese. A Special Committee may require more than one language. At the discretion of his Special Committee, a candidate for the M.A. degree may be required to demonstrate reading ability in one foreign language.

FIELD REQUIREMENTS. A course of studies leading to a higher degree in the Field of Government seeks to insure for each candidate a broad knowledge of the Field, as well as a specialized competence which will enable him to pursue with distinction a professional or scholarly career in political science.

APPROVED MAJOR AND MINOR SUBJECTS

In regard to minor subjects, see the first paragraph of the description below.

Group I	Group III
American Government	Comparative Government
Group II	Group IV
Political Theory	International Law and Relations

In contemporary political science, many of the traditional classifications are changing. The Field of Government, therefore, does not limit minors to a specified number of subjects. For example, within the major subject, American government, a candidate for a higher degree may choose to minor in American constitutional law, the American political process, or some other substantial aspect of this subject. Within political theory, a candidate may wish to minor in modern or ancient and medieval theory. Within comparative government, a candidate may wish to minor in Western or non-Western political systems. Within international law and relations, a candidate may wish to minor in international law only, or the relations of groups of nations whose goals or systems of government make them a reasonable focus for graduate study. Graduate students, both within and without the Field, are encouraged to select, with the approval of their Special Committee, minor subjects which are adapated to their scholarly goals and also represent significant portions of the Field.

A candidate for the Ph.D. degree must offer on the Comprehensive Examination one major and at least two minor subjects. No more than one minor may be chosen from a single group of subjects; one of the minors may be outside the Field of Government. A candidate for the Master's degree must offer one major and at least one minor; the minor or minors must belong to a different group from the major, or may be outside the Field of Government.

All candidates are expected to secure a broad preparation in the Field. The Special Committee and the Director of Graduate Studies may, at the time of the Field Review or the Qualifying Examination, recommend particular courses or seminars outside the major or minor subjects which must be completed satisfactorily. The Committee and the Director will, in place of such courses or seminars, administer an examination to assess the candidate's preparation.

Cornell offers a number of programs in foreign area studies co-ordinated by its Center for International Studies, i.e., the China Program, the Latin American Program, the South Asia Program, and the Southeast Asia Program. There are, in addition to these area programs, Faculty Committees on African, Near Eastern, and Soviet studies. A student wishing to minor in one of these specialized areas may obtain additional information from the following: Professor V. W. Turner, Chairman, Committee on African Studies, McGraw Hall; Professor H. Shadick, Director, China Program, Franklin Hall; Professor

J. M. Stycos, Director, Latin American Program, Rand Hall; Professor J Milton Cowan, Chairman, Committee on Near Eastern Studies, Morrill Hall; Professor M. E. Opler, Director, South Asian Program, White Hall; Professor G. McT. Kahin, Director, Southeast Asia Program, Franklin Hall; Professor M. Gardner Clark, Chairman, Committee on Soviet Studies, Ives Hall.

FIELD REVIEW. Within two weeks after the beginning of residence, the Director of Graduate Studies, with the assistance of an *ad hoc* committee from the faculty of the Field or from other Fields where indicated, will conduct an initial review of the candidate's preparation and tentative plan of study.

QUALIFYING EXAMINATION. Each candidate for the Ph.D. degree will take a Qualifying Examination during the last month of his second term of graduate study. The examination will focus on the course and seminar work done during the year. The Special Committee will decide whether to have a written as well as an oral examination.

Each candidate will be placed in one of three categories on the basis of his performance on the Qualifying Examination. A candidate placed in category (a) will be confirmed in the Ph.D. program. Upon satisfactory completion of his Comprehensive Examination, he may petition the Graduate School to award him a Master's degree. A student placed in category (b) will be awarded a Master's degree upon satisfactory completion of the requirements for that degree. A student placed in category (c) will not be permitted to reregister as a student in the Field of Government.

COMPREHENSIVE EXAMINATION. Each candidate will present his major and minor subjects for a Comprehensive Examination at a time to be fixed by his Special Committee in accordance with the regulations of the Graduate School. The Comprehensive Examination must be passed before the candidate begins full-time work on a thesis or dissertation, and before the completion of six terms of residence, unless the Field sets an earlier or later date because of special circumstances. The examination will be written and oral.

FINAL EXAMINATION. Each candidate will be examined orally on his thesis or dissertation.

RESEARCH AND STUDY OPPORTUNITIES

As noted above, the University has a series of programs in foreign area studies, and students minoring in such areas have every opportunity to participate in the numerous research projects being carried on both here and abroad. A number of the faculty in the Field of Government are members of these programs and can act as advisers for such research.

FACULTY SPECIALIZATIONS

Within the four major subject groupings listed earlier, the fields and specializations of the faculty present a broad range of choice and allow for a diversity in interests.

In the area of *American Government*, Professor Berns specializes in constitutional law and jurisprudence, Professor Hacker in political sociology; Professor Rossiter's field is the political and constitutional history of the United States; Professor Sindler specializes in American political parties and interest groups; and Professor Dotson in public administration.

In the area of *Political Theory*, Professor Bloom specializes in the classical

tradition, Professor Rossiter in American political thought, and Professor Einaudi in modern political philosophy.

In the areas of *Comparative Government* and *International Law and Relations,* Professor Einaudi's field of interest is Western Europe; Professor Muller specializes in the political systems of Great Britain and Germany, and Professor Rush in Soviet politics and foreign policy. Professor Kahin specializes in the international relations of Asia as well as the government and politics of Southeast Asia. Professor Lewis' main area of interest is China, as is Professor Mozingo's. Professor Kenworthy's specialty is Latin American politics, while Professor Ashford's is the government of North African countries and the politics of modernization. Professor Dotson, as well, specializes in the politics of modernization. Professor Briggs is a specialist in international law; and Professor Rovine's field of specialization is international organization.

COURSES*

Seminars

FALL TERM

PROBLEMS OF PUBLIC ADMINISTRATION

(Mr. Dotson.) An effort to identify and assess the extent and properties of bureaucratic power in American government. Special emphasis will be given to theoretical issues associated with the rise of this power.

AMERICAN POLITICAL THOUGHT

(Mr. Rossiter.) The seminar will concentrate on major periods and developments in the American political tradition.

AMERICAN POLITICS

(Mr. Hacker.) A study of social and political ideology in the contemporary United States. Methods and approaches from the following disciplines will be utilized: history, political philosophy, sociology, psychology, and statistics.

POLITICAL DEVELOPMENT AND SOCIAL CHANGE

(Mr. Ashford.) An investigation of the problems of the design of administrative structures for the achievement of developmental goals. The socio-economic plans of specific developing countries will be utilized. Particular attention will be given to patterns of centralization or decentralization, jurisdictions, the assignment of developmental tasks to departments, agencies, corporations, and the design of these and other administrative forms.

CONTEMPORARY NATIONALISM

(Mr. Ashford.) Transformation of nationalist ideology in relation to problems of development.

POLITICAL THEORY

(Mr. Bloom.) Plato's *Republic.*

POLITICAL THEORY

(Mr. Einaudi.) Selected issues in modern political thought.

* Based on an estimate of the courses and seminars which will be given.

INTERNATIONAL RELATIONS
(Mr. Lewis.) The conceptual problems in the study of state relations, with emphasis on aspects of the formation of security policy.

INTERNATIONAL RELATIONS OF ASIA
(Mr. Kahin.) Specific focus to be announced.

SPRING TERM

POLITICAL PARTIES AND ELECTIONS
(Mr. Sindler.)

CONSTITUTIONAL LAW AND JURISPRUDENCE
(Mr. Berns.)

POLITICS OF THE SOVIET UNION
(Mr. Rush.)

POLITICAL DEVELOPMENT AND SOCIAL CHANGE
(Mr. Dotson.)

GOVERNMENT AND POLITICS OF LATIN AMERICA
(Mr. Kenworthy.)

COMPARATIVE GOVERNMENT
(Mr. Einaudi.)

POLITICAL THEORY
(Mr. Bloom.)

INTERNATIONAL LAW AND INTERNATIONAL ORGANIZATION
(Mr. Briggs.)

POLITICAL PROBLEMS OF SOUTHEAST ASIA
(Mr. Kahin.)

Courses of Special Interest to Graduate Students

AMERICAN CONSTITUTIONAL LAW
(Fall term. Mr. Berns.) A study of the law of the Constitution as this has been expounded by the Supreme Court. Emphasis will be placed on the various understandings of freedom that have inspired, or given rise to, that law. The course will be conducted primarily through class discussion of assigned cases.

GOVERNMENT AND POLITICS OF THE SOVIET UNION
(Fall term. Mr. Rush.) An introduction to the Soviet political system.

FOREIGN POLICY OF THE USSR
(Spring term. Mr. Rush.) A survey from the Revolution to the present.

THE POLITICAL PROCESS: POLITICAL ATTITUDES AND PARTICIPATION
(Spring term. Mr. Ashford.) A comparative analysis of participation and involvement in the political process at the local level in the United States, and

in selected European and developing countries. An analysis of attitudinal and personality factors as they relate to political life in the community.

POLITICS AND MODERNIZATION

(Spring term. Mr. Dotson.) A comparative study of political development and social change.

GOVERNMENT AND POLITICS OF LATIN AMERICA

(Spring term. Mr. Kenworthy.)

GOVERNMENT AND POLITICS OF SOUTHEAST ASIA

(Spring term. Mr. Kahin.) Analysis of the organization and functioning of government and politics in the countries of Southeast Asia, with attention given to the nature of the social and economic environments which condition them.

CHINESE GOVERNMENT AND POLITICS

(Fall term. Mr. Lewis.) General introduction to the politics of modern China with particular emphasis on the political processes of the People's Republic of China.

DEVELOPMENT OF MODERN POLITICAL THOUGHT

(Fall term. Mr. Einaudi.) The development of political thought from the sixteenth to the nineteenth century. The course is built around certain essential concepts of political theory: the nature of law, the state and sovereignty, individual rights and the community. Machiavelli, Hobbes, the Enlightenment, Rousseau, Hegel, and Marx will receive particular attention.

AMERICAN POLITICAL THOUGHT

(Fall term. Mr. Rossiter.) Survey of the development of American political thought, with emphasis on the origins and uses of ideas. Other kinds of thought — constitutional, social, religious, economic, educational, cultural — are considered in their relations to political thought.

ORIGINS OF WESTERN POLITICAL THOUGHT

(Spring term. Mr. Bloom.) A survey of the classical political teachings in their development from the pre-Socratics through Greek and Roman antiquity and in their transformation by the revealed religions.

INTERNATIONAL RELATIONS

(Spring term. Mr. Lewis.) An analysis of the basic issues, concepts, contents, and methods which characterize relations among states. Ideological, legal, military, and economic elements which may contribute to harmony and dissent will be discussed in terms of both international society and national foreign policies. The over-all frame of reference will consist chiefly of theories, practices, and institutions developed since World War II.

INTERNATIONAL ORGANIZATION

(Fall term. Mr. Briggs.) An analysis of some international governmental procedures and institutions. Particular attention will be given to the background, organization, and operation of the United Nations, with emphasis on political and legal problems.

INTERNATIONAL LAW

(Throughout the year. Mr. Briggs.) A systematic study of the nature, development, and judicial application of international law. Attention will be given to the role of law in the relations of states. Cases, documentary analysis, and discussions.

SPECIAL DEPARTMENTAL AWARDS

WALTER S. CARPENTER, JR. FELLOWSHIP (Stipend plus tuition and General Fee). Graduate students majoring in comparative government under the direction of the Walter S. Carpenter Professor of International and Comparative Politics are eligible.

NEWTON C. FARR FELLOWSHIP (Stipend plus tuition and General Fee). Graduate students majoring in American government under the direction of the John L. Senior Professor of American Institutions are eligible.

JOHN L. SENIOR FELLOWSHIP (Stipend plus tuition and General Fee). Graduate students majoring in American government under the direction of the John L. Senior Professor of American Institutions are eligible.

In addition to these special departmental awards, graduate students in the Field of Government are eligible for support from the McVoy fund. Awards consist of amounts up to tuition and General Fee with, in special cases, some stipend added.

Hotel Administration

Faculty: Robert A. Beck, Paul R. Broten, Charles E. Cladel, Myrtle H. Ericson, Gerald W. Lattin, Helen J. Recknagel, Eben S. Reynolds, Charles I. Sayles, Thomas W. Silk, Laura L. Smith, Jeremiah J. Wanderstock.

Field Representative: G. W. Lattin, 103 Statler Hall.

APPROPRIATE MAJOR AND MINOR SUBJECTS

Hotel Administration — Hotel Accounting

Graduate work in the Field of Hotel Administration is open to those who have completed in full the requirements for the undergraduate degree in the School of Hotel Administration and to them only.

Students holding Bachelors' degrees in the liberal arts or in general business administration who wish a program in hotel administration normally enroll in the undergraduate division. They may become candidates for an additional Bachelor's degree or at their choice simply enroll for a specialized program of hotel administration courses suited to their particular needs.

Hotel Accounting may not be taken as a minor subject for the degree of Ph.D. if the major subject is Hotel Administration.

INTERPRETATION OF HOTEL FINANCIAL STATEMENTS (HOTEL ACCOUNTING 186)

Credit two hours. Hotel elective. Open to upperclassmen and graduates. Prerequisite, Hotel Accounting 181 and 182. Mr. Lesure.

A study and discussion of hotel balance sheets, profit and loss statements.

A typical hotel balance sheet and operating ratios.

PROBLEMS IN HOTEL ANALYSIS (HOTEL ACCOUNTING 189)

Credit two hours. Hotel elective. Open to upperclassmen and graduates.

Practice in some statistical procedures, using as illustrative material principally hotel and restaurant figures; presentation and interpretation; frequency distributions, average, median, mode, and measures of dispersion. Special emphasis is placed on linear correlation and regression.

INTERNAL CONTROL IN HOTELS (HOTEL ACCOUNTING 286)

Credit two hours. Hotel elective. Open to seniors and graduates and to certain others by permission. Prerequisite, Hotel Accounting 181. Mr. Barrett.

Discussion of the problems encountered in distributing the accounting and clerical work in hotels so as to provide a good system of internal control.

Study of many actual cases of the failure of internal control and the analysis of the causes of the failure. Practical problems and actual techniques of functioning systems of internal control.

LAW AS RELATED TO INNKEEPING (HOTEL ADMINISTRATION 172)

Credit two hours. Hotel elective. Open to upperclassmen and graduates. Best taken after Hotel Accounting 182 and Economics 104. Professor Sherry.

A study of the laws applicable to the ownership and operation of inns, hotels, motels, restaurants, and other places of public hospitality. Consideration of the host's duties to guests, lodgers, boarders, tenants, invitees, licensees, and trespassers; the exclusion and ejection of undesirables; liability for personal injuries on and off the premises; the concept of negligence; liability for damage or loss of property; statutory limitations of liability; lien rights; concession agreements; leases; credit and collection practices; arrest and detention of wrongdoers, and miscellaneous statutes and administrative rules and regulations applicable to public houses. The material is treated from the point of view of the executive responsible for policy and decision making.

SALES PROMOTION (HOTEL ADMINISTRATION 278)

Credit one hour. Hotel elective. Open to upperclassmen and graduates.

The hotel sales department — its function, organization, records, and procedures — is discussed.

The course is arranged with the cooperation of the Hotel Sales Management Association. At each session a different member of the Association, chosen by the Association in consultation with the School for his expertness in some one phase of sales promotion, discusses that phase and under the coordination of the instructor leads the discussion of the subject.

SEMINAR IN PERSONNEL ADMINISTRATION (HOTEL ADMINISTRATION 219)

Credit two hours. Hotel elective. Open to upperclassmen and graduates. Prerequisite, Hotel Administration 119 and permission of instructor. Professor Lattin.

A discussion class which provides the opportunity for students to put into practice the theory and techniques learned in the elementary course. Emphasis is placed on understanding and practicing personnel methods which can directly assist in controlling costs of the man-power program.

COMMUNICATION (HOTEL ADMINISTRATION 238)

Credit three hours. Hotel elective. Open to upperclassmen and graduates. Professor Recknagel.

The composition of written messages used in hotels, restaurants, and clubs. Includes the preparation of letters, memorandums, reports, and advertising by mail.

LECTURES ON HOTEL MANAGEMENT (HOTEL ADMINISTRATION 155)

Credit one hour. Hotel elective. Open to all classes. To be taken for credit each semester. Under the direction of Professor Beck.

A series of lectures given by nonresident speakers prominent in the hotel, restaurant and allied fields.

SPECIAL STUDIES IN RESEARCH (HOTEL ADMINISTRATION 253)

Credit to be arranged. Open to graduate students in Hotel Administration only. Members of the Graduate Faculty.

Designed specifically for graduate students working on theses or other research projects. Any member of the graduate faculty of the School of Hotel Administration, upon consultation with the student, may be selected to direct a particular problem of special interest to the student.

LAW OF BUSINESS: CONTRACTS, BAILMENTS, AND AGENCY (HOTEL ADMINISTRATION 272)

Credit two hours. Hotel elective. Open to upperclassmen and graduates. Best taken after Hotel Accounting 182 and Economics 104. Professor Sherry.

A study of the formation, validity, enforcement, and breach of contracts; sales and dealings in personal property, bailments, storage, and shipment of goods; the laws of principal and agent, and employer and employee. The case method is used throughout, supplemented by notes and collateral readings. The aim is to develop skill and experience in analytical thinking as an aid and as a tool in modern managerial technique.

LAW OF BUSINESS: BUSINESS ORGANIZATION – PARTNERSHIPS AND CORPORATIONS (HOTEL ADMINISTRATION 274)

Credit two hours. Hotel elective. Open to upperclassmen and graduates. Best taken after Hotel Accounting 182 and Economics 104. Professor Sherry.

A study of the available forms of business organization, with special emphasis on general and limited partnerships and corporations. Comparison of the relative advantages and disadvantages of partnerships and corporations. Consideration of the use of limited partnerships in hotel and motel syndications, corporate promotion; financial devices for raising capital; corporate control and management, and the respective rights, duties, and powers of officers, directors, and stockholders. The aim is to correlate the legal, accounting, taxation, and management aspects of organized business enterprises.

SEMINAR IN REAL ESTATE FINANCE AND INVESTMENT (HOTEL ADMINISTRATION 192)

Credit two hours. Hotel elective. Open to upperclassmen and graduates. Prerequisite, Economics 104 or its equivalent.

The changing character of the urban economy and its influence upon land values. Case studies of the development of land into specific improvements to generate a stream of investment income. A study of the leverage of financing and how it is used by the entrepreneur.

GENERAL INSURANCE (HOTEL ADMINISTRATION 196)

Credit three hours. Hotel elective. Upperclassmen and graduates. Mr. McNeill.

Designed to provide the student with a comprehensive introduction to the insurance field. The emphasis is upon fire insurance, casualty insurance, and

multiple peril policies. Such topics are covered as the law of contracts as it relates to insurance; the fire insurance policy and fire insurance forms; business interruption, marine, burglary and crime, and liability insurance; rates and rate making; bonds; negligence and torts; compensation; package policies; adjustment of losses; and the types of insurers.

PROBLEMS OF HUMAN BEHAVIOR IN THE HOTEL AND RESTAURANT INDUSTRY (HOTEL ADMINISTRATION 116)

Credit two hours. Hotel elective. Open to upperclassmen and graduates. Prerequisite, Hotel Administration 114 and permission of the instructor.

A consideration of the social-psychological factors involving conflict and dispute in hotels and restaurants. Extensive use is made of actual case studies within these industries. Interviewing techniques will be discussed and practiced among the group.

LABOR-MANAGEMENT RELATIONS IN THE HOTEL INDUSTRY (HOTEL ADMINISTRATION 316)

Credit three hours. Hotel elective. Open to upperclassmen and graduates. Prerequisite, Economics 104. (This course will satisfy the requirement of elective work in economics, but when so counted it may not also be counted as three hours of Hotel elective.) Professor Beck.

The development of the trade union movement in the United States with special emphasis upon the AFL-CIO union affiliates active in the hotel and food industry. Case studies are included of disputes and grievances arising in unionized hotels and restaurants.

HOTEL PLANNING (HOTEL ENGINEERING 265)

Credit three hours. Limited to seniors and graduates. Prerequisite, 12 hours of hotel engineering or permission of the instructor.

Design of the layout for a proposed hotel, from feasibility study through plans and specifications, emphasizing site solution, floor plans, guest room layouts, and the selection and arrangement of equipment in all of the various departments.

FINANCE (BUSINESS AND PUBLIC ADMINISTRATION 128)

Credit three hours. Open to seniors and graduate students who have taken Economics 104. Permission of the instructor is required. Professor Nilsson.

The student is introduced to the principles and practices of finance and to their application in business and public administration. The uses of financial instruments, problems of short-term and long-term capital financing, methods of security distribution, financial expansion and reorganization, and the operation of specialized financial institutions and money and capital markets are surveyed. Considerable attention is given to the methods of financing current operations and to the financial problems of small business. The regulatory aspects of government financial controls are considered.

BUSINESS ENTERPRISE AND PUBLIC POLICY (BUSINESS AND PUBLIC ADMINISTRATION 202)

Credit three hours. Open to seniors and graduate students who have taken Economics 104. Permission of the instructor is required. Professor Hutchins.

An integrating study of the interrelations among individuals, business firms, and governments in American society. It focuses attention on the problems of exercising socially responsible business leadership and on the nature and

objectives of selected public policies impinging on business. The more important topics covered are management and the individual, or the philosophy of the business society; management's responsibilities to the organization, including certain problems of posture and practices; management's relations with rivals, especially problems of monopoly and competition and the antitrust laws; management's responsibilities to customers, particularly with respect to promotional practices; the special responsibilities of those businesses affected with a public interest, such as transportation companies; the unusual problems of managements entrusted with roles in the national defense, especially in connection with radical innovation and technological development; the positions of firms receiving subsidies designed to promote public objectives, such as shipping enterprises; the relations between business finance and public finance, especially with respect to taxation; and finally management's role in the foreign relations of the United States, particularly with respect to trade, investment abroad, and foreign policy.

PRINCIPLES OF CITY AND REGIONAL PLANNING (ARCHITECTURE 710)

Credit three hours. Open to upperclassmen and graduates. Professor Reps.

A review of the basic influences in the development of cities. A general view of the theory and accepted practice of city and regional planning, including a study of the social, economic, and legal phases.

INTERNATIONAL HOTEL CUISINE (HOTEL ADMINISTRATION 205)

Credit three hours. Hotel elective. Open to upperclassmen and graduates. Professor Bernatsky.

International hotel cuisine is systematically presented. The correct utilization of the animal carcass and of plant life is demonstrated through the skillful preparation of a wide variety of food. The student has the opportunity to observe preparation skill in detail, write recipes, watch correct presentation and service, and taste the prepared food.

SPECIAL PROBLEMS IN FOOD (HOTEL ADMINISTRATION 353)

Spring term. Credit one hour. Permission of instructors required. Prerequisites, Hotel Administration 120, 220, 206, 214, 215, and 201. Professors Ericson and Wanderstock.

A seminar course for upperclassmen and graduate students designed to examine in detail various aspects of food and food service in hotels, restaurants, clubs, and institutions.

RESTAURANT MANAGEMENT (HOTEL ADMINISTRATION 251)

Credit three hours. Hotel elective. Open to upperclassmen and graduates. Professor Bernatsky.

An analysis of the principal operating problems in the restaurant field. Procedures, approaches, and techniques of management are explored and developed through case study, lecture, and discussion.

Household Economics and Management

Faculty: Gwen J. Bymers, Helen G. Canoyer, Alice J. Davey, Mary E. Purchase, Mabel A. Rollins, Rose E. Steidl, Ethel L. Vatter, Kathryn E. Walker.

Field Representative: Gwen J. Bymers, G-8 Martha Van Rensselaer Hall.

APPROPRIATE MAJOR SUBJECTS	APPROPRIATE MINOR SUBJECTS
Ph.D. Household Economics and Management	Household Economics and Management if major is in another field
M.S. Household Economics and/or Home Management	Household Economics and/or Home Management

ADMISSION REQUIREMENTS. Admission to graduate work is based primarily on evidence of the student's competence to do advanced work. A general or specialized major in home economics is acceptable as background for study in this Field. Students with majors other than home economics for their baccalaureate degrees will also be considered since other subject matter areas are applied to the work and finances of the home. All candidates resident in the United States during the year preceding matriculation at Cornell must submit the scores of the Miller Analogies Test or the Aptitude Test of the Graduate Record Examination with their other credentials.

LANGUAGE REQUIREMENTS. Reading knowledge in *one* foreign language at a higher level of proficiency than that which prevailed under the two-language system is required of the Ph.D. candidate. This proficiency may be demonstrated by the satisfactory completion of a course at the 102 level in the Division of Modern Languages. It may also be attained by a Cornell written translation test administered by the Language Board after the student has passed the ETS examinations.

Danish, French, German, Norwegian, Russian, Spanish, or Swedish are approved languages for the Field. No foreign language is required for the M.S. degree.

EXAMINATIONS. For the Ph.D. degree the Field requires a Comprehensive Examination for advancement to candidacy and a Final Examination on completion of the student's research in line with the University requirement. The Field also requires that a Qualifying Examination be passed before the beginning of the third semester of graduate study at Cornell.

RESEARCH AND STUDY OPPORTUNITIES

Programs of graduate work are individually planned to fit the needs and objectives of the student. No prescribed course of study is required, thus, no two programs would be exactly alike. The student's past experiences, education, and future goals are considered in planning his program.

Since the subject matter in household economics and management draws on several disciplines, appropriate *minor subject or subjects* may be chosen from a variety of Fields including Agricultural Economics, Anthropology, Economics, Education, Industrial and Labor Relations, Psychology, and Sociology, as well as other branches of home economics. A single minor to be pursued in depth is approved for the Field.

The Field offers opportunities for study and research with a faculty having specialized interests. The faculty members and their specializations are:

Gwen J. Bymers, Professor: consumption economics; consumer problems; marketing.

Helen G. Canoyer, Professor, Dean of the College: consumer economics; consumption economics; marketing.

Alice J. Davey, Associate Professor: home management, theory and function.

Mary E. Purchase, Associate Professor: household equipment; physical science in the home.

Mabel A. Rollins, Professor and Head of the Department: real income of families and its measurement.

Rose E. Steidl, Associate Professor: work and workplace design; home management.
Ethel L. Vatter, Associate Professor: family economics; research design.
Kathryn E. Walker, Associate Professor: home management; work simplification.

COURSES*

500 (403). SPECIAL PROBLEMS FOR GRADUATE STUDENTS

Fall and spring. Credit and hours to be arranged. Department faculty. For graduate students recommended by their chairmen and approved by the head of the department and the instructor in charge for independent advanced work.

501 (401). RESEARCH METHODOLOGY

Spring. Credit two hours. Prerequisites, one course in statistics and consent of the instructor. Mrs. Vatter. T Th 11. Room 301.

The theory and practice of research in the area of household economics and management. The meaning of science, patterns of scientific investigation in the social sciences, and their applicability to selected concepts in the departmental area.

The course is designed for first or second-year graduate students. Its purpose is to help students achieve the ability to make critical evaluation of pertinent research findings, and to design sound studies of their own.

597 (499). SEMINAR

Fall and spring. Department faculty. T 4. Room 114.

Planned to orient students to graduate work in the field, to keep students and faculty abreast of new developments and research findings, to acquaint them with subject matter in related areas, and to provide opportunity to examine and discuss problems of the field.

599 (407). MASTER'S THESIS AND RESEARCH

Fall and spring. Registration with permission of the instructor and chairman of graduate committee. Misses Bymers, Davey, Purchase, Rollins, Steidl, Mrs. Vatter, Miss Walker.

619 (419). HISTORY AND DEVELOPMENT OF HOME MANAGEMENT CONCEPTS

Fall. Credit three hours. Consult instructor before registering. Miss Davey. M W 9. Room G-20.

An examination of fundamental ideas in home management, to include decision making, and values. The ideas will be traced historically. An overview of current thought and some projection into the future.

620 (420). PHYSICAL SCIENCE IN THE HOME

Fall. Credit two or three hours. Consult instructor before registering. Miss Purchase. W F 1, and laboratory 2 hours, to be arranged. Room G-19.

Selected principles from mechanics, electricity, heat, sound, and light applied to household equipment. Chemical characteristics of soil, of surfaces to be cleaned, and of supplies used for cleaning and protecting surfaces; the laundry process and supplies. Background information in physical science

* Numbers in parentheses indicate former numbering pattern.

for home economists working with equipment in teaching, extension, or home service. Three credits require attending the laboratory.

632 (432). READINGS IN PERSONAL FINANCES

Spring. Credit two hours. Prerequisite, H.E.M. 330 or the equivalent. Consult instructor before registering. F 2–4. Room to be arranged.

Examination of the nature of personal financial problems and of adjustments in families' financial practices under changing conditions. Review of research in family financial management.

640 (440). READINGS IN THE ECONOMICS OF CONSUMPTION

Fall. Credit three hours. Prerequisites, H.E.M. 340 or the equivalent. Consult instructor before registering. Miss Bymers. Time to be arranged.

Critical review of current literature dealing with the economics of consumption.

650 (450). READINGS IN MANAGEMENT OF HOUSEHOLD WORK

Spring. Credit three hours. Consult instructor before registering. Miss Steidl. Hours to be arranged.

Critical review of research and other literature concerned with description and measurement of work, and design of physical arrangements for work. The study of the human costs of accomplishing household work is emphasized.

652 (452). READINGS IN USE OF TIME IN HOMES

Fall. Credit three hours. Consult instructor before registering. Miss Walker. Hours to be arranged.

Critical review of research concerned with the use of time in homes for work and leisure in the United States and abroad.

[689 (489). THE TEACHING OF HOME MANAGEMENT IN COLLEGE]

Spring. Credit three hours. Consult instructor before registering. Miss Davey. Hours by arrangement.

An examination of the ways home management concepts have been taught in the past and may be taught in the future, through home management residence, observation and work with families in their homes, analysis of case studies, and laboratory experiences. Observation of classes and field trips are included.

Alternate-year course: not offered in 1966–67; offered in 1967–68.

690 (490). READINGS IN HOME MANAGEMENT

Fall. Credit two hours. For doctoral candidates. Department faculty. Two-hour discussion period to be arranged.

Review of critical issues in home management.

695 (495). ECONOMIC PROBLEMS OF FAMILIES

Spring. Credit three hours. Primarily for doctoral candidates. Miss Rollins.

Analysis of a few outstanding contributions to economic thought related to this field. Examination of methods of research.

699 (407). DOCTOR'S THESIS AND RESEARCH

Fall and spring. Registration with permission of the instructor and chairman of graduate committee. Misses Bymers, Davey, Purchase, Rollins, Steidl, Mrs. Vatter, Miss Walker.

When appropriate, 200- and 300-level HEM courses listed in the undergraduate Announcement may be taken by a graduate student with the approval of his Special Committee and the professor in charge.

DEPARTMENTAL SCHOLARSHIPS

Helen Canon Scholarship, $750 (anticipated award).
Ruth Ada Birk Eastwood, $950 (anticipated award).

Housing and Design

Faculty: Glenn H. Beyer, Lewis L. Bower, Helen J. Cady, Joseph Carreiro, Marilyn Langford, G. Cory Millican, Sarah Neblett, A. Lorraine Welling.

Field Representative: Marilyn Langford, 3M13 Martha Van Rensselaer Hall.

APPROVED MAJOR AND MINOR SUBJECT

Housing and Design

Language requirement for the Master's degree: college entrance language, or proficiency in a language approved by the Special Committee.

For the degree of M.A. with a major in housing and design, the work should be focused either in housing or in design. The student should have a general knowledge of basic concepts of the particular area (or branch of the area) in the Field of Housing and Design in which he proposes to major.

The program for the degree of M.A. varies for each phase of study. Flexibility in programing allows for varying backgrounds and objectives of students. A major must obtain comprehensive knowledge of one of the emphases within the Field. The student is required to fill in gaps in his background where they apply in such areas as social science, fine arts, statistics, and research methods. Such a student may need to spend additional time at Cornell. The candidate should choose a minor in a related field.

A major in the Field of Housing and Design leading to the Ph.D. degree is offered. The emphasis is on the socio-economic and family aspects of housing.

For work toward the doctorate with a major in Housing and Design the student must expand his knowledge beyond the specialized subject in which he focused for work toward the Master's degree. Professional experience is desirable. Two minors are selected from fields related to housing and design.

Members of the staff will direct work in the following areas:
Design: Professors Cady, Carreiro, Millican, Neblett, Welling.
Socio-economic aspects of housing: Professors Beyer, Bower, Langford.

COURSES

The following is a tentative listing of courses. Additional courses will be offered and some changes as to time and place of instruction may be made. Students should check final listing of departmental Field course offerings with the Secretary's Office, College of Home Economics, Room 146, Van Rensselaer.

[311A. DESIGN: PRINTMAKING]

Fall. Credit three hours. Prerequisite, H.D. 100. Limited to 15 students. Miss Straight. T Th 9–12. Room 322.

A studio course exploring the print as a design form. Emphasis is upon work done with the silk screen, but opportunities are provided for exploring other processes for both fabric and paper. Minimum cost of materials, $10. Not offered in 1966–67.

311B. DESIGN: WEAVING

Fall. Credit three hours. Prerequisite, H.D. 100. Limited to eight students. Miss Cady. T Th 9–12. Room 408.

A studio course exploring weaving as a design process for the structure of cloth. Projects experimenting with various fibers and materials are studied. Minimum cost of materials, $10.

323 (319). CONTEMPORARY DESIGN

Spring. Credit three hours. Miss Welling. M W F 9. Room 317.

A historical study of the emergence and development of contemporary design, 1885 to present.

An examination of the social, economic, technical, and style forces which shape the design forms of the present. Also a critical analysis of selected works of furniture, fabrics, interiors, etc., of our time.

325. INTERIOR DESIGN

Fall. Credit three hours. Prerequisite, H.D. 220. Limited to 15 students. Miss Cady. M W F 10–12. Room 408. Three additional hours of work required.

Interior design problems in evaluation of design qualities of furnishings and materials. Room schemes developed in accordance with the architectural design of the house and family use. Sketches, working drawings, presentation drawings for major projects. Field trip (approximate cost, $30). An equivalent experience may be arranged.

326. INTERIOR DESIGN

Spring. Credit three hours. Prerequisite, H.D. 325. Limited to 15 students. Miss Cady, Mr. Millican, and Miss Welling. W F 1:40–4:30. Room 318.

Special units taught by participating staff. Interior design problems of varying complexities at a more accelerated pace which approximates professional practice.

330. CONTRACT INTERIORS

Spring. Credit three hours. Limited to 15 students. Mr. Millican. T Th 1:40–4:30. Room 318.

This course involves the space planning and visual aspects of business and commercial interiors such as hotels, motels, public spaces, and specialized areas.

The course is primarily designed for Hotel Administration students and fulfills final Hotel Engineering elective requirements. The course is also available to those students in Home Economics with a strong professional focus. Permission of the instructor required for Home Economics students.

345. READINGS IN HOUSING

Spring. Credit two hours. Prerequisite, H.D. 147 and permission of the instructor. Mr. Bower, Miss Langford. Hours for discussion of reading to be arranged.

348. HUMAN ASPECTS OF HOUSING

Fall. Credit three hours. Upperclassmen and graduate students. Miss Langford. M W F 9. Room 301.

A consideration of individuals, families, and special groups in relation to housing requirements. Undertaken both through a critical analysis of human factors which are related to the design of housing and neighborhood and through an examination of current social problems related to housing—those facing the low-income family, the middle-income family, and special groups such as the aged and non-white groups.

349. HOUSING: SUPPLY

Spring. Credit three hours. Prerequisite, H.D. 147. Mr. Bower. M W F 9. Room 301.

This course investigates certain theories and concepts in housing such as problems of surburbanization and city growth; neighborhood factors and community facilities; importance of housing finance; influence of government policies.

439. (339). DESIGN SEMINAR

Spring. Credit three hours. For upperclassmen and graduate students. Instructor's signature required at preregistration. Mr. Carreiro. W 2–4. Room 317.

445. READINGS IN HOUSING

Spring. Credit two hours. Prerequisite, H.D. 447 and permission of the instructor. Mr. Beyer, Mr. Bower, and Miss Langford. Hours for discussion of readings to be arranged.

447. FUNDAMENTALS OF HOUSING

Fall. Credit three hours. Consult with instructor prior to registration. Preregistration required. Mr. Bower. T Th 4–5:30.

An introductory survey of housing as a field of graduate study. Consideration of the spatial context and institutional setting of housing: the structure, operations, and performance of the housing market and the house-building industry; housing finance; the nature, operations, impact, and policy of government housing programs; basic elements of housing market analysis; contemporary housing problems and issues.

500 (403). SPECIAL PROBLEMS FOR GRADUATE STUDENTS

Fall and spring. Credit and hours to be arranged. Department faculty. For graduate students recommended by their chairmen and approved by the head of the department, and the instructor in charge for independent, advanced work.

599 (407). MASTER'S THESIS AND RESEARCH

Fall and spring. Registration with permission of the instructor. Mr. Beyer, Mr. Bower, Miss Cady, Mr. Carreiro, Miss Langford, Mr. Millican, Misses Neblett and Welling.

600 (400). SEMINAR IN CURRENT HOUSING ISSUES

Spring. Credit three hours. Registration by permission of the instructor, based upon student's training, experience, and interest. Instructor's signature required at preregistration. Mr. Beyer. M 4–6. Room 111, West Sibley.

699 (407). DOCTOR'S THESIS AND RESEARCH

Fall and spring. Registration with permission of the instructor. Mr. Beyer, Mr. Bower, Miss Cady, Mr. Carreiro, Miss Langford, Mr. Millican, Misses Neblett and Welling.

Industrial and Labor Relations

Faculty: Leonard P. Adams, Robert L. Aronson, Isadore Blumen, Paul E. Breer, George W. Brooks, Ralph N. Campbell, Neil H. Cheek, Jr., M. Gardner Clark, Alice H. Cook, Donald E. Cullen, Robert E. Doherty, W. Duane Evans, Robert H. Ferguson, Felician F. Foltman, William H. Friedland, Leopold W. Gruenfeld, Kurt L. Hanslowe, George H. Hildebrand, Wayne L. Hodges, Vernon H. Jensen, Milton R. Konvitz, A. Gerd Korman, Henry A. Landsberger, Duncan M. MacIntyre, Philip J. McCarthy, Jean T. McKelvey, Emil A. Mesics, Frank B. Miller, David G. Moore, James O. Morris, Maurice F. Neufeld, Robert L. Raimon, Robert F. Risley, Ned A. Rosen, Jay Schulman, Fred Slavick, N. Arnold Tolles, Harrison M. Trice, William J. Wasmuth, William F. Whyte, Lawrence K. Williams, John P. Windmuller.

Field Representative: Frank B. Miller, 101 Ives Hall.

APPROVED MAJOR SUBJECTS	APPROVED MINOR SUBJECTS
Collective Bargaining, Labor Law, and Labor Movements	Industrial and Labor Relations Problems (available only for students majoring in other Fields of the Graduate School)
Economic and Social Statistics	International and Comparative Labor Relations
Labor Economics and Income Security	
Organizational Behavior	

ADMISSION REQUIREMENTS. All applicants whose native language is English are required to take the aptitude portion of the Graduate Record Examination. All candidates for admission whose native language is not English are required to take either the ETS or TOEFL language test. For admission to the Ph.D., program, a Master's degree or equivalent is required.

LANGUAGE REQUIREMENTS FOR THE VARIOUS DEGREES. The field offers a special professional degree, the Master of Industrial and Labor Relations (M.I.L.R.) which is essentially based on course work. There is no thesis requirement nor is there a requirement for proficiency in a foreign language. For the Master of Science degree and the Ph.D. degree the matter of foreign language requirements is left up to each individual's Special Committee.

FINAL EXAMINATIONS

1. M.I.L.R. EXAMINATION. The M.I.L.R. program is designed to provide broad coverage within the field and some opportunity for advanced specialized work. The program requires three semesters, not to include summer sessions, and a total of 12 courses, eight of which are required. At the conclusion of the third semester, a written and oral comprehensive examination, which covers the entire body of knowledge deemed necessary for professional competence in the field, is administered.

2. M.S. EXAMINATION. The final examination for the Master of Science degree has the following characteristics. It includes both a test of subject matter competence in the major and minor fields and a defense of the Master's thesis. The examination is both written and oral. It is attended by two or more faculty members who are not members of the student's Special Committee. The chairman of the M.S. Committee assumes the obligation to assure the attendance of the additional members of the Graduate Faculty who may be from appropriate Fields other than Industrial and Labor Relations. In addition, the completed thesis must be submitted to the committee sufficiently in advance to insure that the Final Examination can be scheduled and announced with at least 15 days notice.

3. PH.D. EXAMINATION. In addition to the Comprehensive Examination for admission to Ph.D. candidacy, the Field of Industrial and Labor Relations may administer a preliminary examination prior to admitting students to the doctoral program. A defense of the doctoral dissertation is, of course, required. Rules of the Field governing this Final Examination include the announcement to the faculty of the Field by the chairman of the Special Committee at least 15 days before the scheduled date; and the provision that the chairman also invite scholars from outside the Field, where appropriate, whether or not they are members of the University faculty.

RESEARCH AND STUDY OPPORTUNITIES AND SPECIALIZATIONS OF THE FACULTY

Opportunities for professional (usually terminal) study offered by the M.I.L.R. degree have already been pointed out. The faculty for this program is drawn very widely from the various subject matter departments of the field. For specialized program opportunities, it would be most convenient to consider these in terms of the subject matter departments one at a time.

Collective Bargaining, Labor Law, and Labor Movements

Mr. Neufeld, Chairman; Mrs. Cook, Mrs. McKelvey, Messrs. Brooks, Cheek, Cullen, Doherty, Hanslowe, Jensen, Konvitz, Korman, Morris, Windmuller.

This subject matter area is staffed by lawyers, institutional economists, and economic and social historians.

Departmental faculty members specialize in the following three areas: (a) the study of the legal framework within which labor-management relations systems in the United States have developed; (b) the study of the history and structure of various components of the American trade union movement at the local, national, and confederation levels; and (c) the study of institutions, practices, and principles relevant to understanding how parties at interest resolve conflicts over the conditions of the labor contract.

Economic and Social Statistics

Mr. McCarthy, Chairman; Mr. Blumen, Mr. Evans.

Staff members of the department are mathematical statisticians interested in the application of their area of expertise to the social studies. They offer students an opportunity to study how the tools of mathematical statistics help in describing and analyzing socio-economic phenomena and how various hypotheses can be tested quantitatively.

Labor Economics and Income Security

Mr. Hildebrand, Chairman; Messrs. Adams, Aronson, Clark, Ferguson, MacIntyre, Raimon, Slavick, Tolles.

This department is staffed primarily by economists. Such different specialized areas within economics as micro and macro, institutional and theoretical, welfare, developmental, and comparative are represented. In the area of the social insurances, scholarly competence and recognition do not require extensive formal training in economics, although there are also opportunities to apply economics to this subject.

Scholarly interests of students in this subject matter area lie primarily in two directions. Some seek to generalize about the ways in which movements

of prices, wages, and workers are related and to study the mechanisms of various labor markets. Others examine private and/or public programs designed to insure the working population against those risks of living in an industrial society which can be expressed in money terms.

Organizational Behavior

Mr. Foltman, Chairman; Messrs. Breer, Campbell, Cheek, Friedland, Gruenfeld, Hodges, Landsberger, Mesics, F. Miller, Risley, Rosen, Schulman, Trice, Wasmuth, Whyte, Williams.

This department is staffed by (a) behavioral scientists including psychologists, social psychologists, sociologists, and cultural anthropologists, all of whom are concerned with individuals, in work organizations, in industrial society; and (b) students of the manpower and organizational management function in complex work organizations.

The major opportunities for study offered by the department are twofold. Some scholars study the nature of industrial society as a *context* for complex work organizations, or study such organizations per se, or study the behavior of small groups and individuals which form the components of such organizations. A second group links the study of the management of manpower to the study of work organizations, primarily at the level of the *firm* (staffing, training, and development, rewards and punishment systems), but including manpower supply and training problems at the community and national level.

International and Comparative Labor Relations

Mr. Windmuller, Chairman; Mrs. Cook, Mrs. McKelvey, Messrs. Aronson, Clark, Friedland, Hildebrand, Jensen, Konvitz, Landsberger, Morris, Neufeld, Whyte.

Members of this department are also attached to one of the other teaching departments. In this subject matter area, students have an opportuniy to examine the following two major problem areas. The first is a comparative analysis of institutions which have developed to handle the labor market problems of industrial societies other than the United States, i.e., labor movements, patterns of industrial dispute settlement, the nature of governmental intervention both in regulating labor-management conflict and in protecting workers from the risks of industrial life. The second is the study of the same kinds of social institutions and economic conditions in *developing* countries which facilitate or impede industrial development.

COURSES

Collective Bargaining, Labor Law, and Labor Movements

ILR 500. COLLECTIVE BARGAINING I

Credit three hours. Fall and spring terms. Mr. Cullen, Mr. Gross, or Mr. Jensen.

A comprehensive study of collective bargaining with special emphasis being given to legislation pertinent to collective bargaining activities as well as to the techniques and procedures of bargaining and to the important substantive issues that come up in negotiation and administration of the collective agreement. Attention will also be given to problems of handling and settling industrial controversy.

ILR 501. COLLECTIVE BARGAINING II

Credit three hours. Spring term. Prerequisite: ILR 500 or equivalent. Mr. Cullen, Mr. Gross, or Mr. Jensen.

A detailed study of contract making and administration with particular reference to recent trends and problems in collective bargaining. Attention will be given to several representative industries, and prevailing agreements and case problems will be studied.

ILR 502. LABOR RELATIONS LAW AND LEGISLATION

Credit three hours. Spring term. Open to ILR graduate students; non-ILR students should apply to the instructor for permission. Mr. Hanslowe or Mr. Konvitz.

A survey and analysis of the labor relations law in which an examination is made of the extent to which the law protects and regulates concerted action by employees in the labor market. The legal framework within which the collective bargaining takes place is considered and analyzed. Problems of the administration and enforcement of the collective agreement are considered, as are problems of protecting the individual member-employee rights within the union.

ILR 503. ARBITRATION

Credit three hours. Spring term. Prerequisite: ILR 500. Mrs. McKelvey, Mr. Gross, or Mr. Jensen.

A study of the place and function of arbitration in the field of labor management relations, including an analysis of principles and practices, the preparation and handling of materials in briefs or oral presentation, and the work of the arbitrator, umpire, or impartial chairman.

ILR 504. LABOR DISPUTE SETTLEMENT

Credit three hours. Fall term. Prerequisite: ILR 500. Mrs. McKelvey, Mr. Gross, or Mr. Jensen.

An historical and contemporary study of the role of government in the adjustment of labor disputes, including such topics as the Railway Labor Act, Taft-Hartley Act, and state and federal laws governing emergency and public employment disputes. The course will also cover the leading administrative agencies in this field, including the Federal Mediation and Conciliation Service; state mediation agencies with special emphasis on the New York State Board of Mediation; and municipal mediation services. Various governmental techniques for dealing with labor disputes, including injunctions, seizure, fact finding, and compulsory arbitration will be analyzed.

ILR 505. LABOR UNION HISTORY AND ADMINISTRATION

Credit three hours. Fall term. Mrs. Cook, Mr. Brooks, Mr. Korman, or Mr. Neufeld.

A presentation of the history of labor in America, with some reference to colonial and early nineteenth-century labor, but with emphasis upon post-Civil War trade union development; an analysis of the structure and functions of the various units of labor organization, ranging from the national federation to the local union; and some consideration of special problems and activities such as democracy in trade unions and health and welfare plans.

ILR 506. READINGS IN THE HISTORY OF INDUSTRIAL RELATIONS IN THE UNITED STATES

Credit three hours. Fall term. Prerequisite: ILR 505 or equivalent. Mrs. Cook, Mr. Korman, or Mr. Neufeld.

A seminar covering, intensively and in historical sequence, the key documents, studies, legislative investigations, and memoirs concerning American industrial relations systems. Primarily designed to aid students in orienting themselves systematically and thoroughly in the field. Among the authors and reports covered are E. P. Thompson, John R. Commons, Norman Ware, Lloyd Ulman, the Abram Hewitt Hearings, the Henry W. Blair Hearings, the U. S. Industrial Commission, Philip Taft, Paul F. Brissenden, the United States Commission on Industrial Relations, Theodore W. Glocker, George E. Barnett, Frederick W. Taylor, Henry Gantt, Mary Parker Follett, Irving Bernstein, and Walter Galenson.

ILR 507. THEORIES OF INDUSTRIAL RELATIONS SYSTEMS

Credit three hours. Spring term. Prerequisite: ILR 505 or equivalent. Mrs. Cook, Mr. Korman, Mr. Neufeld, or Mr. Polisar.

An examination of the leading theories concerning the origins, forms, organization, administration, aims, functions, and methods of industrial relations systems. Among the theories studied are those formulated by Karl Marx, Mikhail Bakunin, Georges Sorel, Vladimir Lenin, Jujo Brentano, Beatrice and Sidney Webb, Herbert Croly, Antonio Gramsci, Selig Perlman, Frank Tannenbaum, the Guild Socialists, Karl Polanyi, and Clark Kerr, Frederick Harbison, John Dunlop, and Charles A. Myers.

LABOR LAW (Law 312)

Credit three hours. Fall term. Mr. Hanslowe.

The study of collective bargaining, including the right of employees to organize and to engage in concerted activities (strikes, boycotts, picketing); the resolution of questions concerning the representation of employees; the duty of employers and unions to bargain; the administration and enforcement of collective bargaining agreements; grievance procedure and arbitration; the duty of fair representation; and internal union affairs.

ILR 508. DEVELOPMENT OF LABOR RELATIONS TRAINING PROGRAMS

Credit three hours. Spring term. Mr. Brooks.

Designed for students (principally, but not exclusively, foreign students) with an institutional base in an organization (union, management, or government) that has its own collective bargaining agreement and experience, so that the student can develop specific training course material for use in that organization or institution; background theory and principles of training in this area including alternative methods and techniques, implications of using lay teachers as part of the training operation and effect upon training material; instruction in the use of training material in extension courses (where possible, the student would participate directly in extension teaching in School programs); intensive work in the drafting of training course or courses, which is the major project for the term.

ILR 600. LABOR RELATIONS LAW AND LEGISLATION

Credit three hours. Spring term. Mr. Hanslowe or Mr. Konvitz.

Following a brief survey of the development of labor relations law and legislation in the United States, an intensive study will be made of selected controversial aspects of the subject. Concentration will be on the questions that currently have a special interest because of their impact on public opinion as well as on labor-management relations. Some of the problems that will probably be analyzed are: national emergency disputes; strikes by public

employees (e.g., teachers); limits on organizational picketing; the secondary boycott; enforcement of arbitration clauses and awards; legal aspects of featherbedding in some selected industries.

ILR 601. COLLECTIVE BARGAINING

Credit three hours. Fall and spring terms. Mrs. McKelvey, Mr. Cullen, or Mr. Jensen.

An intensive analysis of the process and procedures of collective bargaining and the substantive issues in labor-management relations. Special consideration is given to the techniques and procedures used in drafting and administering the collective agreement, with emphasis being placed on the day-to-day problems that grow out of the administration of labor-management relations.

ILR 603. GOVERNMENTAL ADJUSTMENT OF LABOR DISPUTES

Credit three hours. Spring term. Mrs. McKelvey, Mr. Gross, or Mr. Jensen.

A study of particular problems of the role of the government in the adjustment of labor disputes. Opportunity is afforded to investigate and analyze the various techniques which are commonly used, and to investigate particular governmental agencies and their operations, including federal, state, and municipal agencies.

ILR 604. THEORIES OF INDUSTRIAL AND LABOR RELATIONS

Credit three hours. Spring term. Mr. Konvitz.

A study of some significant ideas that have played important roles in our industrial society, especially for their effects on labor-management relations. The approach is philosophical and ethical but with an awareness of the social role of ideas. In the past, the semester was devoted to a study of labor relations theories from the standpoint of Marxist ideology (Marx, Engels, and Laski); labor relations from the standpoint of the economic and social theories of Adam Smith and his predecessors; theories of the nature of work in recent Roman Catholic and Protestant theology.

ILR 605. LABOR UNION HISTORY AND ADMINISTRATION

Credit three hours. Spring term. Prerequisite: ILR 506 and 507, or permission of the instructor. Mrs. Cook, Mr. Brooks, Mr. Korman, or Mr. Neufeld.

Special, intensive studies in the history, structure, administration, government, and internal management of labor unions and confederations of unions. During each semester a different phase of labor union history and administration will be examined. Examples of such problems, varying from semester to semester, are unity in the American labor movement; left-wing unionism; racketeering and corruption; democratic practices; the purposes and techniques of great organizational drives; unions and political action; the role of business and unionism in American life; unions and the community; unions and their relationship with government; unions and international affairs; and the accomplishments of labor unions in such fields as education, banking, housing, pension systems, health and welfare services, co-operatives, public relations, and community services.

ILR 606. LABOR AND GOVERNMENT 1927–1947

Credit three hours. Spring term. Prerequisite: ILR 505. Mrs. Cook.

An historical survey of the pre-New Deal, the New Deal, the War, and the immediate Post-War periods, culminating in the passage of the Taft-Hartley Act. The course will trace the development and explore the nature and effect of government policy on labor welfare and labor relations legislation.

Students will each select a specific event or problem for intensive research on which they will report to the class and prepare a paper.

607. LEGAL PROBLEMS OF ECONOMIC REGULATION (Also listed as Law 114 and Economics 651)

Credit three hours. Fall term. Permission of instructor required. Mr. Hanslowe, Mr. Kahn (economics).

Exploration of legal problems encountered in regulating economic activity. The course is concerned with alternative techniques of government regulation, with economic criteria relevant to application of these techniques, and with problems of administrative structure, organization and procedure appropriate to the effectuation of economic policy. Materials will be drawn from the fields of administrative law, regulated industries (such as transportation and natural gas), labor law, and anti-trust. Previous or concurrent work in one or more of these fields and/or in economics will be highly desirable for students in the course, which is open to qualified students from other departments of the University. One purpose of the course will be to provide a forum for interchange of views and techniques between students of law and other graduate students of economic and public policy. There will be assigned readings, and each course participant will be required to complete a substantial research assignment.

608. RESEARCH SEMINAR IN THE HISTORY OF LABOR

Credit three hours. Fall term. Prerequisite: ILR 505, 506, and 507 or equivalent. Mr. Korman.

A seminar in the social history of the nineteenth century devoted to the study of workers in urbanizing and industrializing communities. Research ventures will extend across the various fields of history combining in particular the traditional field of labor history with aspects of urban and business history.

609. PROFESSIONALS AND THEIR ORGANIZATIONS

Credit three hours. Spring term. Permission of instructor required. Mrs. Cook.

Attention will be directed to characteristics of professional occupations and to problems of the professional, both self-employed and salaried. A variety of professional organizations will be studied including professional associations and unions, both in public and private sectors of the economy.

699. DIRECTED STUDIES

Credit to be arranged. Fall and spring terms.

For individual research conducted under the direction of a member of the faculty.

Economic and Social Statistics

ILR 310. DESIGN OF SAMPLE SURVEYS

Credit three hours. Spring term. Prerequisite: one term of statistics. Mr. McCarthy.

Application of statistical methods to the sampling of human populations. A thorough treatment of the concepts and problems of sample design with respect to cost, procedures of estimation, and measurement of sampling error. Analysis of non-sampling errors and their effects on survey results (e.g., interviewer bias and response error). Illustrative materials will be drawn from the fields of market research, attitude and opinion research, and the like.

ILR 311. STATISTICS II

Credit four hours. Fall term. Prerequisite: Statistics 210 or permission of instructor. Mr. McCarthy.

An intermediate nonmathematical statistics course emphasizing the concepts associated with statistical methods. Includes a treatment of estimation and tests of hypotheses with reasons for choice of various methods and models. Application to problems involving percentages, means, variances, and correlation coefficients with an introduction to nonparametric methods, analysis of variance, and multiple regression and correlation.

ILR 410. TECHNIQUES OF MULTIVARIATE ANALYSIS

Credit three hours. Fall term. Prerequisite: ILR 311. Mr. Blumen.

An advanced undergraduate and beginning graduate course emphasizing the techniques of multivariate statistical analysis, together with a discussion of underlying assumptions and illustrations of applications. There is no mathematical prerequisite, but some matrix algebra and related topics will be introduced. Techniques covered will include multiple regression and correlation, principal components, correlation between sets of variables, tests of hypotheses on sets of means and variances, multivariate analysis of variance, multivariate methods for ranked and qualitative variables, discrimination between populations, and applications of modern computing techniques in multivariate analysis.

ILR 411. STATISTICAL ANALYSIS OF QUALITATIVE DATA

Credit three hours. Spring term. Prerequisite: ILR 311 and permission of instructor. Mr. Blumen.

An advanced undergraduate and beginning graduate course. Includes treatment of association between qualitative variates, paired comparisons, rank order methods, and other non-parametric statistical techniques, including those related to chi squared.

ILR 510. ECONOMIC AND SOCIAL STATISTICS

Credit three hours. Fall and spring terms. Mr. McCarthy.

A nonmathematical course for graduate students in the social studies without previous training in statistical method. Emphasis will be placed on discussion of technical aspects of statistical analysis and on initiative in selecting and applying statistical methods to research problems. The subjects ordinarily covered will include analysis of frequency distributions, regression and correlation analysis, and selected topics from the area of statistical inference.

ILR 610. ECONOMIC AND SOCIAL STATISTICS

Credit three hours. Fall term. Prerequisite: permission of instructor. Mr. Evans.

This course is directed primarily toward the basic concepts underlying quantification in economics, and an examination of how these requirements are realized in practice. It is intended to familiarize students with the tools used to analyze labor force, employment, unemployment, production, value-added, productivity, labor costs, prices, capital stocks, etc., what they mean, their proper areas of application, and their limitations. Topics in the methodology of economic statistics, including time series analysis and index number problems, will be reviewed.

699. DIRECTED STUDIES

Credit to be arranged. Fall and spring terms.

For individual research conducted under the direction of a member of the faculty.

Labor Economics and Income Security

540. LABOR ECONOMICS

Credit three hours. Fall and spring terms. Required of graduate students majoring or minoring in Labor Economics and Income Security and M.I.L.R. candidates. Not normally open to undergraduates. Prerequisite: Economics 103–104 or equivalent. Enrollment limited to 20 students each term. Mr. Ferguson and other members of the department.

Economic issues in the employment and compensation of labor. Topics discussed include labor force growth and composition, structure and functioning of labor markets, unemployment, wage theories, wage levels and structures, the economic influence of unions, income distribution, the problem of poverty.

542. DEVELOPMENT OF WAGE THEORY

Credit three hours. Fall term. Mr. Tolles.

Intensive consideration of the original texts of leading wage theorists from Adam Smith to J. B. Clark. The logic used by each of the authors is analyzed in the light of the varying problems they perceived, the doctrines each of them advocated, and the consequent relevance of each theory to present-day wage-employment problems.

543. CONTEMPORARY WAGE THEORY

Credit three hours. Spring term. Open to graduate students who have completed ILR 540 or its equivalent. Mr. Ferguson.

Discussion of modern wage and employment theories. Emphasis is placed upon developing the analytical skill of the student, rather than coverage of subject matter.

544. SOCIAL SECURITY AND PROTECTIVE LABOR LEGISLATION

Credit three hours. Fall term. Required of graduate students majoring or minoring in Labor Economics and Income Security, and M.I.L.R. candidates. Mr. Slavick.

The fundamental aspects of employee protection and income security. Emphasis will be placed upon state and federal minimum wage and hour laws, health and safety legislation, employee benefit programs, and the social insurances. The underlying causes of the legislation, as well as the legislative history, the administrative problems and procedures, and the social and economic impact of the legislation will be studied. Efforts of unions, employers, and government in the establishment of labor standards will also be considered.

641. COMPARATIVE SOCIAL AND LABOR LEGISLATION

Credit three hours. Spring term. Mr. MacIntyre.

The seminar is designed as a comparative study of social and labor legislation in the United States and foreign countries. Emphasis will be given to the economic and social conditions which promote legislation and the effects of the laws on the economy of the nation and the structure of industry. Research reports, lectures, and discussion of legislation under consideration.

644. CURRENT ISSUES IN ECONOMIC SECURITY

Credit three hours. Fall term. Mr. MacIntyre and Mr. Slavick.

An examination of issues arising in government, union, and management programs providing protection for income and essential welfare services. Economic and administrative problems and interrelationships of private and public plans will be studied. A seminar with readings, research reports, discussions, and occasional lectures.

645. COMPARATIVE ECONOMIC SYSTEMS: SOVIET RUSSIA

Credit three hours. Fall and spring terms. Prerequisite: ILR 445. Mr. Clark.

Preparation and discussion of individual papers on selected topics concerning the Soviet economy.

647. SEMINAR IN LABOR ECONOMICS

Credit three hours. Spring term. Mr. Tolles.

Preparation, defense, and group discussion of individual papers on selected topics in labor market economics. Each individual topic, subject to approval of the seminar group, will involve an analysis of some specific problem, policy, theory, or relationship as selected by the individual student.

648. SEMINAR IN LABOR ECONOMICS

Credit three hours. Fall term. (Also listed in the College of Arts and Sciences as Economics 641.) Mr. Hildebrand.

Reading and discussion of selected topics in current labor economics in the fields of theory and policy.

699. DIRECTED STUDIES

Credit to be arranged. Fall and spring terms. Departmental staff.

Individual research conducted under the direction of a member of the faculty.

Organizational Behavior

Graduate students majoring or minoring at the Master's or doctoral level in the area of organizational behavior will normally complete the core offering in this area, Organizational Behavior I and II, ILR 520, 521. Depending upon the nature of the program of the individual student, both courses may be taken in the same term, or they may be taken in different terms with either course preceding the other. In addition, graduate students majoring in organizational behavior will normally take ILR 564–565, Behavioral Research Theory, Strategy and Methods I and II. (Exemptions and exceptions are made on an individual basis.)

All M.I.L.R. students will be expected to take both core courses as well as an elective course within the subject area of organizational behavior as a part of their program unless exempted under procedures established in the M.I.L.R. program. ILR 523, Manpower and Organization Management, is recommended as the optional course within the subject area.

ILR 520. ORGANIZATIONAL BEHAVIOR I

Credit three hours. Fall and spring terms. Required of graduate students majoring or minoring in the area of organizational behavior and M.I.L.R. candidates. Open to other graduate students with a major or minor in the field of industrial and labor relations. Department faculty.

Survey of concepts and studies from the fields of individual and social psychology selected for their pertinence to the area of organizational behavior. The relationship between research findings and application to organizational problems will be stressed. Consideration of individual differences of various kinds; attitude formation and its relation to social processes; factors affecting different kinds of learning; motivation and its relationship to productivity; perception and its relationship to evaluation of performance; leadership and the influence process; group formation and its effect on the individual and the organization.

ILR 521. ORGANIZATIONAL BEHAVIOR II

Credit three hours. Fall and spring terms. Required of graduate students majoring or minoring in the area of organizational behavior and M.I.L.R. candidates. Open to other graduate students with a major or minor in the field of industrial and labor relations. Department faculty.

Organizational Behavior II deals primarily with three major subject matter areas including: (1) the structure and dynamics of organizations, (2) the administration of the employee relations functions, and (3) cases and problems which help the student to integrate and apply conceptual understandings underlying work in the subject of organizational behavior. Designed to provide graduate students with the basic background and understanding of the organization and management of organizations and of the problems arising within the organizational context. The basic background, coupled with work in employee relations, is designed as a preliminary to more intensive work in organizational behavior.

ILR 522. THEORIES OF ORGANIZATION

Credit three hours. Spring term. Mr. Schulman.

Intended for students interested in more intensive work in theories of organizations and organizational behavior. Writings in the now extensive field of organizational theory will be examined. These may include the intellectual predecessors of the field (Marx, Weber, and Durkheim). Contemporary works of organizational theory may include Homans, Blau, Caplow, Barnard, March and Simon, Etzioni, Crozier, Dahrendorf. The course will require a term paper and extensive readings in primary sources.

ILR 523. MANPOWER AND ORGANIZATION MANAGEMENT

Credit three hours. Alternate terms. Prerequisite: ILR 520 or 521. Mr. Mesics, Mr. Miller, Mr. Trice, or Mr. Wasmuth.

A basic graduate course covering the major areas of manpower and organizational policy as they relate to human behavior and work organizations. Intensive consideration will be given to such aspects of personnel work as selection and placement, compensation, training and development, employee-employer relations, health and safety, employee benefits and services, and personnel research. The course will examine how the conduct of the personnel function affects attainment of all organizational objectives. In addition, the personnel and industrial relations occupations will be examined in terms of their career patterns and organizational role.

ILR 524. PUBLIC POLICY AND DEVELOPMENT OF HUMAN RESOURCES

Credit three hours. Fall term. Mr. Foltman.

Analysis of the need for development of human resources, trends in work force requirements and implications for public policy, the role of government and of educational institutions in providing development programs, and the effectiveness of such programs. Attention to the rationale, organization, and

administration of specific programs, such as apprenticeship, vocational and technical schools, technical institutes, university programs for development of technical, scientific, and managerial skills, and the foreign technical assistance program. Implications and problems of public support for the development of human resources.

ILR 525. PERSONNEL SELECTION AND PLACEMENT

Credit three hours. Spring term. Prerequisite: ILR 210 Statistics I (statistical reasoning), 510, or equivalent. Permission of instructor is required for non-ILR students. Mr. Campbell, Mr. Rosen, or Mr. Trice.

A study of the employment function in personnel administration. Designed to analyze the techniques and devices used in the recruitment, interviewing, testing, selection, and placement of personnel. Emphasis is placed on applied psychological measurement principles and techniques. Interviews, personnel history analysis, psychological tests, and the evaluation of these procedures in terms of appropriate criteria of success on the job will be considered in detail.

ILR 526. ADMINISTRATION OF COMPENSATION

Credit three hours. Fall term. Open to graduate students who have completed ILR 521, 523, or equivalent. Mr. Perrins.

The development and administration of wage and salary programs with major emphasis on internal consideration. Subjects include program principles, objectives, and policies; organization of the function; and procedures to implement policies. Topics include job and position analysis; preparation of description-specifications; job evaluation; incentive applications; wage and salary structures; the use of wage surveys; supplemental payments, including premium pay, bonuses, commissions, and deferred compensation plans; and the use of automatic increment provisions. Case studies and assigned projects will cover selected programs.

ILR 527. MANAGEMENT AND LEADERSHIP DEVELOPMENT

Credit three hours. Fall term. Mr. Campbell or Mr. Foltman.

Study of the factors affecting the growth and development of managers and leaders in industrial and other organizations. Consideration is given to the organizational environment; formal and informal developmental programs; leadership theory; and individual attitudes and beliefs. Special emphasis is given to analysis of specific case studies of actual practice.

ILR 528. CASE STUDIES IN PERSONNEL ADMINISTRATION

Case three hours. Fall term. Mr. Mesics or Mr. Wasmuth.

A seminar devoted to an analysis of personnel management activities and their impact on organizational objectives and administration. Cases, incidents, and field data, derived from a variety of institutional settings, will provide a framework for examining and explaining the various roles played by personnel managers. When it is appropriate, attention will be given to the evolution and formalization of personnel activities within growing small business organizations. Students will have an opportunity for field work and are required to prepare individual cases for class presentation and discussion.

ILR 529. DESIGN AND ADMINISTRATION OF TRAINING PROGRAMS

Credit three hours. Spring term. Mr. Foltman or Mr. Mesics.

A comprehensive study of organizational training with special emphasis on intraorganization policy, program, and evaluation. Attention will be given, through case discussion, to the philosophy and administration of selected training programs.

ILR 562. ADMINISTRATIVE THEORY AND PRACTICE

Credit three hours. Spring term. Prerequisite: ILR 520 or permission of the instructor. Mr. Campbell.

Analysis of the role of the decision-maker in carrying out his administrative functions. Consideration will be given to organizational structure and relationships, process of planning and decision making, measurement and control, and the direction of work. Basic theories from scientific management, bureaucratic studies, and human relations research will be analyzed with regard to their usefulness to the practicing administrator. Current practices will be evaluated against research findings. Cases will be used frequently to examine the nature of administration as both art and science.

ILR 563. THEORIES AND METHODS OF ORGANIZATIONAL CHANGE

Credit three hours. Spring term. Prerequisite: ILR 520, ILR 521 and/or consent of instructor. Department faculty.

The primary concern will be an examination of certain change agents as they attempt to initiate, structure, and direct organizational change. Attention will be given to the strategies used by these change agents as they are related to selected theories of organizational behavior and organizational change. Among the change agents which will be considered are consultants, union organizers, applied social scientists, staff and managerial personnel.

ILR 564. BEHAVIORAL RESEARCH THEORY, STRATEGY, AND METHODS I

Credit variable. Fall term. Permission of instructor required. Department faculty.

Designed to meet the needs of M.S. and Ph.D. candidates majoring in organizational behavior, but other graduate students may enroll.

Units of material to be included are: (1) theoretical, conceptual, and ethical questions; (2) survey research and attitude scaling procedures; (3) laboratory research methods; (4) participant observation and interview methods, and (5) the use of documents and qualitative data analysis. The course will provide the student with important philosophical background for doing research and will expose him to a well-balanced, interdisciplinary set of quantitative and qualitative research tools. Readings will be supplemented by projects and laboratory exercises.

ILR 565. BEHAVIORAL RESEARCH THEORY, STRATEGY, AND METHODS II

Credit variable. Spring term. Permission of instructor required. Department faculty.

Must be taken in sequence with ILR 564 except by petition. Designed to meet the needs of M.S. and Ph.D. candidates majoring in organizational behavior, but other graduate students may enroll.

ILR 625. MANPOWER AND ORGANIZATION MANAGEMENT

Credit three hours. Fall and spring terms. Mr. Foltman, Mr. Mesics, Mr. Trice, and department faculty.

A seminar in which intensive study will center in one or two specific areas of manpower and organization management. For example, the area of evaluation of personnel functions might be selected, with each student taking as his seminar project the evaluation of a particular personnel function. Other areas that might be chosen for intensive study are policy formulation

and implementation; wage and salary administration; communication; organizational and personal development; testing and rating, training, attitude and morale studies, and personnel research. Designed to provide a framework for individual and group research efforts in the area of personnel administration and to aid constructively such research. Seminar time will be made available for review of such efforts. Readings, field visits, and guest speakers are included.

ILR 627. CURRENT ISSUES AND RESEARCH IN HUMAN RESOURCES DEVELOPMENT

Credit three hours. Fall and spring terms. Fall term: Mr. Foltman or Mr. Gruenfeld. Spring term: Mr. Foltman or Mr. Gruenfeld.

A graduate seminar centering on selected issues and relevant research involved in the development of managerial and work force skills (particular emphasis for the seminar to be determined with the seminar group). Seminar papers and class discussions might concentrate on such topics as management development, impact of technological change on training programs, development of scientific and professional personnel, or labor union education.

ILR 628. CASE STUDIES IN ORGANIZATIONAL BEHAVIOR, COMMUNICATION, AND PUBLIC OPINION

Credit three hours. Spring term. Mr. Hodges.

A seminar dealing with representative cases and problems in the public and in-plant relationships of industry and labor, with particular emphasis on employee communications and community relations.

ILR 660. SEMINAR ON PERSONALITY AND ORGANIZATION

Credit three hours. Fall or spring term. Prerequisite: ILR 520 and ILR 521, or permission of instructor. Mr. Williams.

This seminar attempts to integrate available research and focuses on both personality and organizational variables. Investigations in the field of culture and personality will be examined for their utility in the understanding of organizational functioning. The relationship of personality to economic development will also be examined. Participants will be encouraged to write a term paper on the interrelationship of technology and values.

ILR 661. LEADERSHIP IN ORGANIZATIONS

Credit three hours. Spring term. Permission of instructor required. Mr. Gruenfeld.

This seminar is designed to examine theories and research findings from the behavioral sciences that are relevant to leadership and the influence process in groups and organizations. Personality, situational factors, intragroup processes, interpersonal perception as well as motivation to lead and to follow will be discussed. The implications for leadership training, organization development and action research will be explored.

ILR 662. CROSS-CULTURAL STUDIES OF WORK AND INSTITUTIONAL DEVELOPMENT

Credit three hours. Fall and spring terms. Permission of instructor required. Mr. Whyte.

A research seminar devoted to the analysis of survey and anthropological field reports from Peruvian villages, industrial plants, and schools. Each student will select a problem area for analysis and will write a research report.

ILR 699. DIRECTED STUDIES

Credit to be arranged. Fall and spring terms.

For individual research conducted under the direction of a member of the faculty.

International and Comparative Labor Relations

ILR 530. COMPARATIVE INDUSTRIAL RELATIONS SYSTEMS I

Credit three hours. Fall term. Prerequisite for non-ILR graduate students: ILR 250, Survey of Industrial and Labor Relations, or consent of instructor. Mr. Neufeld or Mr. Windmuller.

An introductory course concerned with the history, structure, institutional arrangements, and philosophy of the labor relations systems of several countries in advanced stages of industrialization. Countries to be examined include Great Britain, France, Germany, and the Soviet Union.

ILR 531. COMPARATIVE INDUSTRIAL RELATIONS SYSTEMS II

Credit three hours. Spring term. Prerequisite for non-ILR graduate students: ILR 250, Survey of Industrial and Labor Relations, or consent of instructor. Mr. Neufeld or Mr. Windmuller.

A comparative review of systems of labor relations of countries in the early and intermediate stages of economic development. The course surveys the development of industrial labor forces, the evolution and functions of labor organizations, the role of government in industrial relations, and the emergence of different patterns of labor-management relations. The course also covers the history of individual labor relations systems in selected countries of Asia, Africa, the Middle East, and the Western Hemisphere.

ILR 532. SOCIAL ASPECTS OF MODERNIZATION

Credit three hours. Fall term. Open to graduate students who have had two courses in sociology or with the consent of the instructor. Mr. Friedland or Mr. Landsberger.

Analysis of the concepts of change, progress, and development and their ideological content. Indicators and correlates of development and their measurement. Types of theories: endogenous vs. exogenous; monolineal vs. multilineal; convergent vs. parallel vs. divergent, etc. Types of causes: economic, technological, group-status, demographic, individual-motivation. Critical sectors and institutions: political and the problem of revolutions; educational and the problem of mobility; military and the problem of democracy; intellectuals and the problem of ideologies.

ILR 533. INDUSTRIAL RELATIONS IN LATIN AMERICA

Credit three hours. Spring term. Mr. Morris.

A broad survey of industrial and labor relations in Latin America in their geographic, political, economic, and social settings. A framework for analysis of industrial relations systems in developing societies is presented and applied to the Latin American area. This is followed by discussion of labor codes, organized labor and political parties, management, and labor-management relations. The labor movements and industrial relations systems of five or six of the Latin American republics are then presented as case studies. Comparisons are made with United States experience whenever possible. Finally, the history and present status of hemisphere labor movements are presented and special comment is made on the role of United States labor in these movements.

ILR 534. SOCIAL PROBLEMS OF INDUSTRIALIZATION IN LATIN AMERICA

Credit three hours. Spring term. Prerequisite: two courses in sociology or ILR 532 or consent of instructor. Mr. Landsberger.

Review of economic background. Demographic problems: population "explosion," urbanization, migration, immigration and emigration. Social class structure: property and income distribution and distribution of political power. Role of key groups: military, intellectuals, white collar employees, urban and rural working class, new industrialists, old aristocracy. Problem-solving institutions: education, social security, health, housing, land reform. Alliance for Progress. Throughout, differences as well as similarities between Latin American countries will be stressed.

ILR 535. POLITICS AND INDUSTRIALIZATION IN EMERGING NATIONS

Credit three hours. Fall term. Mr. Ahmad.

The problems and perspectives of industrialization in developing nations are studied with special reference to three related questions: (1) the methods and theories for analyzing societies undergoing fundamental transformation from the agrarian to the industrial way of life; (2) the causes, character, and direction of this revolution of modernization; (3) the role of ideologies, elites, and institutions in the modernizing process.

Selected countries of Asia, Africa, the Middle East, and Latin America are analyzed as alternative models of modernization. Attention is given to the role of labor and industrial organization, and of foreign aid in the process of development.

ILR 630. INTERNATIONAL AND COMPARATIVE LABOR PROBLEMS

Credit three hours. Fall term. Prerequisite: ILR 530 or 531 or consent of instructor. Mr. Windmuller.

Students will examine selected problems in labor relations in the light of international and comparative experience and will be expected to prepare, discuss, and defend individual research papers. Seminar topics will vary from year to year in line with student and faculty interests.

ILR 631. SOCIAL PROBLEMS OF INDUSTRIALIZATION

Credit three hours. Spring term. Permission of instructor required. Mr. Friedland or Mr. Landsberger.

A seminar concerned with social aspects of the process of industrialization for students already conducting research in this area. Students will have the opportunity to present papers, and discuss recent advances in the study of social change which is the product of industrialization.

ILR 632. PEASANT MOVEMENTS

Credit three hours. Spring term. With rare exceptions, a reading knowledge of at least one relevant foreign language (e.g., German, French, Russian, Spanish, Chinese, Japanese) will be required. Mr. Landsberger or Mr. Ahmad.

A study of peasant movements, past and present, in different societies in order to clarify differences and similarities, and their causes with respect to: objectives of such movements; means utilized; groups and institutions on which pressure is brought; groups and institutions with which alliances are effected; social, economic and political status of all groups involved; value systems and ideologies of peasant movements; success and failure.

ILR 633. SOCIOLOGICAL AND HISTORICAL ANALYSES OF SOCIALIST THEORY AND PRACTICE

Credit three hours. Fall term. Mr. Friedland.

A research seminar addressed to selected areas of socialist thought. The seminar will concentrate each year on a different problem and examine the nature of that problem, not only in its historical dimensions but also in terms of its sociological consequences. The aspects of socialist thought to be examined may include the following subjects: the consequences of the division of labor for social stratification in socialist societies; monism and pluralism in socialist societies; the role of trade unions in socialist societies; and nationalism and internationalism in socialist thought.

699. DIRECTED STUDIES

Credit to be arranged. Fall and spring terms.

For individual research conducted under the direction of a member of the faculty.

Attention is also called to courses in other ILR departments which may be useful in fulfilling requirements for the minor in International and Comparative Labor Relations: ILR 440, Labor Force Analysis and Manpower Economics, Mr. Aronson; ILR 645, Comparative Economic Systems: Soviet Russia, Mr. Clark; ILR 641, Comparative Social and Labor Legislation, Mr. MacIntyre or Mr. Slavick.

Institution Management

Faculty: Mary K. Bloetjes, Kathleen Cutlar. Field Representative: Mary K. Bloetjes.

APPROVED MAJOR AND MINOR SUBJECT

Appropriate Major Subject: Administrative Dietetics (for M.S.)

Appropriate Minor Subject: Administrative Dietetics (for M.S.) (for Ph.D.)

A strong background of undergraduate courses in food and nutrition and the supporting physical and biological sciences, and a well-balanced program in other branches of home economics are expected. Undergraduate courses in institution management and some experience in administrative dietetics are desirable.

Graduate work leading to the Master's degree may emphasize either administrative or technical aspects of the Field. There is no prescribed program of study for either the major or the minor in this Field. It is expected that the program will supplement the student's previous training and experience to achieve a well-rounded knowledge of the subject, with due consideration given to the student's purpose in undertaking graduate study.

Appropriate minors are in other branches of home economics, particularly food or nutrition or, outside home economics, in the Fields of Industrial and Labor Relations and Education.

Members of the staff direct research in layout and equipment, in curriculum, and in various aspects of management.

The Field of Institution Management in the College of Home Economics offers opportunities for research in a well-equipped quantity food research laboratory and available operational food services. Several graduate assistantships and the Katharine W. Harris fellowship are available.

COURSES*

440. QUALITY AND QUANTITY FOOD CONTROL

Spring. Credit two hours. Prerequisites, I.M. 241, and I.M. 419. Open to seniors by special permission. Mrs. Bloetjes. T Th 4. Room 124.

The integration of production quantities, purchase standards, account classifications, and distribution control based on standard portioned menu items. Emphasis on the application of data processing.

500 (403). SPECIAL PROBLEMS FOR GRADUATE STUDENTS

Fall and spring. Credit and hours to be arranged. Department faculty. For graduate students recommended by their chairmen and approved by the head of the department and the instructor in charge for independent, advanced work.

510 (410). SEMINAR IN DIETARY AND FOOD SERVICE ADMINISTRATION

Spring. Credit one hour. Required of all graduate students in the department. Miss Cutlar. W 4, Room 301.

519 (419). THEORY OF QUANTITY MENU ITEM PRODUCTION AND SERVICE

Fall. Credit three hours. Instructor's signature required for preregistration. Mrs. Bloetjes. M W F 10. Room 124.

Principles of processing, production scheduling, equipment, and labor scheduling and cost control will be emphasized in relation to menu items prepared in quantity for institutions. Provides a basic understanding of the production aspects of quantity menu items and will be coordinated with the students' summer practicum experience.

520 (420). ADVANCED FOOD SELECTION AND PURCHASE

Fall. Credit three hours. Instructor's signature required for preregistration. Lecture and discussion, T 2–4, Th 3. Room 301.

A discussion of sources, standards of quality, grades, care, and storage of various food commodities. Emphasis on the development of purchasing policies and the organization of purchasing procedures.

525 (425). ADVANCED ORGANIZATION AND MANAGEMENT

Spring. Credit two hours. Instructor's signature required for preregistration. M F 2. Room G-106.

Analysis and interpretation of major administrative problems in the operation of a dietary department. Scientific application of business management, and of budgetary and production control principles are studied in relation to quantity meal service.

527 (427). DIETARY DEVELOPMENT LAYOUT AND EQUIPMENT SELECTION

Spring. Credit two hours. Instructor's signature required for preregistration. Miss Cutlar. W 2–4. Room 124.

Focused on the principles of layout planning and equipment selection for hospitals, schools, and other food service facilities; survey of current trends and projected developments affecting planning for the future. A one-day

* Course numbers in parentheses refer to 1965-66 *Announcement of the College of Home Economics.*

field trip to a restaurant supply firm and typical dietary facilities is planned. Cost $5.

528. (428). SCHOOL LUNCH MANAGEMENT

Spring. Credit two hours. Instructor's signature required for preregistration. T Th 12 and one additional hour to be arranged. Room 3-M-11.

A survey course of the national school lunch program including organizational structure, cost control record keeping, and special management procedures that are concerned with the nutritional aspects of the school lunch operation on the local level. Analysis of monthly reports and reimbursement controls for the Type A lunch and the special milk program will be furnished.

A minimum of two field trips will be required for study of active school lunch programs.

529 (429). SANITARY ASPECTS OF MENU ITEM PREPARATION IN QUANTITY

Spring. Credit two hours. Instructor's signature required for preregistration. T Th 11 and additional conferences to be arranged. Room 3-M-11.

Topics will include sources of food contamination, holding conditions as they affect bacterial multiplication, and principles of sanitary handling and holding of ingredients and menu items as they apply to hospital and school food services. Emphasis will be placed on the presentation of recent research data.

599 (407). MASTER'S THESIS AND RESEARCH

Fall and spring. For graduate students with training and experience satisfactory to the instructor. Hours to be arranged. Mrs. Bloetjes and Miss Cutlar.

International Agricultural Development

Faculty: Douglas E. Ashford, Frederick T. Bent, Carl W. Boothroyd, Paul A. Buck, Marlin G. Cline, Howard E. Conklin, Loy V. Crowder, Tom E. Davis, Bert L. Ellenbogen, Herbert L. Everett, Reeshon Feuer, Donald K. Freebairn, William H. Friedland, Frank H. Golay, David B. Hand, Robert F. Holland, William K. Jordan, William C. Kelly, George C. Kent, Richard P. Korf, Frank V. Kosikowski, Douglas J. Lathwell, J. Paul Leagans, John K. Loosli, Harry A. MacDonald, John G. Matthysse, John W. Mellor, Philip A. Minges, Robert B. Musgrave, Thomas T. Poleman, Jr., Robert A. Polson, Robert M. Smock, Earl L. Stone, Jr., Robert D. Sweet, George W. Trimberger, Kenneth L. Turk, André G. van Veen, Frank W. Young.

Field Representative: Kenneth L. Turk, 102 Roberts Hall.

APPROPRIATE MINOR SUBJECT

International Agricultural Development

This Field is intended primarily for students who are preparing for service in foreign countries. The student will seek depth of knowledge by majoring in a biological, physical, or social science. The minor subject draws from several disciplines with the objective of assisting the student in understanding the special conditions and problems of newly developing economies. While this minor is planned specifically for students majoring in one of the graduate Fields of agriculture, other qualified students are welcome. It is intended for students from other countries as well as for those from the United States. Stu-

dents will register for seminars, courses, and special problems offered by the several departments and colleges.

A student minoring in this Field is encouraged to gain speaking proficiency in a language likely to prove most useful in this area of service in addition to meeting the language requirements in his major Field.

A student may not minor in this Field if he is minoring in Asian Studies or Latin American Studies, and he may not select a professor for this minor who also serves on the Graduate Faculty in the student's major Field.

COURSES

International Agriculture

600. SEMINAR: INTERNATIONAL AGRICULTURAL DEVELOPMENT Fall and spring terms. No credit. Third and fourth Wednesdays 4:30–5:30. Plant Science 404. Professor Turk and staff.

Primarily for graduate students interested in an integrated view of problems related to international agricultural development. Undergraduates with a specialization in International Agriculture are encouraged to attend without registering. The seminar will focus on developing an understanding of the nature and interrelatedness to agricultural development of the social sciences, plant and animal sciences, foods and nutrition, and natural resources.

ECONOMIC ASPECTS OF THE WORLD'S FOOD. (AGRICULTURAL ECONOMICS 560.)

SEMINAR ON AGRICULTURAL POLICY. (AGRICULTURAL ECONOMICS 651.)

SEMINAR ON THE AGRICULTURAL DEVELOPMENT OF SOUTH ASIA. (AGRICULTURAL ECONOMICS 664.)

SEMINAR ON LATIN AMERICAN AGRICULTURAL POLICY. (AGRICULTURAL ECONOMICS 665.)

SEMINAR ON THE ECONOMICS OF TROPICAL AGRICULTURE. (AGRICULTURAL ECONOMICS 667.)

SEMINAR IN THE ECONOMICS OF AGRICULTURAL DEVELOPMENT. (AGRICULTURAL ECONOMICS 668.)

LOW-COST ROADS. (AGRICULTURAL ENGINEERING 491.)

GEOGRAPHY AND APPRAISAL OF SOILS OF THE TROPICS. (AGRONOMY 401.)

TROPICAL AGRICULTURE. (AGRONOMY 422.)

ECONOMIC CROPS OF THE WORLD, THEIR NATURE, PROPERTIES, PRODUCTS, AND USE. (AGRONOMY 425.)

LIVESTOCK PRODUCTION IN THE TROPICS. (ANIMAL SCIENCE 400.)

ADVANCED PARASITOLOGY. (MEDICAL ENTOMOLOGY.) (ENTOMOLOGY 552.)

INTERNATIONAL COMMUNICATION. (EXTENSION TEACHING 501.)

INTERNATIONAL FOOD DEVELOPMENT. (FOOD SCIENCE 403.)

PROBLEMS AND PROGRAMS IN INTERNATIONAL NUTRITION (School of Nutrition 100.)

SEMINAR IN WORLD PROBLEMS OF FOOD AND POPULATION (School of Nutrition 250.)

PRINCIPLES OF SEED PRODUCTION, TECHNOLOGY, AND DISTRIBUTION. (PLANT BREEDING 506.)

PRINCIPLES OF EXTENSION EDUCATION PROGRAMING AND TEACHING. (RURAL EDUCATION 524.)

COMMUNICATION IN EXTENSION AND COMMUNITY DEVELOPMENT PROGRAMS. (RURAL EDUCATION 525.)

SEMINARS: COMPARATIVE EXTENSION EDUCATION SYSTEMS. (RURAL EDUCATION 626.)

SEMINAR: IMPLEMENTING EXTENSION AND COMMUNITY DEVELOPMENT PROGRAMS IN DEVELOPING COUNTRIES. (RURAL EDUCATION 627.)

RURAL SOCIAL SYSTEMS. (RURAL SOCIOLOGY 412.)

LATIN AMERICAN SOCIETIES IN TRANSITION. (RURAL SOCIOLOGY 414.)

COMPARATIVE RURAL SOCIETIES. (RURAL SOCIOLOGY 420.)

CROSS-CULTURAL RESEARCH METHODS. (RURAL SOCIOLOGY 516.)

APPLICATIONS OF SOCIOLOGY TO DEVELOPMENT PROGRAMS. (RURAL SOCIOLOGY 528.)

CONTEMPORARY THEORIES OF SOCIAL CHANGE. (RURAL SOCIOLOGY 530.)

SPECIAL TOPICS IN PLANT SCIENCE EXTENSION. (VEGETABLE CROPS 429.)

Latin American Studies

Faculty: Charles Ackerman, Frederick B. Agard, Solon Barraclough, Jerome S. Bernstein, Dalai Brenes, Frank Cancian, Tom E. Davis, Martin Dominguez, Charles L. Eastlack, Donald K. Freebairn, Rose K. Goldsen, Richard Graham, Allan R. Holmberg, Eldon Kenworthy, Henry A. Landsberger, James O. Morris, Thomas Poleman, Bernard Rosen, Donald F. Sola, J. Mayone Stycos, William F. Whyte, Frank W. Young.

Field Representative: Tom E. Davis, 205 Rand Hall.

APPROVED MINOR SUBJECT

Latin American Studies

The requirements for the minor in Latin American Studies include (1) a knowledge of Latin American history, culture, political organization, and problems of economic development, and (2) a reasonable command of spoken Spanish or Portuguese and comprehension of written Spanish.

Law

Faculty: Robert A. Anthony, Herbert W. Briggs, W. David Curtiss, W. Tucker Dean, W. Ray Forrester, Harrop A. Freeman, Kurt L. Hanslowe, Harry G. Henn, William E. Hogan, Milton R. Konvitz, John W. MacDonald, Ian R. MacNeil, Lewis W. Morse, Walter E. Oberer, Robert S. Pasley, Norman Penny, David L. Ratner, Ernest F. Roberts, Jr., Rudolf B. Schlesinger, Gray Thoron, Ernest N. Warren.

Visiting Professor: Ronald H. Maudsley, Fall Term, 66–67, Brasenose College, Oxford, England.

Field Representative: Robert S. Pasley, 258 Myron Taylor Hall.

APPROPRIATE MAJOR SUBJECT	APPROPRIATE MINOR SUBJECTS
Law	For Those Majoring in Law:*
	City and Social Planning
	Economics
	American Government
	Political Theory
	Comparative Government
	International Law and Relations
	Industrial and Labor Relations
	International Agricultural Development
	For Those Majoring in Other Fields (Especially in the Social Sciences):
	Law†

The Master of Laws (LL.M.) and the Doctor of the Science of Law (J.S.D.) degrees are conferred. The former is intended for the student who desires to increase his knowledge of law by work in a specialized field. The latter is intended for the student who desires to become a legal scholar and to pursue original investigations into the function, administration, history, and progress of law.

The minimum residence required is two full semesters, but completion of the LL.M. program will usually require one summer in addition, and the J.S.D. program normally requires three to four semesters. Longer periods may be required by the nature of the candidate's program, which is arranged on an individual basis. A candidate for either degree will ordinarily be expected to concentrate on one legal field and to do a substantial amount of work in at least one other field.

Students who meet the requirements for admission to the Graduate School's Division of Law but who do not wish to become candidates for a degree may, at the discretion of the faculty, be admitted as non-degree candidates to pursue an approved program of advanced legal studies.

(A) ADMISSION REQUIREMENTS. Candidates for the LL.M. or J.S.D. degree are accepted only when, in the judgment of the Law School faculty, the candidate shows exceptional qualifications, the Cornell program offers sufficient advanced courses in the special field of the applicant's interest, and

* A minor is not required of those majoring in the Field of Law. Subjects listed are suggestive only.

† With the approval of the Field of Law.

the Law School faculty is in a position to supervise properly the proposed course of study. An applicant for candidacy for an LL.M. or J.S.D. degree is expected (1) to hold a baccalaureate degree from a college or university of recognized standing; (2) to hold a degree of Bachelor of Laws or a degree of equivalent rank from an approved law school; (3) to have had adequate preparation to enter upon study in the field chosen; and (4) to show promise of an ability, evidenced by his scholastic record or otherwise, to pursue satisfactorily advanced study and research and attain a high level of professional achievement. An applicant for candidacy for a J.S.D. degree must, in addition, have had professional practice or experience in teaching or advanced research since obtaining his degree of Bachelor of Laws.

An application for admission as a candidate for either degree should state in as much detail as possible the objective for which the applicant wishes to do advanced graduate work and the particular fields of study which he wishes to pursue. It should also contain a brief personal and academic history of the applicant. Other general requirements for admission to the Graduate School should be complied with.

Applicants from countries other than the United States can be considered for candidacy for the LL.M. or J.S.D. degree only if they have completed their basic studies in law in a university abroad with grades of high distinction and have completed all the studies necessary for admission or licensing for the practice of law in their own country, and if their presence at Cornell Law School would, because of special circumstances, be of particular interest to the faculty and students. These requirements apply whether or not the applicant is seeking financial aid. Applicants for the J.S.D. degree must also have had substantial experience in professional practice, teaching, or advanced research after obtaining their first university degree in law. Any applicant for whom English is not a native language must give satisfactory evidence of ability to carry on his studies in English satisfactorily.

No special examinations or tests are required for admission. For further details, see the *Announcement of the Law School.*

(B) LANGUAGE REQUIREMENTS. The Special Committee of a candidate may require demonstration of a reading knowledge of one or more foreign languages if the Committee deems it to be desirable for the proper achievement of the candidate's program, but there is no fixed language requirement applicable generally to graduate work in law.

(C) EXAMINATION AND THESIS REQUIREMENTS. The only examinations required are those administered in the courses taken for credit by the candidate. These must be passed with a high order of excellence.

A thesis of from 50 to 100 pages (or its reasonable equivalent, e.g., in the form of a report on field research) is required of LL.M. candidates. J.S.D. candidates are required to submit a scholarly dissertation evidencing original research and independent thinking, worthy of publication as a contribution to legal literature.

(D) RESEARCH AND STUDY OPPORTUNITIES. While a candidate may select any topic of law which interests him, special opportunities exist at Cornell in city and regional planning, comparative law, commercial law, copyright and trademark law, government contracts, industrial and labor relations, international legal studies, and water resources law. There are faculty specialists, both in the Law School and in other branches of the University, in all these subjects, as well as in the subjects commonly offered at all American law schools.

(E) COURSES

The courses offered in the Law School are all open to LL.B., LL.M., and J.S.D. candidates. Reference should be made to the Announcement of the Law School for detailed description. The following course is, however, required of all candidates for the LL.M. or the J.S.D.:

JURISPRUDENCE

Two hours. Selected readings. Professor Konvitz.

Jurisprudential writings have contributed to the shaping not only of legal institutions and principles but also of Western culture and the modern mind in general. Some of these writings will be read and discussed, with special concentration on the writings of Plato, Aristotle, and Cicero from the classical world; Aquinas as representative of the medieval world; Hobbes and Locke from the Renaissance and Reformation; Hume and Kant from the Enlightenment and Age of Reason.

See also the description at page 29 of the International Legal Studies Program and at page 41 of the Water Resources Center.

Linguistics

Faculty: Frederick B. Agard, Nicholas C. Bodman, J M. Cowan, Charles L. Eastlack, John M. Echols, Gordon H. Fairbanks, James W. Gair, Robert A. Hall, Jr., Baxter Hathaway, Charles F. Hockett, Robert B. Jones, Robert E. Kaske, Gerald B. Kelley, Herbert L. Kufner, Richard L. Leed, Pardee Lowe, Antonio Lozano, James W. Marchand, John McCoy, Joseph R. Puryear, Fred C. Robinson, Mario Saltarelli, Don F. Solá, John Wolff.

Visiting Professor of Linguistics: Bh. Krishnamurthy.

Field Representative: Gordon H. Fairbanks, 223 Morrill Hall.

APPROVED MAJOR SUBJECTS

General Linguistics
English Linguistics, see English Language and Literature
French Linguistics, see Romance Studies
Germanic Linguistics, see German
Italian Linguistics, see Romance Studies
Romance Linguistics, see Romance Studies
Slavic Linguistics, see Slavic Studies
Spanish Linguistics, see Romance Studies

APPROVED MINOR SUBJECTS

General Linguistics
Chinese Linguistics, see Asian Studies
English Linguistics, see English Language and Literature
French Linguistics, see Romance Studies
Germanic Linguistics, see German
Indo-European Linguistics, see The Classics
Italian Linguistics, see Romance Studies
Romance Linguistics, see Romance Studies
Slavic Linguistics, see Slavic Studies
South Asian Linguistics, see Asian Studies
Southeast Asian Linguistics, see Asian Studies
Spanish Linguistics, see Romance Studies

ADMISSION REQUIREMENTS. There are no special requirements for admission to study in the Field of Linguistics other than the general requirements for admission to the Graduate School.

LANGUAGE REQUIREMENTS. The candidate for either an M.A. or a Ph.D. degree is required to demonstrate a reading knowledge of two languages other than his native language, of which at least one must be chosen from the group English, French, German, and Russian.

EXAMINATIONS. Students for the Ph.D. degree are required to take an Examination for Admission to Candidacy. All new students at Cornell will take this examination no earlier than at the end of their second semester of graduate study and no later than at the end of their fourth semester of graduate study. In addition to the Examination for Admission for Candidacy, a student will take a Final Examination covering the field of his studies and will take an examination on his thesis. These examinations may be taken separately or may be combined as a single examination after the thesis has been completed. Under this program it is possible for a well-qualified student with a good background in linguistics to complete an M.A. degree in one year and a Ph.D. degree in three years after the B.A. Students entering Cornell without such background in linguistics will normally expect to take two years for the M.A. and four years for the Ph.D. after the B.A. degree. It is not required that an M.A. degree be earned on the way to a Ph.D. degree.

SPECIALIZATION WITHIN THE FIELD OF LINGUISTICS

The Ph.D. program in linguistics covers the whole range of pure and applied linguistics. The broad scope of the linguistic program can be seen from the major and minor subjects that are possible at Cornell and also from the following specializations of the various faculty members. The list of subjects indicates those Fields that deal specifically with linguistics from which a major subject and minor subjects may be chosen. For any given major subject a student may make a choice of minor subjects not only from the minor subjects listed but from a wide range of other fields such as anthropology, computer science, French literature, German literature, Russian literature, and others.

The specializations of the various faculty members are:

Frederick B. Agard: Romance linguistics, Portuguese, Rumanian.

Nicholas C. Bodman: Chinese and Sino-Tibetan linguistics.

J M. Cowan: language pedagogy, acoustical phonetics.

Charles L. Eastlack: Portuguese descriptive linguistics, Brazilian indigenous languages.

John M. Echols: Malayo-Polynesian linguistics.

Gordon H. Fairbanks: Indo-European, Indo-Aryan, Armenian.

James W. Gair: general linguistics, South Asian linguistics, Sinhalese.

Robert A. Hall, Jr.: Comparative Romance linguistics, history of Italian langauge and literature, pidgin and creole languages.

Baxter Hathaway: English linguistics.

Charles F. Hockett: anthropological linguistics.

Robert B. Jones: descriptive and comparative linguistics of Southeast Asia.

Robert E. Kaske: English linguistics.

Gerald B. Kelley: Dravidian linguistics, computational linguistics, general linguistics.

Bh. Krishnamurthy: Dravidian linguistics.

Herbert L. Kufner: Germanic linguistics.

Richard L. Leed: Slavic linguistics, Russian.

Pardee Lowe: Germanic linguistics.
Antonio Lozano: Romance linguistics.
James W. Marchand: Germanic linguistics, general linguistics.
John McCoy: Japanese and Chinese linguistics, Chinese dialects.
Joseph R. Puryear: Germanic linguistics, medieval.
Fred C. Robinson: English philology.
Mario Saltarelli: General linguistics, transformational grammar, Romance (Spanish and Italian) linguistics.
Don F. Solá: Spanish linguistics, Quechua.
John Wolff: Indonesian and Philippine linguistics.

COURSES

General Linguistics

LINGUISTICS 303. PHONOLOGY

Fall term. Credit four hours. Prerequisite, Linguistics 202. Hours to be arranged. Mr. Bodman.

LINGUISTICS 304. MORPHOLOGY

Spring term. Credit four hours. Prerequisite, Linguistics 202. Hours to be arranged. Mr. Sola.

LINGUISTICS 305. LANGUAGE STRUCTURES

Fall term. Credit four hours. Prerequisite, Linguistics 202. Hours to be arranged. Mr. Agard.

LINGUISTICS 306. SYNTAX

Spring term. Credit four hours. Prerequisite, Linguistics 202. Hours to be arranged. Mr. Kelley.

LINGUISTICS 307. PRACTICAL PHONETICS

Fall term. Credit three hours. Prerequisite, Linguistics 202. Hours to be arranged. Mr. Lowe.

LINGUISTICS 331. INDIA AS A LINGUISTIC AREA

Fall term in alternate years. Credit four hours. Prerequisite, Linguistics 202 or 302. Hours to be arranged. Mr. Fairbanks or Mr. Gair or Mr. Kelley.

LINGUISTICS 403–404. ANALYTIC TECHNIQUES

Thoughout the year. Credit four hours a term. Prerequisite, Linguistics 201–202 or 301. M F 10. Mr. Hockett and Staff.

A practical training course in the techniques of observation and analysis of descriptive linguistics.

LINGUISTICS 413. LINGUISTIC DATA PROCESSING

Fall term. Credit two hours. Prerequisite, Linguistics 201 or 301 and consent of the instructor. M 3–5, laboratory hour to be arranged. Mr. Kelley.

LINGUISTICS 432. INDO-ARYAN STRUCTURES

Spring term in alternate years. Credit four hours. Prerequisite, Linguistics 201 or 301. Hours to be arranged. Mr. Fairbanks, Mr. Gair, or Mr. Kelley. Not offered in 1966–67.

LINGUISTICS 436. DRAVIDIAN STRUCTURES

Spring term in alternate years. Credit four hours. Prerequisite, Linguistics 201 or 301. Hours to be arranged. Mr. Kelley.

A synchronic examination of the chronological and grammatical structures of the major languages of the family. Typological studies in Dravidian languages.

LINGUISTICS 441–442. HISTORY OF THE ROMANCE LANGUAGES

Throughout the year in alternate years. Credit four hours a term. T Th 2–3:30. Mr. Agard.

LINGUISTICS 443–444. COMPARATIVE ROMANCE LINGUISTICS

Throughout the year in alternate years. Credit four hours a term. T Th 2–3:30. Mr. Hall. Not offered in 1966–67.

LINGUISTICS 445. PROBLEMS AND METHODS IN ROMANCE LINGUISTICS

Fall term every third year. Credit four hours. M W F 9. Mr. Hall. Will be offered again in Fall 1967.

LINGUISTICS 446. ROMANCE DIALECTOLOGY

Spring term every third year. Credit four hours. M W F 9. Mr. Hall. Will be offered again in Spring 1968.

LINGUISTICS 449. AREAL TOPICS IN ROMANCE LINGUISTICS

Fall term every third year. Credit four hours. Course may be repeated. Hours to be arranged. Will be offered again in Fall 1967.

LINGUISTICS 502. COMPARATIVE METHODOLOGY

Spring term in alternate years. Credit four hours. Prerequisite, Linguistics 201–202 or 301. Hours to be arranged. Mr. Fairbanks.

A study of the methods and techniques in comparative linguistics; application of these methods to various language families depending on the student's background.

LINGUISTICS 504. HISTORY OF LINGUISTICS

Spring term. Credit four hours. Prerequisite, consent of the instructor. Hours to be arranged.

LINGUISTICS 505. LITERATURE, LANGUAGE, AND CULTURE

Fall term. Credit four hours. Hours to be arranged. Mr. Hall.

A survey of the relation of literature to its linguistic medium and cultural matrix.

LINGUISTICS 506. PIDGIN AND CREOLE LANGUAGES

Spring term. Credit four hours. Hours to be arranged. Mr. Hall.

A survey of the field of pidginized and creolized languages, with discussion of methodological problems, historical relationships, and reading of selected texts.

LINGUISTICS 508. LINGUISTIC TYPOLOGY

Spring term. Credit two or four hours. Prerequisite, Linguistics 404. Hours to be arranged. Mr. Hockett.

LINGUISTICS 511–512. ACOUSTICAL PHONETICS

Throughout the year. Credit four hours a term. Prerequisite, consent of the instructor. Hours to be arranged. Mr. Cowan.

LINGUISTICS 513. TRANSFORMATIONAL ANALYSIS

Fall term. Credit four hours. Hours to be arranged.

An introduction to the theory, literature, and practice.

LINGUISTICS 516. LITERACY

Spring term. Credit four hours. Prerequisite, Linguistics 201 or 301. T Th 2–3:15. Mr. Solá.

LINGUISTICS 521–522. COMPARATIVE INDO-EUROPEAN LINGUISTICS

Throughout the year in alternate years. Credit four hours a term. Prerequisite, consent of the instructor. Hours to be arranged. Mr. Fairbanks.

A comparative study of the phonology and morphology of the Indo-European languages and of their interrelationships.

LINGUISTICS 530. ELEMENTARY PALI

Either term as needed. Credit three hours. Hours to be arranged. Mr. Fairbanks.

LINGUISTICS 531–532. ELEMENTARY SANSKRIT

Throughout the year in alternate years. Credit three hours a term. Hours to be arranged. Not offered in 1966–67.

LINGUISTICS 534. COMPARATIVE INDO-ARYAN

Spring term in alternate years. Credit four hours. Prerequisite, Linguistics 202 and 102 or equivalent of an Indo-Aryan language. Hours to be arranged. Mr. Fairbanks.

Comparative reconstruction of Proto-Indo-Aryan phonology and grammar.

LINGUISTICS 536. COMPARATIVE DRAVIDIAN

Spring term in alternate years. Credit four hours. Prerequisite, Linguistics 302 and 102 or equivalent of a Dravidian language. Hours to be arranged. Mr. Kelley.

Comparative reconstruction of Proto-Dravidian phonology and grammar.

LINGUISTICS 537–538. OLD JAVANESE

Throughout the year. Credit four hours a term. Hours to be arranged. Mr. Echols.

LINGUISTICS 541–542. COMPARATIVE GERMANIC LINGUISTICS

Throughout the year in alternate years. Credit four hours a term. Prerequisite, consent of the instructor. Hours to be arranged. Mr. Marchand.

LINGUISTICS 561–562. COMPARATIVE SLAVIC LINGUISTICS

Throughout the year in alternate years. Credit four hours a term. Prerequisite, consent of the instructor. Hours to be arranged. Mr. Foos.

LINGUISTICS 571–572. SEMINAR IN SOUTHEAST ASIAN LINGUISTICS

Throughout the year. Credit four hours a term. Prerequisites, Linguistics 201–202 or 301 and consent of the instructor. Hours to be arranged. Mr. Jones.

Descriptive and comparative studies of mainland Southeast Asian languages are dealt with in alternate terms. Topics may be selected in accordance with the interests of the students.

LINGUISTICS 573–574. MALAYO-POLYNESIAN LINGUISTICS

Throughout the year. Credit four hours a term. Prerequisites, Linguistics 201–202 or 301 and consent of the instructor. Hours to be arranged. Mr. Wolff. Not offered in 1966–67.

LINGUISTICS 581–582. SINO-TIBETAN LINGUISTICS

Throughout the year. Credit four hours a term. Prerequisite, Linguistics 201–202 or 301 or Chinese 402–403 and consent of the instructor. Hours to be arranged. Mr. Bodman.

Descriptive and comparative studies of Chinese dialects and Tibeto-Burman languages.

LINGUISTICS 600. SEMINAR

Each term. Admission by permission of the instructor. Hours and credits to be arranged. Various members of the Staff.

LINGUISTICS 615–616. DIRECTED RESEARCH

Chinese Linguistics

CHINESE 402. HISTORY OF THE CHINESE LANGUAGE

Either term. Credit four hours. Prerequisite, consent of the instructor. Hours to be arranged. Mr. Bodman.

CHINESE 403. LINGUISTIC STRUCTURE OF CHINESE

Either term. Credit four hours. Prerequisite, consent of the instructor. Hours to be arranged. Mr. Bodman.

English Linguistics

ENGLISH 383. THE ENGLISH LANGUAGE

Fall term. Credit four hours. M W F 9. Mr. Robinson.

A historical and topical analysis of the development of English, from its beginnings to the present.

ENGLISH 501. READINGS IN OLD ENGLISH

Fall term. Credit four hours. Mr. Robinson.

Elements of Old English grammar and readings in the shorter literary texts.

ENGLISH 503. MIDDLE ENGLISH

Fall term. Credit four hours. Mr. Kaske.

Reading and critical analysis of major works, excluding Chaucer and the drama.

ENGLISH 547. GRAMMATICAL ANALYSIS

Fall term. Credit four hours. Mr. Hathaway.

Study of the structures of English revealed in the transformation of the basic components of predictions.

French Linguistics

FRENCH 401–402. HISTORY OF THE FRENCH LANGUAGE

Throughout the year in alternate years. Credit four hours a term. Prerequisites, qualification in French and Linguistics 201 or 301. M W F 11.

Fall term: detailed study of the structural development of French from the origins to the Old French period. Spring term: selected readings in Old French texts, examination of structural changes from the Old French period to the present.

FRENCH 403. LINGUISTIC STRUCTURE OF FRENCH

Fall term. Credit four hours. Prerequisites, qualification in French and Linguistics 201 or 301. M W F 3.

A descriptive analysis of present-day French, with emphasis on its phonetics, phonemics, morphology, and syntax. Required of students seeking certification by New York State.

FRENCH 554. GALLO-ROMANCE DIALECTOLOGY

Spring term in alternate years. Credit four hours. Prerequisite, Linguistics 431–432 or 433–434 or consent of the instructor. T Th 2.

FRENCH 555. HISTORICAL PHONOLOGY OF FRENCH

Fall term in alternate years. Credit four hours. Prerequisite, Linguistics 301 or consent of the instructor. T Th 2. Not offered in 1966–67.

FRENCH 558. LINGUISTIC STRUCTURES OF OLD AND MIDDLE FRENCH

Spring term in alternate years. Credit four hours. Prerequisite, French 403 or consent of the instructor. T Th 2. Not offered in 1966–67.

FRENCH 600. SEMINAR IN FRENCH LINGUISTICS

Offered in accordance with student needs. Credit four hours a term. Hours to be arranged. Mr. Hall.

German Linguistics

GERMAN 401. HISTORY OF THE GERMAN LANGUAGE I

Fall term in alternate years. Credit four hours. Prerequisites, German 204 or consent of the instructor and Linguistics 201 or 301 taken previously or concurrently. M W F 11. Mr. Lowe.

GERMAN 402. HISTORY OF THE GERMAN LANGUAGE II

Spring term in alternate years. Credit four hours. Prerequisite, German 401 or consent of the instructor. M W F 11. Mr. Lowe.

GERMAN 403. LINGUISTIC STRUCTURE OF GERMAN

Fall term. Credit four hours. Prerequisites, German 204 or consent of the instructor and Linguistics 201 or 301 taken previously or concurrently. M W F 10. Mr. Kufner.

A descriptive analysis of present-day German, with emphasis on its phonetics, phonemics, morphology, and syntax.

GERMAN 405. INTRODUCTION TO MIDDLE HIGH GERMAN

Fall term. Credit four hours. Prerequisite, consent of the instructor. M W F 11. Mr. Puryear.

Intended for students with no previous knowledge of Middle High German; will begin with the study of the Middle High German language and then proceed to the reading of selected texts.

GERMAN 501. INTRODUCTION TO GERMANIC LINGUISTICS
Fall term in alternate years. Credit four hours. W 2–4. Mr. Puryear.

GERMAN 502. GOTHIC
Spring term in alternate years. Credit four hours. W 2–4. Mr. Puryear.

GERMAN 503. OLD SAXON
Fall term in alternate years. Credit four hours. M W F 2. Mr. Kufner. Not offered in 1966–67.

GERMAN 504. OLD HIGH GERMAN
Spring term in alternate years. Credit four hours. M W F 2. Mr. Marchand. Not offered in 1966–67.

GERMAN 509. OLD NORSE I
Fall term. Credit four hours. Hours to be arranged. Mr. Bjarnar.

GERMAN 510. OLD NORSE II
Spring term. Credit four hours. Hours to be arranged. Mr. Bjarnar.

LINGUISTICS 541–542. COMPARATIVE GERMANIC LINGUISTICS
Thoughout the year in alternate years. Credit four hours a term. Prerequisite, consent of the instructor. Hours to be arranged. Mr. Marchand.

GERMAN 601. GERMAN DIALECTOLOGY
Fall term. Four hours credit. Hours to be arranged. Not offered in 1966–67.

GERMAN 602. EARLY NEW HIGH GERMAN
Spring term. Four hours credit. Hours to be arranged. Not offered in 1966–67.

GERMAN 651. SEMINAR IN GERMANIC LINGUISTICS I
Fall term. Four hours credit. Th 2. Mr. Marchand. Not offered in 1966–67.

GERMAN 652. SEMINAR IN GERMANIC LINGUISTICS II
Spring term. Four hours credit. Th 2. Mr. Marchand. Not offered in 1966–67.

Hindi Linguistics

HINDI 401. HISTORY OF HINDI
Fall term in alternate years. Credit four hours. Prerequisites, Hindi 101–102 or equivalent and Linguistics 202 or 302. Hours to be arranged. Mr. Fairbanks. Not offered in 1966–67.

HINDI 600. SEMINAR IN HINDI LINGUISTICS
Each term. Admission by permission of the instructor. Hours and credits to be arranged. Various members of the staff.

Indonesian Linguistics

INDONESIAN 403. LINGUISTIC STRUCTURE OF INDONESIAN
Either term. Credit four hours. Prerequisites, Indonesian 101–102 or the equivalent and Linguistics 201. Hours to be arranged. Mr. Wolff.

LINGUISTICS 573–574. MALAYO-POLYNESIAN LINGUISTICS

Throughout the year. Credit four hours a term. Prerequisites, Linguistics 201–202 or 301 and consent of the instructor. Hours to be arranged. Mr. Wolff. Not offered in 1966–67.

Italian Linguistics

ITALIAN 431. STRUCTURE OF ITALIAN

Fall term in alternate years. Credit four hours. Prerequisite, qualification in Italian. M W F 9. Mr. Hall.

ITALIAN 432. ITALIAN DIALECTOLOGY

Spring term in alternate years. Credit four hours. M W F 9. Mr. Hall.

ITALIAN 433. OLD ITALIAN TEXTS

Fall term in alternate years. Credit four hours. Prerequisite, consent of the instructor. M W F 9. Mr. Hall. Will be offered in fall of 1967.

ITALIAN 434. HISTORY OF THE ITALIAN LANGUAGE

Spring term in alternate years. Credit four hours. Prerequisites, Qualification in Italian and Linguistics 201 or 301. M W F 9. Mr. Hall. Will be offered in spring of 1968.

ITALIAN 600. SEMINAR IN ITALIAN LINGUISTICS

Each term. Admission by permission of the instructor. Hours and credits to be arranged. Various members of the staff.

Quechua Linguistics

QUECHUA 600. SEMINAR IN QUECHUA LINGUISTICS

Either term. Admission by permission of the instructor. Hours and credits to be arranged. Mr. Solá.

Russian Linguistics

RUSSIAN 401–402. HISTORY OF THE RUSSIAN LANGUAGE

Throughout the year in alternate years. Credit four hours a term. Prerequisites, qualification in Russian and Linguistics 201–202. M W F 2. Mr. Leed.

The study of the divisions of the Russian language chronologically and geographically; the relationships of the Russian language, the Slavic group, the Indo-European group; the changes in the sounds and forms of the Russian language; vocabulary borrowings from Eastern and Western languages.

RUSSIAN 403. LINGUISTIC STRUCTURE OF RUSSIAN

Fall term in alternate years. Credit four hours. Prerequisite, Qualification in Russian and Linguistics 201 or 301. M W F 2. Mr. Lipson. Not offered in 1966–67.

RUSSIAN 501. OLD BULGARIAN

Fall term in alternate years. Credit four hours. Hours to be arranged. Mr. Lipson. Not offered in 1966–67.

RUSSIAN 502. OLD RUSSIAN

Spring term in alternate years. Credit four hours. Hours to be arranged. Mr. Leed. Not offered in 1966–67.

LINGUISTICS 561–562. COMPARATIVE SLAVIC LINGUISTICS

Throughout the year in alternate years. Credit four hours a term. Prerequisite, consent of the instructor. Hours to be arranged. Mr. Foos.

RUSSIAN 600. SEMINAR IN SLAVIC LINGUISTICS

Offered in accordance with student needs. Credit four hours. Hours to be arranged. Mr. Leed, Mr. Lipson, or Mr. Foos.

RUSSIAN 611. SEMINAR IN RUSSIAN DIALECT GEOGRAPHY

Fall term. Credit four hours. Prerequisite, consent of the instructor. Hours to be arranged. Mr. Leed.

Spanish Linguistics

SPANISH 401–402. HISTORY OF THE SPANISH LANGUAGE

Throughout the year in alternate years. Credit four hours a term. Prerequisites, qualification in Spanish and Linguistics 201 or 301. M W F 2. Mr. Agard or Mr. Saltarelli or Mr. Solá.

Fall term: reading and analysis of progressively older Spanish texts, ending with the earliest monuments of Spanish literature. Spring term: the development of Spanish phonology, grammar, and lexicon from its Latin origins to modern times.

SPANISH 403. THE GRAMMATICAL STRUCTURE OF SPANISH

Fall term. Credit four hours. Prerequisites, qualification in Spanish and Linguistics 201 or 301. M W F 2. Mr. Solá.

Descriptive analysis of the morphological and syntactical structure of present-day standard Spanish.

SPANISH 600. SEMINAR IN IBERO-ROMANCE LINGUISTICS

Offered in accordance with student needs. Credit four hours. Hours to be arranged. Mr. Agard or Mr. Solá.

Tagalog Linguistics

TAGALOG 403. LINGUISTIC STRUCTURE OF TAGALOG

Either term. Credit four hours. Prerequisite, Linguistics 201 or 301. Hours to be arranged. Mr. Wolff.

Related Courses

ANTHROPOLOGY 451. ETHNOLINGUISTICS

Fall term. Credit four hours. W 2–4. Mr. Hockett.

A survey of problems and findings in the interrelations of language and culture.

CHILD DEVELOPMENT 414. SEMINAR IN LANGUAGE DEVELOPMENT

Fall term. Credit three hours. Open to juniors, seniors and graduate students. Hours to be arranged. Mr. Levin.

The development of language during infancy and early childhood will be considered. The topics to be covered include theories of acquisition of language, the learning of sounds, grammar, meanings, and pathologies which involve language.

PSYCHOLOGY 313. COGNITIVE PROCESSES

Fall term. Credit four hours. Prerequisites, six hours of psychology and upperclass standing or honors standing (in any department), or consent of instructor. M W F 12. Mr. Anisfeld.

An examination of the mental processes involved in language learning and use, concept formation, and problem solving; relation between language and thinking. Students are required to carry out a supervised experimental or observational study.

PSYCHOLOGY 416. PSYCHOLOGY OF LANGUAGE

Spring term. Credit four hours. Prerequisite, Psychology 313 or consent of instructor. M W 3:00–4:30. Mr. Anisfeld.

An advanced treatment of the nature of the human capacity for language, the reading process, social and psychological aspects of bilingualism, speech perception and production. Instruction will be supplemented by experimental exercises.

PSYCHOLOGY 517–518. SEMINAR IN LANGUAGE AND THINKING

Either term. Credit four hours.

Psychology

(Please see page 318.)

Rural Sociology

Faculty: Frank D. Alexander, Harold R. Capener, Gordon J. Cummings, Paul Eberts, John Harp, Olaf F. Larson, James W. Longest, Robert A. Polson, William W. Reeder, Philip Taietz, Robin M. Williams, Jr., Frank W. Young.

Field Representative: Paul Eberts, Warren Hall.

APPROVED MAJOR AND MINOR SUBJECTS

Methods in Social Research
Organization Methods and Community Development
Rural Sociology

All American and Canadian applicants are requested to submit the scores of the Graduate Record Examination Aptitude Test with their other credentials.

The foreign language requirement for Ph.D. candidates in the Field of Rural Sociology shall be determined by the members of the student's special committee.

Graduate study in the Field of Rural Sociology prepares one for college teaching and research; extension work in rural sociology; rural development work in the developing countries; research work with governments, private organizations, and agricultural businesses; and consultation in organization methods and community development. A recent Ford Foundation grant sup-

ports an expanded rural sociology program of training and research related to International Agricultural Development.

Members of the Field of Rural Sociology have a continuing research program within the framework of the Cornell University Agricultural Experiment Station in which graduate students may participate for purposes of research training. Among the currently active projects are community organization, comparative community studies including intervillage systems in several countries, adjustments in human and natural resources, social change, and studies of modernization in developing countries. Staff members also participate in the Asian and Latin American area programs.

In addition to these activities some members of the Field of Rural Sociology participate in programs of the Cooperative Extension Service of the New York State College of Agriculture. Programs of human and natural resource development throughout the State are of particular relevance for graduate student training.

The following general areas of study are available to students:

1. Rural Sociology: When offered as a major for the Ph.D., the candidate is expected to acquire a thorough knowledge of (a) rural sociology and research in this field, (b) methodology of social research, (c) sociological theory and its history, and (d) organization methods and community development.

When offered for the M.S. degree or as a minor for the Ph.D., a general knowledge of parts (a) and (c) is required.

2. Methods in Social Research (accepted as a minor only at the Ph.D. level): A thorough knowledge of research in the candidate's major field of study is required. For those with a major in rural sociology this minor also requires a general knowledge of (a) research design, (b) observational and data collection techniques, and (c) methods of analysis for hypotheses testing.

3. Organization methods and Community Development: Students may choose this subject as a major for the M.S. degree or as a minor for the Ph.D. When offered as a major the student is expected to acquire a thorough knowledge of theories, strategies, and techniques of organization methods and community development as related to a general knowledge of sociological theory. When offered as a minor for the Ph.D., the emphasis will include special attention to those aspects of research methods particularly useful for the study of applied problems.

As a general rule students are encouraged to choose their minor field of study outside rural sociology. Among those fields most often chosen by students are: general sociology, demography-ecology, agricultural economics, conservation, anthropology, social psychology, rural education, and international agricultural development. In addition, graduate students are encouraged to take related courses in any department of the University.

R.S. 412. RURAL SOCIAL SYSTEMS

Fall term. Credit three hours. Prerequisite, Course 100 or equivalent. Not open to freshmen or sophomores. M W F 9. Warren 31. Professor Larson.

Intended as a basic course in the sociology of rural life, using the social system concept as a theoretical framework. Rural society in the United States is used as a case to illustrate the structure and function of major rural social systems in modernized societies. Comparisons are made with western European countries. The changing relationship with urban and societal systems is discussed. Some consideration is given to the implications of social structure and function for action programs serving rural people. Field trips to rural areas arranged.

R.S. 420. COMPARATIVE RURAL SOCIETIES

Fall term. Credit three hours. Prerequisite, a course in general sociology or anthropology. M W F 11. Warren 231. Associate Professor F. W. Young.

A comparison of the social organization of rural life in selected countries. The emphasis is on the social structure and the value systems of societies undergoing rapid change.

R.S. 500. EVALUATION RESEARCH

Fall term. Credit two hours. Registration by permission only. F 3–5. Warren 31. Professor Alexander and Associate Professor Longest.

Evaluation as measurement of induced change resulting from action programs and extension education. Public concern with evaluation. Organizing for evaluation. Kinds and levels of evaluation. Utilizing the findings of evaluation studies and research. The by-products of evaluation. Principal emphasis on methodology and techniques, including review of significant evaluation studies and research. Course includes laboratory and field work.

R.S. 515. RESEARCH DESIGN

Fall term. Credit three hours. Open to graduate students only. T Th 1:40–3. Warren 232.

An introduction to the methods of social research. Course topics follow the major steps in the design and execution of sociological research from the definition of the problem and formulation of hypotheses to the interpretation of results and preparation of a final report. Practice exercises are assigned each week utilizing data from departmental projects.

R.S. 516. CROSS-CULTURAL RESEARCH METHODS

Spring term. Credit three hours. Prerequisite, Course 515 or permission of the instructor. W F 1:40–3. Warren 201. Associate Professor F. W. Young.

Problems of adaptive methods to other cultural settings as well as the use of specifically cross-cultural procedures. Discussion of modifications of surveys, key informant interviews, observation techniques, photography, case studies, and the exploitations of census and other available data. Special attention to comparisons based on the data of the Human Relations Area files. Consideration of designs, units of analysis, variables, and hypotheses relevant to problems of less developed countries.

R.S. 528. APPLICATIONS OF SOCIOLOGY TO DEVELOPMENT PROGRAMS

Spring term. Credit three hours. Open to graduate students only. M F 11–12:30. Warren 31. Professor Polson.

Application of sociological theory and methods to the problems of institutions and agencies concerned with rural development. Special emphasis is placed on programs for agricultural extension education and community development in low-income countries.

R.S. 530. CONTEMPORARY THEORIES OF SOCIAL CHANGE

Fall term. Credit three hours. Open to graduate students and to seniors with consent of the instructor. W F 3–4:30. Warren 260.

Selected conceptual approaches of social evolution, revolution, and "modernization" are examined. Consideration is given to diffusion, innovation, and "social stress" as precipitants of change. Attention is given to designing "partial theories" related to changes of a small-scale magnitude.

R.S. 613. SEMINAR: RURAL SOCIOLOGY

Spring term, in alternate years. Credit three hours. Prerequisite, Course 412. Hours to be arranged. Professor Larson. Not given in 1966–67.

A review of the development of rural sociology and of the theoretical points of view represented in systematic works. A review of research literature in selected major subfields of rural sociology. Emphasis is on sociological generalizations and on the integration of theory and research.

638. METHODOLOGICAL APPROACHES TO THEORY CONSTRUCTION

Spring term. Credit three hours. Open to graduate student only. T Th 2–3:30. Warren 201.

A seminar designed to present and discuss the major problems of theory construction and testing within sociology. Topics include the nature of scientific theory, presentation of frames of reference and theoretical arguments, formalization of theoretical systems and types of formal systems, models and axiomatization. Illustrations will be drawn from various substantive fields within the discipline.

Sociology

Faculty: Charles Ackerman, Leonard Berkowitz, Lindsey Churchill, Allan G. Feldt, Rose K. Goldsen, Donald P. Hayes, Richard Jung, William W. Lambert, Parker G. Marden, Robert McGinnis, Leo Meltzer, George C. Myers, Bernard C. Rosen, Gordon F. Streib, J. Mayone Stycos, Wayne E. Thompson, William F. Whyte, Robin M. Williams, Jr.

Field Representative: Wayne E. Thompson, McGraw Hall.

APPROPRIATE MAJOR SUBJECTS	APPROPRIATE MINOR SUBJECTS
General Sociology*	Demography-Ecology
Demography-Ecology†	Research Methodology
Research Methodology†	Social Organization and Change
Social Organization and Change†	Social Psychology
Social Psychology†	

ADMISSION REQUIREMENTS. Candidates for the Master's degree should have an undergraduate degree from a recognized college or university. The Master's degree program or its equivalent is prerequisite to candidacy for the Ph.D. degree in any of the subjects of sociology. Graduate Record Examination scores are required for admissions consideration. In addition to a general background in the social sciences, the entering student should have some knowledge of the basic concepts and applications of quantitative analysis.

LANGUAGE REQUIREMENTS. Language requirement for the Ph.D. degree: A candidate for the degree of Ph.D. in sociology must demonstrate proficiency in one modern language other than his native tongue. Any Special Committee may, at its discretion, require knowledge of foreign languages beyond the field requirement stated above.

Language requirement for the Master's Degree: A modern language or mathematics requirement for the M.A. candidate shall be determined by his Special Committee.

* Required as major subject in the Master's degree Program.
† May be major subjects only in the Ph.D. Program.

FIELD REQUIREMENTS. M.A. candidates at Cornell major in general sociology, which covers the four specific subjects of the Field of Sociology: social organization and change, research methodology, demography-ecology, and social psychology. Students entering Cornell with a Master's degree from other institutions will be required to make up any deficiencies in the subjects mentioned following the recommendations of their special committee.

Ph.D. candidates will select their major from one of the four indicated major subjects listed above. The general requirements of each are specified below. Two minors are required, at least one of which should be chosen from outside the Department of Sociology.

Each Master's candidate must take an oral examination during the first term following the completion of his required core program, normally the third term in residence. A written examination may also be required, if the student's Special Committee recommends it. Any student who proposes to apply for the Ph.D. candidacy must have appointed his Ph.D. Special Committee prior to taking this examination. These Ph.D. committee members will also attend the Master's examination which under these circumstances may be combined with the Ph.D. Qualifying Examination.

It is expected that the Ph.D. degree will normally be completed within two to three years following completion of the M.A. degree by candidates who are in full-time residence. The Ph.D. Qualifying Examination must be taken early in the second semester of the Ph.D. residence, if it has not already been completed as part of the M.A. requirement.

Members of the Field sponsor various social research programs and Field projects in which graduate students may participate for purposes of research training. Research activities of the staff have included studies in intergroup relations (Messrs. Rosen and Williams), attitudes and values (Mrs. Goldsen, Messrs. Meltzer and Williams), demography (Messrs. Feldt, Marden, Myers, Stycos), psycho-social development and abnormal communication and decision processes (Mr. Jung), social gerontology (Messrs. Streib and Thompson), small groups (Messrs. Hayes, Lambert, Longabaugh, Meltzer, Rosen), non-verbal communication (Messrs. Hayes and Meltzer), cross-cultural socialization (Messrs. Lambert and Rosen), social systems analysis and theory construction (Messrs. Ackerman, Jung, McGinnis, and Williams), kinship (Messrs. Ackerman and Streib), educational sociology (Mrs. Goldsen, Messrs. Jung and Thompson). Many of these investigations have been done in cross-cultural settings: Brazil (Messrs. Ackerman and Rosen); Latin America (Mrs. Goldsen, Messrs. Myers, Rosen, Stycos); Ireland (Mr. Streib); Scandinavian countries (Messrs. Jung, Lambert, Streib, Thompson, Williams). Staff members also participate closely in teaching and research activities of the Center for International Studies, the South Asia and Southeast Asia Program, and the Latin American and China area programs.

While teaching assistantships are normally granted only to students already in residence, a number of research assistantships, internships, and traineeships are awarded annually to incoming students. In addition the International Population Program provides fellowships and research internships to selected students of demography, and the Research Training Program in Social Systems Analysis awards traineeships to students with special interests in sociological theory, methodology, and systems analysis.

All applications for admission to graduate study in the Field of Sociology should be made directly to the Field Representative, Department of Sociology, McGraw Hall. Students interested in fellowships or traineeships in the International Population Program should also communicate with Professors George Myers or J. Mayone Stycos. Students interested in traineeships in the Research Training Program in Social Systems Analysis should also communi-

cate with Dr. Richard Jung and Professors Robert McGinnis and Robin M. Williams, Jr.

RESEARCH METHODOLOGY. When offered as a major: (1) a detailed knowledge of the logic of science, (2) a general knowledge of research design, data collection techniques, and analytic procedure, (3) a working knowledge of the theory of social organization and change, (4) a concentration of study in one of the areas listed in (1) and (2).

When offered as a minor, requirements (1), (2) and (3).

SOCIAL ORGANIZATION AND CHANGE. When offered as a major: (1) a thorough knowledge of theories of and research in social organization and social change; (2) a working knowledge of research methods; (3) a detailed knowledge of two subfields in social organization such as the following: formal organization and bureaucracy, the family, ethnic relations, political sociology, social stratification, public opinion, sociology of religion, sociology of work.

When offered as a minor: a general knowledge of parts (1) and (2) of the above requirement and a working knowledge of one subfield.

SOCIAL PSYCHOLOGY. When offered as a major: (1) a thorough knowledge of social psychological theory and research, with emphasis upon current developments; (2) a working knowledge of the methodology of social psychological research; (3) a working knowledge of psychology, sociology, and relevant aspects of other related disciplines; and (4) detailed knowledge of some specialized aspect of social psychology to be selected by the student.

When offered as a minor: a general knowledge of parts (1) and (2) of the above requirements, as well as a working knowledge of whichever aspects of social psychology are relevant to the Ph.D. dissertation topic.

The prospective student is advised to consult the comprehensive brochure, *Sociology at Cornell,* which may be obtained by writing to the Field Representative.

COURSES

In the following list the courses numbered in the 500's or above are principally open to graduate students. Courses numbered in the 400's are open to advanced undergraduate majors as well as graduate students.

All course listings are subject to change. Students should be sure to make final checks with the department before registering.

LABORATORY STUDY OF INTERPERSONAL INTERACTIONS (Psychology 447)

Spring term. Credit four hours. Prerequisite Psychology 342, or Sociology 381, or graduate student status, or permission of the instructor. T 2–4 and one additional hour.

Topics in the study of interpersonal behavior are reviewed. Selected problems within these topic areas are studied by empirical research. Analyses include laboratory and field researches carried out by the students.

402. SOCIAL THEORY

Spring term. Credit four hours. Open only to graduate students and to undergraduate majors in the social sciences. Permission of the instructor required. Mr. Ackerman.

Survey of selected theories and concepts in contemporary sociology reviewed in historical perspective, in relation to the contributions of other

social sciences, and in terms of present-day developments in theory and research. Throughout, emphasis will be placed on trends in contemporary social theory.

404. STUDIES IN SOCIOLOGY

Spring term. Credit four hours. T Th 3–4:30. Mr. Churchill.

A limited number of problems in sociology that have received consistent theoretical and research attention are explored. Analysis and interpretation of selected literature in the field. Prerequisite: permission of the instructor.

412. MATHEMATICAL SOCIOLOGY

Spring term. Credit four hours. Prerequisites, Sociology 101 and one year of college mathematics, or consent of the instructor. Th 2–4 and one additional hour. Mr. McGinnis.

Elementary mathematics as applied to sociological theory. Both deterministic and probalistic models are considered. Stochastic probability processes are emphasized in relation to theories of social change.

421. MEASUREMENT THEORY IN SOCIAL ANALYSIS

Fall term. Credit four hours. Prerequisites, Sociology 321 and an introductory course in college mathematics or statistics or consent of the instructor. M W F 2. Mr. Churchill.

Elementary measurement theory is examined as a basis for constructing social variables. Guttman's ordinal scale theory is considered in detail. Equal interval measurement techniques of psychophysics are applied to other concepts such as social perception and status.

423. ANALYSIS OF QUANTITATIVE DATA

Fall term. Credit four hours. Open to upperclass majors and graduate students with the consent of the instructor. Th 4–6. Laboratory period to be arranged. Mrs. Goldsen.

In the first semester, quantitative materials from current studies are analyzed by students. Problems of editing, classifying and coding data are dealt with in the laboratory sessions. Students are expected to learn how to use IBM unit record equipment in their analyses. Scales, scores, and composite indexes are developed. Students are expected to write their exercises as weekly research reports, which are annotated by the instructor and discussed in class.

424. ANALYSIS OF QUALITATIVE DATA

Spring term. Credit four hours. Open to upperclass majors and graduate students with the consent of the instructor. Th 4–6. Laboratory period to be arranged.

This is the continuation of Sociology 423. The second semester emphasizes the equivalent problems which arise in analyzing qualitative research data.

425. TECHNIQUES OF DEMOGRAPHIC RESEARCH

Fall term. Credit four hours. Prerequisite, Sociology 330 or consent of the instructor. T Th S 11. Mr. Myers.

Methods of processing and analyzing demographic data. Measures of mortality, fertility, and migration as applied to census and vital statistics data will be analyzed, and the more general applications of demographic techniques to other classes of data illustrated.

426. REGIONAL POPULATION ANALYSIS

Spring term. Credit four hours. Prerequisite, Sociology 330 or consent of the instructor. M W F 11. Mr. Marden.

Research application of basic demographic techniques to selected regions of the world particularly the economically less-developed regions. Attention is directed to field survey techniques, including sampling and questionnaire construction, as well as formal demographic analysis. Students may work on selected research projects for the semester.

433. INTERNATIONAL URBANIZATION

Fall term. Credit four hours. M W F 12. Mr. Marden.

An examination and appraisal of the growth and development of urban communities in developing nations. The structure and composition of such communities and their relationship to a regional economy are compared with similar phenomena in the Western world.

INTRODUCTION TO HUMAN ECOLOGY

Spring term. Credit three hours. (See Planning 713, Architecture.) Mr. Feldt.

An examination of the form and development of the human community with respect to spatial, temporal, and functional patterns of organization. Demographic, environmental, and technological characteristics are treated as parameters relevant to the ecological structure of the community.

441. STRUCTURE AND FUNCTIONING OF AMERICAN SOCIETY — I

Fall term. Credit four hours. Prerequisite, Sociology 101 or consent of the instructor. T Th S 9. Mr. Williams.

Systematic analysis of the major institutions of kinship, stratification, economic activity, political structure, education, and religion. Special attention is given to values and their interrelations in the modern social order. A survey of the more important types of groups and associations making up a pluralistic nation is included.

442. STRUCTURE AND FUNCTIONING OF AMERICAN SOCIETY — II

Spring term. Credit four hours. Prerequisite, Sociology 441 or consent of the instructor. T Th S 9. Mr. Williams.

Primary attention is directed to the study of interrelations of institutions, including analysis of the regulation of economic and political systems. Group co-operation and conflict are surveyed. Analysis of important processes of change in institutions, values, and social organizations.

444. SOCIAL STRATIFICATION PROSEMINAR

Spring term. Credit four hours. T 2–4.

481. EXPERIMENTAL GROUP DYNAMICS

Fall term. Credit four hours. Prerequisites, a course in statistics and a course in social or experimental psychology. Open to upperclassmen and graduate students. Hours to be arranged.

A practicum. Supervised research experience in the design, execution, and analysis of experimental research on topics such as group cohesiveness, group pressures, group goals, leadership, group performance, and interpersonal influence and communication. Students will read and discuss experimental studies as well as pertinent theoretical articles.

491. SELECTED TOPICS IN SOCIOLOGY

Either term. Credit two hours. Open only to majors and graduate students. Hours to be arranged. Staff.

492. SELECTED TOPICS IN SOCIOLOGY

Either term. Credit four hours. Open only to majors and graduate students. Hours to be arranged. Staff.

[511. THEORY OF CULTURE AND SOCIAL ORGANIZATION]

Fall term. Credit four hours. Prerequisite, Sociology 402 or equivalent. T Th S 11. Mr. Williams. Not offered in 1966–67.

512. HISTORY OF SOCIOLOGICAL THEORY

Spring term. Credit four hours. Open to majors and graduate students. T Th 2–3:30.

513. DEMOGRAPHIC THEORY

Fall term. Credit four hours. Open to majors and graduate students. T 4–6.

Deals with theory construction, hypothesis derivation, and the integration of theory and research in demography. Although emphasis is placed on contemporary theories, earlier formulations beginning with Malthus also are examined insofar as they deal with fertility, mortality, migration, and the people-resource question.

[514. PROSEMINAR IN COMPARATIVE BUREAUCRACY]

Spring term. Credit four hours. Hours to be arranged. Not offered in 1966–67.

522. METHODOLOGY

Spring term. Credit four hours. Prerequisite, an introductory methods and statistics course or consent of the instructor. F 2–4 and M 4. Mr. McGinnis.

Science is considered as a model process, both axiomatic and experimental. Sociology is evaluated as a partial representation of the model. The logical status of sociological knowledge is emphasized.

523. SEMINAR: STOCHASTIC PROCESSES IN SOCIOLOGY

Fall term. Credit four hours. Prerequisites, one year of college mathematics and one term of statistics, or consent of the instructor. Hours to be arranged. Mr. McGinnis.

Finite probability theory is reviewed. Recurrent events, stationary Markov chains and dynamic Markov processes are evaluated as models of social organization and change.

524. SEMINAR: SOCIOLOGICAL APPLICATION OF GAME AND DECISION THEORY

Fall term. Credit four hours. Prerequisites, one year of college mathematics and one term of statistics, or consent of the instructor. T Th 9–11. Mr. McGinnis.

530. INTRODUCTION TO DEMOGRAPHY

Spring term. Credit four hours. Primarily for graduate students. Undergraduates must secure the consent of the instructor. T Th 2–3:30. Mr. Marden.

A survey of the methods, theories, and problems of contemporary demography.

541. SOCIAL ORGANIZATION AND CHANGE

Fall term. Credit four hours. T Th 2–3:30. Mr. Williams.

An analysis of major problems in theory and research in the general field of social organization and change. The subject will be studied from the standpoint of the nature and size of the social system (small groups, communities, large-scale organizations, societies) and also in terms of the social processes and properties of the system, such as integration, authority, conformity, and deviance.

581. PERSPECTIVES IN SOCIAL PSYCHOLOGY

Fall term. Credit four hours. M W 4–5:30. Mr. Rosen.

Critical analysis of the major current perspectives in social psychology.

PROSEMINAR IN SOCIAL PSYCHOLOGY (Psychology 571–572)

611. SEMINAR: THEORY AND RESEARCH IN SOCIAL PSYCHOLOGY

Fall term. Credit four hours. Hours to be arranged. Mr. Hayes.

Research on Interaction and Social Structure.

612. SEMINAR: CONTEMPORARY RESEARCH IN DEMOGRAPHY

Spring term. Credit four hours. T 4–6. Mr. Stycos.

Critical analysis of recent research investigations in Latin American demography.

[613. SEMINAR: THEORY AND RESEARCH]

Fall term. Credit four hours. W 2–4. Mr. Williams. Not offered in 1966–67.

614. SEMINAR: THEORY AND RESEARCH

Spring term. Credit four hours. Hours to be arranged.

615–616. DIRECTED RESEARCH

Either term. Credit to be arranged. Hours to be arranged. Staff.

617. SEMINAR: THEORY AND RESEARCH

Fall term. Credit four hours. To be arranged. Mr. Marden.

618. SEMINAR: THEORY AND RESEARCH

Spring term. Credit four hours. Mr. Tavuchis.

619. SEMINAR: THEORY AND RESEARCH

Fall term. Credit four hours. Th 2–4. Mr. Thompson.

Critical examination of topics in the sociology of education.

620. SEMINAR: THEORY AND RESEARCH

Spring term. Credit four hours. Hours to be arranged.

621. SEMINAR: THEORY AND RESEARCH

Fall term. Credit four hours. Hours to be arranged.

661. SEMINAR: SOCIAL SYSTEMS ANALYSIS

Fall term. Credit four hours. Hours to be arranged. Messrs. Ackerman and Williams.

Concepts and theories.

662. SEMINAR: SOCIAL SYSTEMS ANALYSIS

Spring term. Credit four hours. Hours to be arranged. Mr. Jung.
Foundations of systems analysis.

663. SEMINAR: SOCIAL SYSTEMS ANALYSIS

Fall term. Credit four hours. Hours to be arranged. Mr. Jung.
Foundations of social systems analysis.

664. SEMINAR: SOCIAL SYSTEMS ANALYSIS

Spring term. Credit four hours. Hours to be arranged. Mr. McGinnis and staff.
Advanced treatment of selected topics.

682. SEMINAR IN SOCIAL PSYCHOLOGY

Spring term. Credit four hours. Hours to be arranged. Mr. Lambert.

Statistics

Faculty: Robert E. Bechhofer, Isadore Blumen, Roger Farrell, Walter T. Federer, Donald L. Iglehart, Harry Kesten, Jack Kiefer, Philip J. McCarthy, Narahari U. Prabhu, Douglas S. Robson, Shayle R. Searle, Frank L. Spitzer, Bernt P. Stigum, Howard M. Taylor, N. Scott Urquhart, Lionel Weiss, Jacob Wolfowitz.

Field Representative: Isadore Blumen, 360 Ives Hall.

APPROPRIATE MAJOR SUBJECT

Statistics

APPROPRIATE MINOR SUBJECTS

Provisions for minoring in statistics are given in the sections of this Announcement devoted to the Fields of Industrial Engineering and Operations Research, Industrial and Labor Relations, Mathematics, and Plant Breeding and Biometry.

ADMISSION REQUIREMENTS. Since one of the principal aims of graduate work in the Field of Statistics is that of training individuals who will have a thorough knowledge of the theoretical basis of modern statistical method and will have demonstrated ability to make significant contributions to this theory, applicants should ordinarily have obtained nearly the equivalent of an undergraduate major in mathematics. It is strongly recommended that applicants resident in the United States during the year before entering the Graduate School present scores on the Graduate Record Examination Aptitude Test.

LANGUAGE REQUIREMENT. There is no foreign language requirement for the M.S. degree. A candidate for the Ph.D. degree must demonstrate reading ability in one language besides English, chosen from among French, German, or Russian.

PROGRAM OF STUDY. A student majoring in the Field of Statistics must complete a graduate sequence of courses in mathematical statistics which has been approved by his Special Committee. Other course work required of majors in statistics will be chosen from among the offerings, as listed below, of the members of the Field. A doctoral student in the Field of Statistics

ordinarily has two minor subjects but may, in consultation with the chairman of his Special Committee, choose to work in one minor subject. One minor subject will often be in an area of interest to the student in which the methods of statistics find extensive application. A second minor is usually devoted to mathematics, computing, or a similar subject.

PH.D. EXAMINATIONS. In addition to the Admission to Candidacy examination, which will ordinarily be administered by the student's Special Committee during or at the end of the third year of graduate study, and the Final Examination on the thesis, the student will be given a Qualifying Examination. This examination will occur shortly after the first year of graduate study. It will serve to determine the ability of the candidate to pursue doctoral studies and to assist the Special Committee in developing a program of study for the candidate.

TEACHING AND RESEARCH INTERESTS OF THE FACULTY

In extremely broad terms, the teaching and research interests of faculty members are in the following general areas: biological applications of probability and statistics (Federer, Robson, Searle, Urquhart); engineering and operations research applications of probability and statistics (Bechhofer, Iglehart, Prabhu, Taylor, Weiss); mathematical theory of probability and statistics (Farrell, Kesten, Kiefer, Spitzer, Wolfowitz); social science applications of probability and statistics (Blumen, McCarthy, Stigum).

Some of the more specific areas of current interest are: analysis and probability theory (Kesten, Spitzer); design and analysis of experiments (Bechhofer, Federer, Kiefer, Robson, Searle, Urquhart, Wolfowitz); econometrics (Stigum); high speed computing (Searle); mathematical theory of statistics (Farrell, Kiefer, Wolfowitz); multiple decision procedures (Bechhofer); multivariate analysis (Blumen, Urquhart); nonparametric statistics (Blumen, Weiss); queuing and inventory theory (Iglehart, Prabhu); sampling theory (McCarthy, Robson); sequential sampling methods (Kiefer, Weiss); statistical control theory (Taylor); statistical genetics (Federer, Robson, Searle).

COURSES

Descriptions of the following courses may be found in this Announcement under the Fields with which they are identified; in those sections reference is also made to several advanced seminars, both formal and informal, the content of which varies from year to year.

Advanced Undergraduate and Master's Level Courses

INDUSTRIAL ENGINEERING AND OPERATIONS RESEARCH

9460. Introduction to Probability Theory with Engineering Applications

9470. Introduction to Statistical Theory with Engineering Applications

9512. Statistical Methods in Quality and Reliability Control

9570. Intermediate Engineering Statistics

INDUSTRIAL AND LABOR RELATIONS

310. Design of Sample Surveys

311. Statistics II

410. Techniques of Multivariate Analysis

411. Statistical Analysis of Qualitative Data

MATHEMATICS

472. Statistics

PLANT BREEDING AND BIOMETRY

410–411. Mathematical and Statistical Models in Biology

417. Matrix Algebra in Biology and Statistics

510. Statistical Methods I

511. Statistical Methods II

Advanced Master's and Doctor's Level Courses

INDUSTRIAL ENGINEERING AND OPERATIONS RESEARCH

9560. Applied Stochastic Processes

9561. Queuing Theory

9564. Statistical Aspects of Reliability Analysis

9571. Advanced Industrial and Engineering Statistics

9572. Statistical Decision Theory

9573. Statistical Multiple Decision Procedures

INDUSTRIAL AND LABOR RELATIONS

610. Economic and Social Statistics

614. Theory of Sampling

MATHEMATICS

571. Probability

572. Statistical Inference

574. Advanced Probability

575. Information Theory

673. Analysis of Variance

674. Design of Experiments

675. Statistical Estimation

676. Decision Functions

677–78. Stochastic Processes

PLANT BREEDING AND BIOMETRY

513. Design of Experiments I

514. Design of Experiments II

517. Linear Estimation and Tests of Hypothesis

518. Special Topics in Sequential Sampling, Bioassay, Non-parametric Statistics, etc.

519. Statistical Genetics

Textiles and Clothing

Faculty: Charlotte W. Baumgartner, Rachel Dardis, Elsie F. McMurry, Betty F. Smith, Frances M. Spratt, Evelyn E. Stout, M. Vivian White.

Field Representative: Betty F. Smith, 240 Martha Van Rensselaer Hall.

APPROVED MAJOR AND MINOR SUBJECTS

A *Master of Science* degree may be earned in social science aspects of textiles and clothing, textiles, or textiles and clothing. Suggested minor areas include: anthropology, business administration, chemistry, industrial and labor relations, psychology, sociology, statistics, and appropriate areas in home economics. For this degree it is recommended that background preparation include apparel design, calculus, chemistry (general and organic), economics, physics, psychology or sociology, and textiles.

A *Master of Arts* degree may be earned in clothing, or textiles and clothing. Suggested minor areas include: anthropology, economics, fine arts, history, industrial and labor relations, psychology, sociology, speech and drama, and appropriate areas in home economics. For this degree it is recommended that background preparation include apparel design, chemistry, economics, fine arts, history, history of art, mathematics, psychology, sociology, and textiles.

Qualified doctoral candidates wishing to do advanced work in the Field of Textiles and Clothing may major in a related Field and do thesis research in the area of textiles and clothing. Doctoral candidates may minor in this Field.

All applicants are required to submit scores of the Graduate Record Examination Aptitude Test. Deficiency in the recommended background subjects does not preclude admission but may increase the time necessary to earn a degree.

Degree programs are individually planned to fit the needs of the student, his objectives, and the Field's objectives. Students are encouraged to make use of the wide opportunities for study in other Fields on campus as well as in this Field. Excellent facilities are available for research in all areas of the Field. Ongoing research projects allow for student participation.

STUDY AND RESEARCH OPPORTUNITIES IN THE FIELD

Clothing, or Textiles and Clothing with Professors McMurry or Spratt. Faculty special interests are: Mrs. McMurry, costume history and apparel design; Miss Spratt, apparel design.

Social Science Aspects of Textiles and Clothing with Professors Baumgartner, Dardis, or McMurry. Faculty special interests are: Dr. Baumgartner, the socio-economic aspects of textiles and clothing and clothing consumption; Dr. Dardis, textile and apparel economics and marketing.

Textiles, or Textiles and Clothing with Professors Smith, Stout, or White. Faculty special interests are: Dr. Smith, textile chemistry, especially the cross-linking of cellulose in cotton fabrics; Dr. Stout, the physical aspects of textile fibers and fabrics and evaluative methods for measurement of their properties; Miss White, the science and technology of textiles.

A number of teaching and research assistantships are available in the Department of Textiles and Clothing. The Herbert and Lillian M. Powell Fellowship will be available for 1967–68; candidates in the Textiles and Clothing Field are given preference for this fellowship.

COURSES

431. HISTORY OF COSTUME

Fall. Credit three hours. Prerequisite, History of Art 201. For upperclassmen and graduate students. May be elected by students from other colleges of the University. Mrs. McMurry. M W 2–3:30. Room 3-M-11.

A comparative study of dress of selected cultures from ancient times to the end of the fifteenth century, stressing (1) the relationship of social, economic, and political factors affecting dress and the mores as expressed through dress, and (2) the contribution of ancient cultures to the apparel arts of the Western world.

Illustrated lectures; readings; term problems; direct study of the basic forms of dress as exemplified in the Costume Collection.

A two-day trip to New York to study museum collections is arranged when feasible. Students are responsible for field trip expenses.

432. HISTORY OF COSTUME

Spring. Credit three hours. Prerequisites, History of Art 201, and 202 or 204. For upperclassmen and graduate students. May be elected by students from other colleges of the University. Mrs. McMurry. M W 2–3:30. Room 3-M-11.

A comparative study of dress of selected cultures from the sixteenth century through the first half of the twentieth century. Emphasis will be placed upon the development of the apparel arts of Western civilization and the factors which brought about change and development.

Illustrated lectures, readings, and term problems designed to bring students into direct contact with the Costume Collection and other primary sources such as the Regional History Collection.

433. ECONOMICS OF THE TEXTILE AND APPAREL INDUSTRIES

Fall. Credit three hours. Prerequisites, T.C. 170 or permission of instructor, and Economics 103 and 104 or equivalent. Students who have taken T.C. 221 or 222 should consult instructor before registering. Miss Dardis. T Th 11–12:15. Room 121.

Trends in the production and consumption of textiles and apparel; economic analysis of the textile and apparel industries; factors affecting changes in out put, price, location, and market structure.

445. APPAREL DESIGN: TAILORING PROCESSES

Fall. Credit three hours. Prerequisite, T.C. 215. Limited to 16 students. Miss Humphrey. T Th 9–11. Two additional hours of work in laboratory required. Room 213.

Design in apparel achieved through structural potentials of fabric and combination of fabrics; processes adaptable to the physical characteristics of fabrics in relation to cost, style, and use. Provides opportunity for students to explore and create processes relative to types of fabrics; to judge processes objectively in terms of achieving design qualities; and to exercise judgment in choice of process in relation to end use. Not offered in spring, 1968; two sections will be offered in fall, 1967: T Th 9–11 and T Th 2–4.

475. TEXTILES: CHARACTERIZATION AND EVALUATION

Fall. Credit three hours. Prerequisite, T.C. 170. Miss Stout. W F 11–1 and two unscheduled hours of independent laboratory work weekly. Limited to 16 students. Rooms 278, 280, 277A.

A series of cooperative class problems involving a wide range of fibers and fabrics, testing procedures, and laboratory equipment. Research methods of analysing and interpreting data and of presenting reports. Laboratory work includes the use of various testing instruments and standard and tentative test methods of both the American Society for Testing and Materials and the American Association of Textile Chemists and Colorists, as well as devised experimental methods. American Standards Association L-22 Minimum Requirements for Textile End-Use Performance are used where appropriate.

476. TEXTILE CHEMISTRY

Fall. Credit four hours. Prerequisites, T.C. 170 and one year of organic chemistry (Chemistry 357–358 preferred) or permission of instructor. Miss Smith. Lecture, W F 8. Room 301. Laboratory, W F 10–12. Room 234.

An introduction to the chemistry of the major classes of natural and man-made fibers, including their structure, properties, and reactions. Laboratory work will include the qualitative identification of textile fibers, and a consideration of chemical damage to fabrics, finishes, and dyes.

477. STRUCTURE AND PROPERTIES OF TEXTILE FIBERS

Spring. Credit three hours. Prerequisite, T.C. 170 and 576. Physics 101–102 or 207–208, and organic chemistry. Miss White. T 2–3:30. Room 234. Th 2–3:30. Room 124.

Physical and chemical properties of textile fibers are considered in relation to current ideas of fiber structure. Emphasis is placed on fiber properties which contribute to ease of care, serviceability, comfort, and aesthetic characteristics of the finished textile.

478. LABORATORY: STRUCTURE AND PROPERTIES OF TEXTILE FIBERS

Spring. Credit two hours. Prerequisite, T.C. 477. Registration by permission of instructor. Miss White. Time to be arranged. Room 234.

Laboratory investigation of structure and properties of textile fibers.

500. SPECIAL PROBLEMS FOR GRADUATE STUDENTS

Fall and spring. Credit and hours to be arranged. Department faculty. For graduate students recommended by their chairmen and approved by the head of the department and the instructor in charge for independent, advanced work.

530. SEMINAR: CLOTHING AS RELATED TO HUMAN BEHAVIOR

Spring. Credit three hours. Upperclassmen by permission of instructor. T Th 2. Room 301.

A critical review of literature concerned with social-psychological aspects of clothing, with emphasis on methods of approach. The formulation and planning of a problem in this field. Alternate-year course; not offered in 1966–67.

531. SEMINAR: PSYCHOLOGICAL IMPLICATIONS OF CLOTHING FOR CHILDREN AND ADOLESCENTS

Spring. Credit three hours. Upperclassmen by permission of instructor. T Th 2. Room 301.

A critical review of literature, concerned with children's and adolescents' interests in clothing, including their clothing preferences, their attitudes toward clothing and its importance, and the effects of clothing upon their

feelings and behavior. Emphasis will be placed on research methods in the area. Alternate-year course; offered in 1966–67.

533. ECONOMICS OF THE TEXTILE AND APPAREL INDUSTRIES

Spring. Credit three hours. Prerequisite, T.C. 433. Upperclassmen by permission of instructor. Students who have taken T.C. 221 or 222 should consult instructor before registering. Miss Dardis. Time and room to be arranged.

Current problems of the textile and apparel industries; textile trade fluctuations; international trade in textiles and textile products.

551. APPAREL DESIGN: DESIGNERS' PROBLEMS

Spring. Credit three hours. Prerequisite T.C. 350; T.C. 333 desirable. May be taken preceding or following T.C. 555 but not parallel. Miss Humphrey. T Th 2–4. Room 213.

Methods of developing apparel design ideas adaptable to present-day mass production methods. Development of designs for various levels of production costs and various categories of apparel. Studio work involves independent investigation on the part of the student in the area of her specialized interest. Lectures, discussions, field trips. Students are responsible for field trip expenses.

555. DESIGN AND COLOR IN APPAREL: ADVANCED COURSE

Spring. Credit three hours. Prerequisites, T.C. 350, Housing and Design 200, or Drawing 111 or Art 340a. Mrs. McMurry. M W 2–4. Approximately two additional hours of laboratory work required. Room 216.

Selected problems in designing apparel will provide opportunity to solve the interrelated problems in the development of a design set by such factors as the materials and technical procedures. Alternate-year course; not offered in 1966–67.

570. SEMINAR: STRUCTURE AND PROPERTIES OF TEXTILE MATERIALS

Fall. Credit two hours. Registration by permission of instructor. Miss White. T 2–4. Room 234.

Critical review of research literature. Consideration of current theories regarding the relationships of yarn and fabric structure, finish, and conditions of service to the performance of textile materials.

575. TEXTILES: CHARACTERIZATION AND EVALUATION

Spring. Credit three hours. Prerequisite, T.C. 475; statistics, and T.C. 476 and 477 recommended. Miss Stout. W F 11–1 and two unscheduled hours of independent work weekly. Room 277A, 278, 280.

A series of cooperative class problems involving various fibers in fabric form, testing procedures, and specialized equipment. Physical, chemical, and microscopical procedures are combined in studying certain problems.

576. ADVANCED TEXTILE CHEMISTRY

Spring. Credit four hours. Prerequisites, T.C. 475 and 476 and quantitative analysis or permission of instructor. Miss Smith. Lecture, W F 8. Room 301. Laboratory, W F 10–12. Room 234.

An examination of the molecular structure, properties, and reactions of the major classes of natural and man-made fibers. Laboratory work will include a study of the molecular structure of a cellulosic, a protein, and a man-made fiber and the quantitative analysis of textile fibers and materials.

578. SEMINAR IN TEXTILES

Spring. Credit one hour. Seniors by permission of instructors. Misses Smith, Stout, and White. Time to be arranged. Room 278.

Critical discussion of research literature. Class activities may include panel discussion, field trips, reports by students, faculty, or others with special knowledge in certain areas of the textile field.

599. THESIS AND RESEARCH

Fall and spring. Registration with permission of the instructor. Department faculty.

608. SEMINAR IN TEXTILES AND CLOTHING

Fall and spring. Department faculty. F 4. Room 117.

Consideration of research areas and methods in textiles and clothing, and of interdisciplinary relationships between textiles and clothing and other fields. Presentation of student thesis plans and reports, student-faculty discussions, and outside speakers.

Water Resources

(See pages 455–456.)

BIOLOGICAL SCIENCES

Fields of: Agronomy, Animal Breeding, Animal Husbandry, Animal Nutrition, Animal Physiology, Biochemistry, Botany, Conservation, Dairy Science, Entomology and Limnology, Evolutionary Biology, Floriculture and Ornamental Horticulture, Food and Nutrition, Food Science and Technology, Genetics, Microbiology, Neurobiology and Behavior, Plant Breeding, Plant Pathology, Pomology, Poultry Science, Psychology, Vegetable Crops, Veterinary Medicine, and Zoology.

Agronomy

Faculty: Martin Alexander, W. H. Alloway, Richard W. Arnold. David R. Bouldin, Marlin G. Cline, Winton Covey, Jeffrey E. Dawson, Bernard E. Dethier, Reeshon Feuer, George R. Free, Joseph F. Hodgson, Harry A. Kerr, Ralph E. Krenzin, Joe Kubota, Douglas J. Lathwell, Edgar R. Lemon, Dean L. Linscott, Robert F. Lucey, Harry A. MacDonald, Murray H. Milford, Robert D. Miller, Hugh F. Mulligan, Robert B. Musgrave, Ralph L. Obendorf, Gerald W. Olson, Michael Peech, William S. Reid, Thomas W. Scott, Robert R. Seaney, Earl L. Stone, Jr., Madison J. Wright, Paul J. Zwerman. At Geneva: Benjamin E. Clark, Willard F. Crosier, Anivar A. Khan, LeRoy W. Nittler.

Field Representative: David R. Bouldin, 472 Caldwell Hall.

APPROPRIATE MAJOR SUBJECTS	APPROPRIATE MINOR SUBJECTS
Field Crop Science	Field Crop Science
Meteorology	Meteorology
Seed Technology (M.S. only)	Seed Technology
Soil Science	Soil Science

ADMISSION REQUIREMENTS. Scholastic records of students applying for admission to graduate work in Agronomy are judged by the extent and quality of previous training in chemistry, biological sciences, physics, mathematics, and geology, emphasis depending on the intended major subject. The Graduate Record Examination is of value but is not required. A passing grade in a test of English proficiency is required of applicants whose native language or previous medium of instruction was not English.

Plant Breeding, which at many institutions is included in Agronomy, is a separate but closely related Field at Cornell. Students primarily interested in plant breeding can apply to that Field, or can choose it as a minor subject.

Ordinarily, students complete a Master's program before being accepted for a doctoral program, but direct admission to a doctoral program is permitted when students are exceptionally well prepared.

FOREIGN LANGUAGE REQUIREMENTS. Proficiency in foreign language is not required for the M.S. degree. Proficiency in translating one foreign language into English must be demonstrated by candidates for the Ph.D. in this Field. Applicants should consult the Field Representative for details.

EXAMINATIONS. For the Master's degree the Field requires a final oral examination. For the doctorate, the Field requires an initial oral examination to assess the student's preparation and enable the Special Committee to specify coursework appropriate to his intended research and career; an oral examination (qualifying) at or near the conclusion of coursework; and a final oral examination on the thesis. The Master's examination may also, by prior agreement, serve as the first doctoral examination.

OPPORTUNITIES FOR GRADUATE STUDY AND RESEARCH. The Field will occupy, beginning late in 1967, one of the most modern and diversified agronomic research facilities in the world. An air-conditioned eleven story research tower and adjoining wings will incorporate fully-equipped laboratory, teaching, office, and supporting spaces for work in field crop science, soil science, meteorology, and seed technology. The Field of Plant Breeding and the Section of Genetics and Physiology of the Division of Biological Sciences will occupy a part of the tower and wings.

Graduate students have access also to newly-constructed growth chambers and greenhouse facilities on the campus. The Agronomy Department operates three main field stations near Ithaca, representative of major agricultural regions of the state, to provide sites and equipment for field experimentation.

Seed technology studies are conducted also in new quarters at Geneva; students may arrange to work there while enrolled at Ithaca. Some members of the Field are staff members at the U.S. Plant, Soil, and Nutrition Laboratory (USDA) on the campus.

A large number of Fields may be elected as minors. In addition to physical, biological, and agricultural social sciences these include Water Resources, Soil Engineering, Soil and Water Engineering, and International Agricultural Development.

A limited number of students can do most, or all, of their research overseas under provisions of special agreements between Cornell and certain other institutions.

SPECIAL INTERESTS OF THE FACULTY

Field Crop Science and Seed Technology

1. Crop chemistry: Professor MacDonald
2. Crop ecology: Professor Musgrave

3. Crop physiology: Professors MacDonald, Musgrave, Obendorf, and Wright.
4. Crop preservation: Professors Musgrave and Wright
5. Crop production: Professors Krenzin, Lucey, and Seaney
6. Seed technology: Professors Clark, Crosier, Khan, MacDonald, and Nittler
7. Weeds and herbicides: Professor Linscott
8. Aquatic plant ecology: Professor Mulligan

Meteorology

1. General meteorology: Professors Covey and Dethier
2. Micrometeorology: Professors Covey and Lemon
3. Climatology and microclimatology: Professor Dethier

Soil Science

1. Forest soils: Professor Stone
2. Organic soils: Professor Dawson
3. Soil and water conservation: Professors Free, Kerr, and Zwerman
4. Soil chemistry: Professors Dawson, Hodgson, and Peech
5. Soil fertility: Professors Allaway, Bouldin, Lathwell, Reid, and Scott
6. Soil microbiology: Professor Alexander
7. Soil mineralogy: Professor Milford
8. Soil morphology, genesis, and cartography: Professors Arnold, Cline, Feuer, Kubota, and Olson
9. Soil physics: Professors Lemon and Miller
10. Soil-water studies in aquatic environments: Professors Bouldin, Dawson, and Lathwell.

Prospective students are urged to correspond with the professor whose interests are nearest their own.

COURSES

401. GEOGRAPHY AND APPRAISAL OF SOILS OF THE TROPICS

Spring term. Credit three hours. Lectures, W F 12. Caldwell 100. Discussion, F 2–4:30. Warren 37. Associate Professor Van Wambeke.

Character, production potential, and management requirements of soils of tropical rain forests, tropical savannahs, tropical deserts, and tropical highlands, including soils under paddy culture. Emphasis is on the identification of soil properties associated with the principal kinds of soil, bases for predicting their occurrence, and bases for their interpretation in terms of production potential and management requirements. Lectures are used to introduce principles whose applications are treated by problem-solving, discussion, and independent study of the literature. Individuals who have not had the equivalent of Course 301 will be expected to become familiar with standard nomenclature of field properties of soil by self-study.

402. CHEMICAL METHODS OF SOIL ANALYSIS

Spring term. Credit three hours. Prerequisites, Course 200 and Chemistry 236 or their equivalent. T Th 2–4:30. Caldwell 100. Professor Peech.

Lectures, laboratory exercises, and demonstrations designed to familarize the student with different chemical techniques for studying soils.

[403. ORGANIC SOILS]

Fall term. Credit two hours. Offered in alternate years. Prerequisite, Course 200. Lecture, T Th 9. Warren 31. Professor Dawson. Not offered in 1966–67.

Physical and chemical properties of organic soils used for crop production and soil conditioning. One all-day Saturday field trip.

408. SOIL PHYSICS, LABORATORY

Fall term. Credit one hour. S 8–10:30 or as arranged. Caldwell 294. Professor R. D. Miller.

Exercises in physical methods used in soil investigations.

450. SPECIAL TOPICS IN SOIL SCIENCE

Fall and spring terms. Credit one to six hours. The topics to be treated will be arranged at the beginning of each term for individual self-study or for group discussions. Time to be arranged. Staff.

461. REGIONAL AGRONOMY STUDIES

Fall term. Credit four hours. Prerequisites, Courses 111 and 200 or permission of the instructor. Enrollment limited and must be approved by instructor in charge. Discussion, Th 12. Caldwell 100. Three weeks field study trip preceding June. Assistant Professor Milford and staff.

[501. SOIL CHEMISTRY]

Fall term. Credit three hours. Offered every other year. Prerequisites, Course 200 and a one-year course in introductory physical chemistry, or consent of the instructor. Lectures, T Th S 10. Warren 31. Professor Peech. Not offered in 1966–67.

Chemical and mineralogical composition and chemical properties of soils, with emphasis on ionic equilibria in soils.

503. MORPHOLOGY, GENESIS, AND CLASSIFICATION OF SOILS

Spring term. Credit three hours. Given every other year, alternating with Course 524. Prerequisite, graduate standing or permission of the instructor. T Th S 10. Warren 37. Associate Professor Arnold.

Principles of soil classification, reactions and processes of soil genesis, and development and significance of major groups of soils of the world. One all-day field trip on a date to be arranged.

506. ADVANCED SOIL MICROBIOLOGY

Fall term. Credit one hour. Prerequisite, Course 306 or permission to register. Time and place to be arranged. Associate Professor Martin Alexander.

Discussions of current topics in special areas of soil microbiology. Particular attention is given to biochemical problems in microbial ecology.

507. SOIL PHYSICS, LECTURES

Fall term. Credit three hours. Given in alternate years. Prerequisites, Course 200 and one year of college physics or permission of the instructor. M W F 9. Warren 260. Professor R. D. Miller.

A study of physical properties and processes of soil, with emphasis on basic principles.

524. SOIL FERTILITY, ADVANCED COURSE

Spring term. Given in even-numbered years. Prerequisite, graduate status, major or minor in agronomy, or permission of instructor. Lectures, T Th S 9. Warren 37. Associate Professor Bouldin.

A study of selected topics in soil-plant-fertilizer relationships with em-

phasis on concepts of soil fertility, interpretation of experimental data, and soil-fertilizer chemistry.

422. TROPICAL AGRICULTURE

Spring term. Credit two to four hours, depending upon student preparation, participation, and related courses taken. Lectures and discussions, M W F 10. Plant Science 37. Prerequisites, a course covering elementary botany and permission of instructor. Professor MacDonald.

Designed to provide some knowledge and understanding of the tropical environment and its agriculture. Topics covered include the agriculture, principal crops, and cropping problems of the tropics and sub-tropics. Particular stress is given to (a) agricultural ecology, (b) agricultural patterns, traditions, and problems, (c) economic crops, their botany, adaptation, cultural requirement, improvement, management, protection, production, and use, and (d) resources, limitations, and opportunities for tropical agricultural development and improvement. Independent study of the literature is encouraged and facilitated. Lectures supplemented by illustrations, demonstrations, and discussions.

425. ECONOMIC CROPS OF THE WORLD, THEIR NATURE, PROPERTIES, PRODUCTS, AND USE

Spring term. Credit four hours. Prerequisite, course in field crop production and organic chemistry or biochemistry and permission of instructor. Lectures, M W F 9. Laboratory, W 2–4:30. Warren 37. Professor MacDonald.

A study of the agronomic crops of the world in relation to their occurrence, adaptation, culture, production, and use. Special attention is devoted to feed, food, fiber, oil, drug, and various other crops of arid and tropical regions. Crop processing, product extraction, and storage will be discussed. Emphasis will be on plants and plant products for the use of man.

451. SPECIAL TOPICS IN FIELD CROPS

Fall and spring terms. Credit one to six hours. The topic to be traded will be arranged at the beginning of each term for individual self-study or for group discussions. Time to be arranged. Staff.

513. CROP ECOLOGY

Fall term. Credit two hours. Given every other year, alternating with Course 514. Prerequisites, Course 200, 111, and Biological Science 240. Class meetings to be twice weekly for first eight weeks of semester for two hours per meeting. Times to be arranged. Professor Musgrave.

An extension of Course 313 and a study of special techniques used to obtain and analyze physiological data on crop plant responses to environmental conditions occurring in the field.

[514. GRASSLANDS AND GRASSLAND RESEARCH]

Fall term. Credit three hours. Offered in alternate years. Prerequisites, Course 312, Plant Breeding 200, and Biological Science 240, or their equivalents, and permission to register. M W F 9. Warren 245. Professor MacDonald. Not offered in 1966–67.

A study of ecological factors underlying the development, maintenance, and management of different grassland types for different uses, and the principles and practices of grassland and forage-crop investigations. Different grassland species, types, and associations will be discussed in relation to adaptation, production, and use. Emphasis will be on research.

561. RESEARCH IN FIELD-CROP PRODUCTION

Fall, spring, and summer terms. All members of the professional staff.

690. SEMINAR

Fall and spring terms. Required of graduate students majoring or minoring in the department. T 4:30. Caldwell 100.

560. RESEARCH IN SOIL SCIENCE

Fall and spring terms. All members of the professional staff.

[411. INTRODUCTORY DYNAMIC METEOROLOGY]

Fall term. Credit three hours. Offered in alternate years. Prerequisites, Physics 207–208 and Mathematics 111–112 or permission of the instructor. Lectures M W F 8. Plant Science 141. Associate Professor Covey. Not offered in 1966–67.

Properties of air, hydrostatic stability and convection, radiation in the earth's weather system, and atmospheric circulations.

[412. INTERMEDIATE DYNAMIC METEOROLOGY]

Spring term. Credit three hours. Offered in alternate years. Prerequisites, Course 411 and Mathematics 213 or permission of instructor. Associate Professor Covey. Not offered in 1966–67.

Consideration of the atmospheric part of the earth's weather system. Review of attempts to find the governing relations in useful form, and to identify, measure, and compute the significant parameters.

413. MICROMETEOROLOGY

Fall term. Credit three hours. Given in alternate years. Prerequisites, same as for Course 411. Associate Professor Covey.

Weather and climate near the ground, considered from the local point of view. Interaction of plants and their local physical environment.

550. SPECIAL TOPICS IN METEOROLOGY AND CLIMATOLOGY

Fall or spring term. Credit one or more hours. Prerequisite, permission of the instructor. Staff.

Study of meteorological topics more advanced than or different from those in other courses. Subject matter depends on the background and desires of those enrolling.

562. RESEARCH IN METEOROLOGY

Fall and spring terms. Credit one or more hours. Thesis research. Staff.

691 SEMINAR IN METEOROLOGY

Prerequisite, permission of the professor in charge. Topic for Spring 1967, "Interaction of Lands and Atmosphere in the Earth's Weather System." Associate Professor Covey.

Subjects for future times may be such things as hydrometeorology, paleoclimatology, atmospheric pollution. These will be planned and announced well in advance.

Animal Breeding

Faculty: Robert W. Bratton, J. H. Bruckner, Randall K. Cole, Robert H. Foote, Charles R. Henderson, L. Dale Van Vleck.

Field Representative: C. R. Henderson, Morrison Hall.

APPROPRIATE MAJOR SUBJECTS	APPROPRIATE MINOR SUBJECTS
Animal Breeding	Animal Breeding
Animal Genetics	Animal Genetics

Students entering into study in Animal Breeding and Genetics are expected to have had good basic undergraduate training in biology, chemistry, and mathematics. Previous experience with large animals or with poultry is desirable but not absolutely essential.

There is no specific foreign language requirement of the field, but individual faculty members of the field may require one or more languages depending upon the student's area of specialization and previous training in languages.

Professors Henderson and Van Vleck specialize in statistical genetics research and teaching with particular emphasis on selection programs for improvement of large animals.

Professors Bratton and Foote engage in research and teaching in reproductive physiology and related areas, and are concerned with the use of these techniques in the genetic improvement of populations.

Professors Bruckner and Cole conduct their research in the area of poultry genetics.

Superior facilities are available for graduate student training in each of these areas. Students are expected to participate actively in these research programs and generally are provided assistantships.

COURSES

ANIMAL SCIENCE 420. PROBLEMS IN GENETICS OF ANIMAL BREEDING

Professor Van Vleck.

ANIMAL SCIENCE 520. EXPERIMENTAL METHODS IN QUANTITATIVE GENETICS AND ANIMAL BREEDING

Professor Henderson.

In addition faculty members assist with: Animal Science 601. Seminar; Poultry Science 609, Seminar in Poultry Biology.

Animal Husbandry

Faculty: Warren F. Brannon, Robert W. Bratton, H. Wilmot Carter, Carl E. Coppock, J. Murray Elliot, Robert H. Foote, William Hansel, Charles R. Henderson, Douglas E. Hogue, John K. Loosli, Alex M. Meek, William G. Merrill, John I. Miller, Ellis A. Pierce, Wilson G. Pond, John T. Reid, Glen H. Schmidt, Samuel T. Slack, Sedgwick E. Smith, Robert W. Spalding, James R. Stouffer, Hugh F. Travis, George W. Trimberger, Kenneth L. Turk, L. Dale VanVleck, Willard J. Visek, Richard G. Warner, George H. Wellington.

Visiting Professor: Ralph Bogart, Oregon State University

Field Representative: J. K. Loosli, 149 Morrison Hall.

APPROPRIATE MAJOR AND MINOR SUBJECTS

Animal Breeding	Animal Nutrition
Animal Husbandry	Dairy Husbandry

A student to be admitted into graduate study in the Field of Animal Husbandry should have demonstrated a high order of scholarship at the undergraduate level; should have had a good selection of Animal Science courses, and as many physical science and biology courses as possible.

There is no uniform Field requirement on foreign languages, but rather the choice of a foreign language is left to the individual's Special Committee.

A final oral examination is required for an M.S. degree which may also serve as the qualifying examination for the Ph.D. degree.

RESEARCH AND STUDY OPPORTUNITIES

The Field of Animal Husbandry is well staffed and equipped to offer research and study opportunities in the following areas of specialization:
Animal Breeding: Professors Bratton, Foote, Henderson, and VanVleck.
Animal Nutrition: Professors Elliot, Hogue, Loosli, Merrill, Pond, Reid, Smith, Visek, and Warner.
Animal Physiology: Professors Hansel, Schmidt, and Visek.
Beef Husbandry: Professor Miller.
Dairy Husbandry: Professors Carter, Coppock, Elliot, Meek, Merrill, Schmidt, Slack, Spalding, Trimberger, and Turk.
Meats: Professors Stouffer and Wellington.
Sheep Husbandry: Professors Brannon and Hogue.
Swine Husbandry: Professors Pierce and Pond.

COURSES

400. LIVESTOCK PRODUCTION IN THE TROPICS

Spring term. Credit three hours. Prerequisite, Course 100, 112 or 220, or permission of the instructor. Lectures and discussions, T Th 10–12:30. Morrison 342. Professors Loosli and Matthysse.

A discussion of the present and potential roles of domesticated animals as a source of food, power, and fiber in tropical areas of the world. Physiological effects of climatic and other environmental factors, breed and species characteristics involving adaptability, heat tolerance, disease resistance, and management in relation to feed utilization, will be summarized. The efficiency of production of meat, milk, wool, and eggs will be considered.

410. PRINCIPLES OF ANIMAL NUTRITION

Fall term. Credit two hours. Prerequisites, a course in human or veterinary physiology and a course in organic chemistry or biochemistry. Lectures, T Th 10. Morrison 342. Professor Loosli.

The chemistry and physiology of nutrition and the nutritive requirements for growth, reproduction, lactation, and other body functions.

427. FUNDAMENTALS OF ENDOCRINOLOGY

Fall term. Credit three hours. Prerequisite, a course in human or veterinary physiology, or by permission. Lectures, T Th S 10. Morrison 167. Professor Hansel.

A general course in the physiology of the endocrine glands, and the roles played by each hormone in the regulation of normal body processes.

451. PHYSIOLOGY AND BIOCHEMISTRY OF LACTATION

Spring term. Credit three hours. Prerequisite, Courses 427 or Veterinary Physiology 310. A course in biochemistry is recommended before registering for this course. Lectures, T Th 9. Morrison 163. Laboratory, T 2–4:30. Morrison 174. Associate Professor Schmidt.

An advanced course in the anatomy of the mammary gland, the physiological mechanisms of milk secretion, and the biochemical synthesis of milk constituents in laboratory and farm animals.

[490. MEAT TECHNOLOGY]

Fall term. Credit three hours. Offered in alternate years. Prerequisite, Course 290 or by permission. Lecture T 9. Morrison 82. Laboratory, T Th 2–4:30. Professor Wellington. Not offered in 1966–67.

The basic methods of meat processing, formulations, methods of meat product testing, and meat product development through study and laboratory experience.

500. RESEARCH

Fall and spring terms. Credit and hours by arrangement. All members of departmental staff.

501. PROTEINS AND AMINO ACIDS

Fall term. Credit two hours. M W 10. Martha Van Rensselaer 339. Associate Professor M. A. Morrison.

502. LIPIDS AND CARBOHYDRATES

Fall term. Credit two hours. T 11 and F 10. Martha Van Rensselaer 339. Professor R. J. Young.

503. NUTRITIONAL ENERGETICS

Spring term. Credit two hours. M W 10. Morrison 342. Professor Reid.

504. MINERALS AND VITAMINS

Spring term. Credit two hours. T 11 and F 10. Morrison 342. Professor M. L. Scott.

510. SPECIAL TOPICS IN ANIMAL NUTRITION

Spring term. Credit one hour. Registration by permission. Th 8. Morrison 342. Professor S. E. Smith.

A presentation and discussion of the knowledge and techniques of special fields of animal nutrition, with particular reference to farm animals.

511. LABORATORY WORK IN ANIMAL NUTRITION

Spring term. Credit three hours. Prerequisites, quantitative analysis and Course 410, or its equivalent, and permission of the instructor. M W F 2–4:30. Morrison 342 and 443. Professor Warner.

Each student engages in a series of short research projects with experimental animals, such as rats, dogs, and sheep. Both classical and modern techniques of animal experimentation are taught. The applications of biochemical methods to the solution of animal nutrition problems are included.

520. EXPERIMENTAL METHODS IN QUANTITATIVE GENETICS AND ANIMAL BREEDING

Fall term. Credit three hours. Prerequisite, Plant Breeding 514 or a course in mathematical statistics. Time and place to be arranged. Professor Henderson.

Estimation of genetic and environmental parameters required to design efficient selection programs. Particular emphasis is given to interpretation of experimental and survey data with unequal subclass numbers and to prediction of genetic progress resulting from alternative selection methods.

601. SEMINAR IN ANIMAL HUSBANDRY

Fall and spring terms. Credit one hour. Required of all graduate students taking either a major or a minor subject in animal science. M 11. Morrison 348. Staff.

610. SEMINAR IN ANIMAL REPRODUCTION AND ENDOCRINOLOGY

Spring term. No credit. Open to graduate students with majors or minors in animal physiology. Th 4. Morrison 342.

619. SEMINAR IN ANIMAL NUTRITION

Fall term. Credit one hour. Open to graduate students with major or minor field of study in animal nutrition. Registration by permission. T 4:30. Morrison 348. Animal Nutrition staff.

A critical review of the literature and other topics of special interest to graduate students in animal nutrition.

Animal Nutrition

Faculty: Richard H. Barnes, Cyril L. Comar, J. Murray Elliot, Douglas E. Hogue, Roland M. Leach, Jr., Frederick W. Lengemann, John K. Loosli, Leo Lutwak, William G. Merrill, Malden C. Nesheim, Wilson G. Pond, J. Thomas Reid, Milton L. Scott, Ben E. Sheffy, Sedgwick E. Smith, Hugh F. Travis, André G. van Veen, Willard J. Visek, Richard G. Warner, Robert H. Wasserman, Robert J. Young.

Field Representative: W. G. Pond, 252 Morrison Hall.

APPROPRIATE EITHER AS MAJOR OR MINOR SUBJECT

Animal Nutrition

ADMISSION REQUIREMENTS. Candidates for admission to this Field must meet the general requirements for admission to the Graduate School. In addition, they should be well prepared in basic sciences.

For graduate study with nutrition as the major subject, preparation is highly desirable in analytical and organic chemistry, general biology or zoology, genetics, mathematics, physics, physiology, and a foreign language. Some deficiencies in background preparation can be made up after admission to candidacy but this usually prolongs the time necessary to complete degree requirements.

LANGUAGE REQUIREMENTS. There is no language requirement specified for the Master's degree. There is no language requirement imposed by the Field for candidates for the degree of Ph.D.; rather, the requirements for the individual student for study in a foreign language are determined by his Special Committee.

EXAMINATIONS. The special committee conducts all examinations. For the Master's degree the student must present an acceptable thesis and be examined in one major and one minor field at the end of his course of study. For the Ph.D. degree, the Field requires a qualifying examination. Two minors are required of all students in Doctoral Programs.

RESEARCH AND STUDY OPPORTUNITIES. In preparation for an advanced degree, candidates according to their special interests may acquire training in biochemistry, food technology, histology, nutrition, pathology, physiology, and other areas of science and technology. Candidates for the Ph.D. degree may be expected to study a foreign language if they have not offered adequate foreign language training upon admission. Students are generally advised to select either biochemistry or physiology as a minor for the Master's degree, and both of these subjects as minors for the doctorate. However, other minor subject matter areas may be selected, depending upon the student's interest. Physical chemistry and advanced work in organic chemistry may be required of students particularly interested in the biochemistry of nutrition.

Strong research programs in animal and clinical nutrition are maintained at Cornell University under the direction of members of the Graduate School Faculty responsible for the training of graduate students in this field. A wide latitude is allowed in the selection of the research problem for the degree. If they desire, students may select various phases of established projects which permit them to exercise originality and independence of thinking.

Within the broad Field of Animal Nutrition, faculty interests encompass a wide range of research specializations. These include the following specific categories: proteins and amino acids; fats; energy metabolism; vitamins; minerals; digestion; absorption; nutrient transport; nutrition and disease.

Each of these special subjects can be studied with a variety of animal species. The faculty are listed with the species of their primary interest.

1. Ruminant nutrition: Beef cattle, dairy cattle, sheep.
   Elliot, Hogue, Lengemann, Loosli, Merrill, Reid, Smith, Warner
2. Non-ruminant nutrition: Dogs, laboratory animals, mink, poultry, swine.
   Barnes, Comar, Elliot, Hogue, Leach, Lengemann, Loosli, Nesheim, Pond, Reid, Scott, Sheffy, Smith, Travis, Visek, Warner, Wasserman, Young
3. Clinical and human nutrition: Barnes, Lutwak, van Veen, Visek

COURSES

ANIMAL SCIENCE 410. PRINCIPLES OF ANIMAL NUTRITION

Fall term. Credit two hours. Prerequisites, a course in human or veterinary physiology and a course in organic chemistry or biochemistry. Lectures T Th 10. Morrison 342. Professor J. K. Loosli.

The chemistry and physiology of nutrition and the nutritive requirements for growth, reproduction, lactation, and other body functions.

ANIMAL SCIENCE 511. LABORATORY WORK IN ANIMAL NUTRITION

Spring term. Credit three hours. Prerequisites, quantitative analysis and Course 410, or its equivalent, and permission of the instructor. M W F 2–4:30. Morrison 342 and 443. Professor R. G. Warner.

Each student engages in a series of short research projects with experimental animals, such as rats, dogs, and sheep. Both classical and modern techniques of animal experimentation are taught. The applications of biochemical methods to the solution of animal nutrition problems are included.

ANIMAL SCIENCE 510. SPECIAL TOPICS IN ANIMAL NUTRITION

Spring term. Credit one hour. Registration by permission. Th 8. Morrison 342. Professors J. T. Reid and S. E. Smith.

A presentation and discussion of the knowledge and techniques of special fields of animal nutrition, with particular reference to farm animals.

POULTRY SCIENCE 511. RESEARCH IN NUTRITION

Fall or spring term. Credit and hours to be arranged. For graduate students only. Registration by permission of staff member concerned. Professors R. J. Young and M. L. Scott, Associate Professor M. C. Nesheim.

For students desiring experience in planning, conducting and reporting independent research projects in poultry nutrition.

ANIMAL AND POULTRY SCIENCE 619. SEMINAR IN ANIMAL NUTRITION

Fall term. Credit one hour. Open to graduate students with major Field of study in animal nutrition. Registration by permission. T 4:30. Morrison 348. Animal Nutrition staff.

A critical review of the literature and other topics of special interest to graduate students in animal nutrition.

GRADUATE SCHOOL OF NUTRITION 100. PROBLEMS AND PROGRAMS IN INTERNATIONAL NUTRITION

Fall term. Credit four hours. Registration by permission. Lectures M W 11–12:30, F 11–12. Savage Hall. Professor A. G. van Veen.

To acquaint students with the planning of effective programs and policies in the Fields of nutritional and food science with the purpose of improving nutrition conditions in developing countries, with proper emphasis on the role of agriculture and public health. Among topics considered are typical foods and diets in different parts of the world, assessment of food and nutrition conditions, protein-rich and other protective foods, food processing and preservation in developing countries, food standards, and food control.

GRADUATE SCHOOL OF NUTRITION 292. NUTRITION SEMINAR

Spring term. Credit one hour. M 4:15. Savage 100. Professor R. H. Barnes and faculty.

Advanced Nutrition

A series of nutrition courses offered jointly by the Department of Food and Nutrition, College of Home Economics; Department of Animal Science, College of Agriculture; Department of Poultry Science, College of Agriculture; and the Graduate School of Nutrition. Prerequisites: courses in nutrition, physiology, and biochemistry to include intermediary metabolism, or with permission of instructor.

The biochemical and physiological bases of digestion, absorption, transport and metabolism of nutrients; species differences where applicable; historical as well as current concepts of nutrition.

PROTEINS AND AMINO ACIDS (Food and Nutrition 501)

Fall term. Credit two hours. M W 10. Martha Van Rensselaer 339. Associate Professor M. A. Morrison.

LIPIDS AND CARBOHYDRATES. (Animal Science 502)

Fall term. Credit two hours. T 11 and F 10. Martha Van Rensselaer 339. Professor R. J. Young.

NUTRITIONAL ENERGETICS. (Animal Science 503)

Spring term. Credit two hours. M W 10. Morrison 342. Professor J. T. Reid.

MINERALS AND VITAMINS. (Animal Science 504)

Spring term. Credit two hours. T 11 and F 10. Rice 301. Professor M. L. Scott.

Animal Physiology

Faculty: John Bentinck-Smith, Emmett N. Bergman, Robert W. Bratton, Alison P. Casarett, Cyril L. Comar, Alan Dobson, Thomas Eisner, Robert H. Foote, Edgar L. Gasteiger, Perry W. Gilbert, William Hansel, Frederick W. Lengemann, Samuel L. Leonard, Leo Lutwak, Kenneth McEntee, William N. McFarland, Robert S. Morison, Louis L. Nangeroni, Richard D. O'Brien, Robert L. Patton, Frank Rosenblatt, Glen H. Schmidt, Alvin F. Sellers, Charles E. Stevens, Daniel N. Tapper, Ari van Tienhoven, Willard J. Visek, Robert H. Wasserman, William A. Wimsatt, John F. Wootton, Robert R. Zimmermann.

Field Representative: C. L. Comar, C-124 Veterinary College.

APPROPRIATE MAJOR AND MINOR SUBJECT

Animal Physiology

See also listing under special interests of the faculty for major area subjects. Minors may be selected from such areas as biochemistry, biometry, chemistry, ecology, electrical engineering, genetics, microbiology, nutrition, physics, and psychology.

All applicants, where possible, should submit the results of the Graduate Record Examination (Aptitude and Advanced Biology Tests). Students preparing for work in the Field of Animal Physiology are urged to obtain a good knowledge of biology, chemistry, biochemistry and physics. Calculus, statistics and genetics are also advisable.

There is no foreign language requirement for the Master's degree. For the Ph.D. degree the Field requires a single language, other than English, chosen by the Special Committee in the area of study of the student, at the minimal level prescribed by the Language Examination Board. This requirement must be met by the time the student takes his Admission to Candidacy Examination. The Special Committee may, in certain instances, require a second langauge, or a higher level of proficiency for a single language.

In addition to the examinations specified by the graduate school, the Field requires that doctoral candidates pass a Qualifying Examination. This should be taken before two residency units have been earned.

A doctoral candidate in Animal Physiology must have two minor Fields with a representative from each on his committee. At least one of the minor committeemen must not be a member of the Animal Physiology Field. An additional voting member will be appointed to the candidate's committee by the Field of Animal Physiology.

SPECIAL INTERESTS OF THE FACULTY

Behavioral physiology: Eisner, Gilbert, Zimmermann.
Cardiovascular physiology: Bergman, Dobson, Sellers.
Comparative neurology and neuropharmacology: O'Brien.
Comparative physiology: McFarland.
Endocrinology: Hansel, Leonard, van Tienhoven.
Enzymology: Wootton.
Gastrointestinal physiology: Dobson, Sellers, Stevens, Visek, Wasserman.
Insect physiology: Eisner, Patton.
Metabolism: Bergman, Lengemann, Lutwak, Visek.
Neurophysiology: Gasteiger, Gilbert, Rosenblatt, Tapper.
Pathological physiology: Bentinck-Smith.
Physiology of lactation: Schmidt.
Radiation biology and physical biology: Casarett, Comar, Lengemann, Wasserman.
Reproduction: Bratton, Casarett, Foote, Gilbert, Hansel, Leonard, McEntee, van Tienhoven, Wimsatt.
Ruminant physiology: Bergman, Dobson, Sellers, Stevens.
Vertebrate physiology: Gilbert, Nangeroni, Sellers, Wimsatt.

A prospective student is urged to correspond with the professor in the above list whose interests are nearest his own.

COURSES

Because Animal Physiology is an interdepartmental Field, appropriate courses may be found listed under the departments which cover the major and minor subject areas, and the special interests of the faculty. Some specific courses of general interest in Animal Physiology are listed below:
Biol. Sci. 414. Mammalian Physiology
Biol. Sci. 511. Cellular Physiology
Biol. Sci. 513. Experimental Endocrinology
Biol. Sci. 516. Special Topics in Comparative Physiology
Biol. Sci. 520. Comparative Neurology
Biol. Sci. 521–2. Brain Mechanisms and Models
An. Sci. 427. Fundamentals of Endocrinology
An. Sci. 451. Physiology and Biochemistry of Lactation
Poultry Sci. 425. Comparative Physiology of Reproduction of Vertebrates
Vet. Med. 914. Experimental Physiology for Graduate Students
Vet. Med. 920. Elements of Physical Biology
Vet. Med. 921. Radioisotopes in Biological Research
Vet. Med. 923. Biological Membranes and Nutrient Transfer
Vet. Med. 924. Functional Organization of the Nervous System

Biochemistry

Faculty: Joseph M. Calvo, Louise J. Daniel, James L. Gaylor, Quentin H. Gibson, Richard J. Guillory, Gordon G. Hammes, George P. Hess, Robert W. Holley, André T. Jagendorf, Elizabeth B. Keller, Richard E. McCarty, Donald B. McCormick, A. Leslie Neal, Walter L. Nelson, Richard D. O'Brien, Harvey S. Penefsky, Efraim Racker, Harold A. Scheraga, John F. Thompson, David C. Wharton, Harold H. Williams, John F. Wootton, Lemuel D. Wright, Ray Wu, Roger G. Young, Donald B. Zilversmit.

Field Representative: Walter L. Nelson, B-18 Wing Hall.

APPROPRIATE MAJOR SUBJECT
Biochemistry

APPROPRIATE MINOR SUBJECTS
Biological Sciences
Chemistry
Physics
Mathematics

ADMISSION REQUIREMENTS. Prior training in the physical sciences should include calculus, physics, and chemistry sequences through introductory physical chemistry; some knowledge of the basic principles of biology is desirable, but this can, if necessary, be acquired as part of the course of study to be prescribed.

LANGUAGE REQUIREMENT FOR MASTER'S DEGREE: none

LANGUAGE REQUIREMENT FOR PH.D. DEGREE: proficiency in two languages (German, French, Russian, Japanese) or a third minor subject may be substituted for *one* of the two language requirements.

Ph.D. candidates are expected to schedule an oral Qualifying Examination shortly after selection of a permanent committee and not later than the second semester of graduate study, an oral course work examination upon completion of the subject matter recommended by the Special Committee, and an oral examination on the thesis and related material.

A wide variety of research opportunities are provided in modern well-equipped laboratories. The research specializations of the faculty are summarized as follows: Joseph M. Calvo, Control of metabolic pathways in bacteria; bacterial genetics; Louise J. Daniel, Biochemical functions of vitamins B_{12} and folic acid, interrelationship of vitamins and trace elements; James L. Gaylor, Biosynthesis of sterols and steroid hormones, control mechanisms of sterol biosynthesis; Quentin H. Gibson, Haemoproteins, flavoproteins, rapid reaction spectrophotometry, and physical methods in enzyme kinetics; Richard J. Guillory, Bioenergetics of muscle contraction; Gordon G. Hammes, Biophysical chemistry, especially enzyme kinetics and mechanisms; George P. Hess, Protein mediated reactions, biological specificity and control mechanisms; Robert W. Holley, Biochemistry of nucleic acids; André T. Jagendorf, Electron transport and phosphorylation mechanisms in chloroplasts; synthesis of chloroplast proteins and their physiological controls; Elizabeth B. Keller, Enzymes, cofactors and ribosomes in protein biosynthesis; Richard E. McCarty, Photosynthetic phosphorylation and electron transport; Donald B. McCormick, Enzymes concerned with transformation of vitamins and coenzymes; A. Leslie Neal, Metabolism of plant pathogenic organisms and malignant cells; Walter L. Nelson, Biochemical mechanisms associated with functional states of cells; Richard D. O'Brien, Selective toxicity, comparative neurochemistry, and neuropharmacology; Harvey S. Penefsky, Relationship between molecular structure and function in mitochondrial ATPase; Efraim Racker, Mechanism of enzyme action, control mechanism, structure and function in mitochondria and chloroplasts, mechanisms in bioenergetics; Harold A. Scheraga, Physical chemistry of proteins; John F. Thompson, Nitrogen and sulphur metabolism of plants; David C. Wharton, Cytochrome oxidase, metalloenzymes, electron transport; Harold H. Williams, biochemistry of proteins and amino acids; selenium metabolism in microorganisms; Lemuel D. Wright, Biosynthesis of biologically active compounds, mevalonic acid metabolism, biotin metabolism; John F. Wootton, Enzyme chemistry, relationships between structure and function; Ray Wu, Regulatory mechanisms in carbohydrate metabolism, metabolism of ascites tumor and Hela cells; Roger G. Young, Mechanism of action of insecticides, fat and wax metabolism of insects; Donald B. Zilversmit, Mechanism of fat absorption. (Combined

graduate programs may be arranged with the following members of the staff of the Geneva Experiment Station: D. B. Hand, F. A. Lee, L. M. Massey, Jr., L. R. Mattick, R. S. Shallenberger, J. P. VanBuren).

COURSES

531. GENERAL BIOCHEMISTRY, LECTURES

Fall term. Credit four hours. Prerequisites, quantitative analysis, organic chemistry 358 or the equivalent, or permission of the instructor. Lectures, M W F S 9. Savage 100. Assistant Professor Calvo.

An integrated treatment of the fundamentals of biochemistry.

533. GENERAL BIOCHEMISTRY, LABORATORY

Fall term. Credit three hours. Must be taken with or following course 531. Laboratory, M W or T Th 2–4:30. Wing 107. One discussion period to be arranged. Professor Nelson, Assistant Professors McCarty and Wharton.

Selected experiments on carbohydrates, lipids, proteins, amino acids, nucleic acids, and metabolism (cellular particulates, kinetics, general enzymology) will be given to illustrate basic biochemical principles. The course will emphasize the quantitative aspects rather than qualitative indentification.

534. ADVANCED GENERAL BIOCHEMISTRY, LECTURES

Spring term. Credit four hours. Prerequisites, Biological Sciences 531 and Physical Chemistry 390 or permission of instructor. Lectures, M W F S 9. Savage 100. Professor Racker and Staff.

A broad treatment of biochemistry at an advanced level.

536. ADVANCED BIOCHEMISTRY, LABORATORY

Spring term. Credit three hours. Prerequisites, Biological Sciences 533 or the equivalent, and Biological Sciences 534 (may be taken concurrently). Registration by permission of instructor before November 1. Laboratory, M W 1:40–4:30; additional periods to be arranged. Wing 106. Professor Racker and Assistant Professor Keller.

Research techniques in biochemistry and molecular biology.

537–538. ADVANCED BIOCHEMISTRY, LECTURES

Fall and spring terms. Credit one or two hours per term. Students may take one or more sections of the course for one to four hours credit, as each section may be taken without having taken a preceding section. Prerequisite, Biological Sciences 534. Lecture, T Th 9. Savage 100. This course will be comprised of advanced lectures divided into four sections of one hour credit each. Fall term: Associate Professor Gaylor, carbohydrates and lipids, one hour; Professor Hess, proteins and enzymes, one hour. Spring term: Assistant Professor Calvo, nucleic acids and control mechanisms, one hour; Associate Professor Thompson and Assistant Professor McCarty, plant biochemistry, one hour.

631. GRADUATE SEMINAR IN BIOCHEMISTRY

Fall and spring term. Credit one hour per term. Hours to be arranged. Savage 100. Staff.

Required of all graduate students majoring in biochemistry. The course may be repeated for credit.

639. BIOCHEMISTRY SEMINAR

Fall and spring terms. No credit. F 4:15. Savage 100. Staff.

Lectures on current research in biochemistry presented by distinguished visitors and staff.

Biology

(Please see Evolutionary Biology, page 278.)

Botany

Faculty: Harlan P. Banks, Richard A. Barr, David M. Bates, David W. Bierhorst, Robert T. Clausen, Roderick K. Clayton, William J. Dress, John W. Ingram, Jr., André T. Jagendorf, George C. Kent, John M. Kingsbury, Richard P. Korf, Harold E. Moore, Jr., Loyd E. Powell, Edgar M. Shantz, Adrian M. Srb, Frederick C. Steward, Harry T. Stinson, John F. Thompson, Harold B. Tukey, Jr., Charles H. Uhl. At Geneva: John Einset.

Field Representative: Richard P. Korf, 326 Plant Science Building.

APPROPRIATE MAJOR AND MINOR SUBJECTS

Cytology
General Botany
Paleobotany
Phycology
Plant Morphology and Anatomy
Plant Physiology
Plant Taxonomy

It is recommended that applicants to the Field of Botany provide scores of the Graduate Record Examination. Except under unusual circumstances all candidates for the Ph.D. will take a Qualifying Examination to be administered by the student's Special Committee during the first semester of residence. The language requirement for the Master's degree: college entrance French and/or German or proficiency in one language other than the native language before completion of the second residence unit. For the Ph.D.: proficiency in two languages other than the native language. Proficiency is to be regarded as a reading comprehension which meets the standards set by the Cornell Language Board, except that in cases where English is allowed as a language a reading and speaking ability will be required.

GENERAL REQUIREMENTS FOR ALL DEGREES

An adequate knowledge of the structure, functions, and classification of plants is required of all candidates with major subjects in the Field of Botany. Candidates also should have basic training in chemistry, physics, geology, and mathematics.

REQUIREMENTS FOR MAJOR SUBJECTS

Additional basic requirements for the major subjects are as follows:

CYTOLOGY AND CYTOGENETICS. An adequate knowledge of cytology and two of the following: genetics or plant breeding, plant morphology and anatomy, plant physiology, or plant taxonomy. A. M. Srb, H. T. Stinson, C. H. Uhl.

GENERAL BOTANY. Additional requirements will be determined in each individual case.

PALEOBOTANY. Additional training in plant morphology and anatomy, and adequate knowledge of paleobotany and general stratigraphic geology. H. P. Banks.

PHYCOLOGY. Individual programs stressing mycology, invertebrate zoology, ecology, limnology, plant morphology, plant physiology, taxonomy, cytology, or genetics will be required as appropriate to each student's interests and purposes in studying the algae. J. M. Kingsbury.

PLANT MORPHOLOGY AND ANATOMY. Additional training in plant morphology and anatomy and plant taxonomy, and adequate knowledge of cytology, genetics, or paleobotany. H. P. Banks and D. W. Bierhorst.

PLANT PHYSIOLOGY. Additional training in plant physiology, and adequate knowledge of chemistry, a general knowledge of mathematics and physics, and training in bacteriology, genetics, mycology, plant pathology, or soils. R. A. Barr, A. T. Jagendorf, L. E. Powell, E. M. Shantz, F. C. Steward, J. F. Thompson, and H. B. Tukey, Jr.

PLANT TAXONOMY Additional training in plant taxonomy and ecology and an adequate knowledge of genetics and statistics. D. M. Bates, R. T. Clausen, W. J. Dress, J. W. Ingram, Jr., R. P. Korf, and H. E. Moore, Jr.

For Summer Research grants and assistantships in botany at the Museum of Northern Arizona, consult the Field Representative.

COURSES

Biological Sciences

541–542. PLANT PHYSIOLOGY, ADVANCED LECTURE COURSES

Fall and spring terms. Credit three hours a term. Primarily for graduate students, but undergraduates will be admitted by prior approval of instructor. Prerequisite, Biological Sciences 240 or its equivalent; Biological Sciences 541 is a desirable but not a required prerequisite for 542. Lectures, M W F 10. Plant Science 143. Professor Steward.

Fall term: Cells and cell physiology; properties of protoplasm, its membranes and organelles; relations of cells, tissues, and organs to water and solutes; water relations and stomatal behavior; inorganic plant nutrition; the essential nutrient elements.

Spring term: Plant metabolism and organic nutrition (photosynthesis, respiration, nitrogen metabolism); translocation; physiology of growth and development.

543–544. PLANT PHYSIOLOGY, ADVANCED LABORATORY

Fall and spring terms. Credit four hours a term. Primarily for graduate students, but undergraduates may be admitted by prior approval of the instructor. Prerequisites, Biological Sciences 240 or equivalent, and Biological Sciences 541–542 (may be taken concurrently). Laboratory, M W or T Th 1:40–5:00. Plant Science 241. Recitation, F 2–3. Plant Science 143. Preregistration strongly recommended. Staff.

The first term is concerned with modern methods. The second term is concerned with their application to special problems in plant physiology.

641. SEMINAR IN TAXONOMY AND ECOLOGY OF VASCULAR PLANTS
Fall term. Credit one hour. Prerequisite, Biological Sciences 442. Lecture and discussion, M 12. Plant Science 143. Professor Clausen.

An examination of primary problems concerned with the classification and environmental relationships of vascular plants.

643. SEMINAR IN PLANT PHYSIOLOGY
Fall and spring terms. Credit one hour per term. Required of graduate students taking work in plant physiology and open to all who are interested. F 11. Plant Science Seminar Room. Staff.

Discussion of current problems in plant physiology; presentation of reports on the research of graduate students and members of the staff. The course may be repeated for credit.

PLANT PATHOLOGY 649. CURRENT TOPICS IN MYCOLOGY
Fall and spring terms. Credit to be arranged. For graduate students with special interests in the particular area. Prerequisite, permission to register. Time to be arranged. Plant Science 422. Professor Korf.

Weekly discussions of current topics in special areas of mycology. Students will be required to do extensive reading of current literature and to present oral and written reports.

Conservation

Faculty: W. Robert Eadie, Alfred W. Eipper, John L. Forney, Lawrence S. Hamilton, Oliver H. Hewitt, Richard J. McNeil, Robert R. Morrow, Arthur M. Phillips, Jr., Edward C. Raney, Gustav A. Swanson, Daniel Q. Thompson, Dwight A. Webster.

Field Representative: W. R. Eadie, 206 Fernow Hall.

APPROPRIATE MAJOR OR MINOR SUBJECTS

Fishery Biology	Oceanography
Natural Resources Conservation	Wildlife Management

APPROPRIATE FOR MINOR SUBJECT ONLY
Forest Conservation

ADMISSION. To undertake study in the biological subjects the student should be well prepared in biological sciences and should have or must acquire a foundation in the specialized Field of study which he intends to pursue. A strong background in the other biological and physical sciences is highly desirable, and a working knowledge of statistical methods is important in all fields. To major in Natural Resources Conservation, the student should come adequately trained in an existing professional Field of study concerned with the management of natural resources, and he should preferably have professional job experience.

Applicants for graduate study in the Field of Conservation are encouraged to submit the results of the Graduate Record Examinations (Aptitude Test, and Advanced Test in Biology if appropriate).

LANGUAGE REQUIREMENT. For the Master's Degree, college entrance foreign language or six hours of college language. For the Ph.D. Degree the language requirement will be determined by the student's Special Committee for Graduate Study.

EXAMINATIONS. A written prequalifying examination is given during the first week of the fall term to all prospective doctoral candidates. In addition, an oral Qualifying Examination is given early in residence to explore possible deficiencies in educational background. This is followed by the comprehensive Examination for Admission to Ph.D. Candidacy which is taken after most of the course work has been completed. There is a final examination on the thesis subject.

SPECIAL INTERESTS OF THE FACULTY

In addition to the special interests listed below attention is directed to the topics of study and courses offered in the Fields of Evolutionary Biology, Botany, Entomology and Limnology, Water Resources, and Zoology. Graduate study in conservation education is directed under the Nature, Science, and Conservation Education program in the Field of Education.
Anadromous and marine fisheries management: Professor Raney.
Forest conservation: Professors Hamilton and Morrow.
Freshwater fisheries management: Professors Eipper, Forney, and Webster.
Natural resources conservation: Professors L. S. Hamilton and Swanson.
Nutrition and physiology of fishes: Professor Phillips.
Wildlife management: Professors Eadie, Hewitt, McNeil, Swanson, and Thompson.

COURSES

Natural Resources Conservation

510. SELECTED TOPICS IN CONSERVATION

Fall term. Credit one hour. F 8. Fernow 210. Mr. Swanson.

Open to upperclassmen only by permission of instructor. Discussions of important conservation problems of current interest.

602. SEMINAR IN NATURAL RESOURCES PLANNING AND DEVELOPMENT

Spring term. Credit two hours. W 2–4. Place to be arranged. Mr. Hamilton.

An interdisciplinary graduate student seminar. Seminar theme varies from year to year to include such topics as: Small watershed planning, multiple use management, urban fringe problems, outdoor recreation, land use planning methods, and river basin development. Field trips and invited resource specialists. For 1967 the focus will be on land use planning.

610. CONSERVATION SEMINAR

Fall and spring terms. Without credit. Th 4:30–6:00 p.m. Place to be arranged. Staff.

Discussions of literature and current research in the broad field of conservation and vertebrate zoology.

Fishery Biology

440. FISHERY SCIENCE

Fall term. Credit three hours. Students other than majors in the Department of Conservation must have permission of instructor to register. M W F 12. Rice 300. Mr. Webster.

Principles and theories involved in dynamics of fish populations. Methods

of obtaining and evaluating statistics of growth, population size, mortality, yield, and production, as well as investigational aspects of fishery biology are included.

441. FISHERY RESOURCE MANAGEMENT

Spring term. Credit three hours. Prerequisite, Course 440 or permission of instructor. Lectures, T Th 11. Discussion to be arranged. Rice 101. Mr. Eipper.

Principles and problems in the management of freshwater and marine fishery resources, considered in relation to problems of human population and management of other natural resources. Multiple use, evaluation, and allocation of water resources, with particular reference to fisheries. Characteristics of fishery resources and their exploitation. Applications of fishery science to the management of fish stocks through maintenance and improvement of habitat, fish population manipulation, and regulation of fishing.

442. BASIC PRINCIPLES OF FISH CULTURE

Spring term. Credit two hours. Prerequisites, general zoology and a course in chemistry. A course in biochemistry or physiology is desirable. Lecture, M 12. Laboratory, M 2–4:30. Fernow 210. Mr. A. M. Phillips.

A study of the nutrition, metabolism, and physiology of hatchery fish and principles of hatchery management.

501. BIOMETRICS OF FISH AND WILDLIFE

Fall term. Credit three hours. Prerequisites, Courses 440 and 441 or 413, elementary differential and integral calculus, and Plant Breeding 510, or permission of instructor. Lectures, M W 10. Laboratory to be arranged. Fernow 210.

Mathematical models and statistical methods useful in measuring ecological processes, particularly those of importance in managing fish and wildlife populations. The characteristics of sampling designs as determined by the properties of the chosen mathematical model, animal behavior, selection characteristics of the sampling gear, and investigational costs. Reliability of estimates; some parametric and non-parametric methods for testing hypotheses. Laboratory work includes experience in data collection and analysis.

601. SEMINAR ON SELECTED TOPICS IN FISHERY BIOLOGY

Fall or spring term. Credit one hour. Time to be arranged. Staff.

Wildlife Management

411. PRINCIPLES OF WILDLIFE MANAGEMENT

Fall term. Credit three hours. Prerequisite, consent of instructor. Lectures, M W F 10. Rice 101. Mr. Hewitt.

Fundamental mechanisms of wildlife populations; ecological, social, and economic aspects of wildlife management.

412. WILDLIFE MANAGEMENT LABORATORY

Fall term. Credit one hour. Required of wildlife management majors registered in Conservation 411. Field and laboratory, F 2–4:30, and several field trips to be arranged. Fernow 212. Mr. Hewitt.

413. WILDLIFE MANAGEMENT METHODS

Spring term. Credit three hours. Prerequisites, Courses 411 and 412. Lecture, F 11. Laboratory, F 1:40–4:30. Fernow 212. Several all-day field trips. Mr. Hewitt.

Methods and techniques in the management of game species and their practical application in the field. Intended for students interested in professional wildlife management.

414. ECONOMIC ZOOLOGY

Spring term. Credit two hours. Prerequisite, Biological Sciences 270. W F 8. Rice 300. Mr. Eadie.

Economics of amphibians, reptiles, birds, and mammals. Economic status, habits, and control of injurious species.

Research

Either term. Credit and hours to be arranged. Problems are undertaken in any of the fields of study in the Department, but adequate preparation in the specialized field, and permission of the instructor are prerequisites. Fernow Hall.

492. MAMMALOGY

Messrs. Eadie, and Layne.

494. FISHERY BIOLOGY

Messrs. Eipper, Forney, Phillips, and Webster.

495. WILDLIFE MANAGEMENT

Messrs. Eadie, Hewitt, McNeil, Swanson, and Thompson.

496. FORESTRY

Messrs. Hamilton and Morrow.

498. NATURAL RESOURCES

Messrs. Brumsted, Hamilton, and Swanson.

Dairy Science

Faculty: Norman C. Dondero, B. L. Harrington (in the Philippines), Robert F. Holland, William K. Jordan, Frank V. Kosikowski, Vladimir N. Krukovsky, Richard A. Ledford, Richard P. March, H. Brooks Naylor, Neil L. Norcross, John W. Sherbon, W. Frank Shipe, James C. White.

Field Representative: Frank V. Kosikowski, 105 Stocking Hall.

APPROVED MAJOR AND MINOR SUBJECTS

Dairy Chemistry	Dairy Microbiology
Dairy Management	Dairy Science

Students interested in undertaking a graduate career in the Field of Dairy Science should have adequate basic preparation in the area in which they intend to specialize. Prior training in dairy or food science is desirable but not essential, for deficiencies can be made up with satisfactory programing.

In general graduate students are expected to attain a broad mastery of the substance of their major Field and to demonstrate the ability to plan and conduct independent research.

The Field offers students challenging and interesting study and research opportunities in four major areas.

Students majoring in dairy management may look forward to study and research on the administration of industrial dairy manufacturing complexes and the organization of international milk development projects. Studies leading to minors in economics, business administration, and international agricultural development are encouraged.

Majors in dairy microbiology may elect study and scientific investigations in: food development from milk fermentations; dairy micology; immunology; and laboratory control of spoilage and disease-producing microorganisms. Courses in basic microbiology and pathogenic bacteriology will supplement those offered by the Field faculty.

Students majoring in dairy chemistry have a number of areas of inquiry in which to work, such as physiological, biological, organic, and physical chemistry.

Similarly, students with a major in dairy science may choose from a variety of specialized activities, such as engineering, technology, and sanitary and environmental health, beginning with milk handling processes on the farm and extending to milk processing in the plant.

LANGUAGE REQUIREMENT FOR THE PH.D. Demonstrated proficiency in one language — French, German, Russian, Japanese, Dutch, Finnish, Norwegian, Swedish, or Danish — before the Final Examination.

The policy of the Field on examinations is to require that a Qualifying Examination be taken within two semesters after enrollment of the student in the Field.

COURSES

302. DAIRY AND FOOD ENGINEERING

Fall term. Credit four hours. Offered in alternate years. Prerequisites, Physics 101 and 102 or the equivalent and Course 100 Lectures, M W F 10. Laboratory, M 2–4:30. Stocking 119. Professor Jordan.

Engineering aspects of dairy and food plant operations.

303. FATS AND OILS

Fall term. Credit three hours. Open to upperclassmen and graduate students. Lecture demonstrations, W F 11. Stocking 120. Laboratory practice, F 1:40–4:30. Stocking 209. Professor Krukovsky.

Certain phases of chemistry and quantitative analysis as applied to the quality control and improvement in the palatability and nutritional values of milk and other fat-containing food products, including the influence of the plant and animal.

310. SENSORY QUALITIES AND EVALUATIONS OF FOODS

Spring term. Credit two hours. T Th 8:30–9:50. Stocking 120. Professor Shipe and assistants.

Deals with the factors affecting the color, odor, flavor, and texture of foods and the evaluation of these qualities. The techniques and interpretations of both objective and subjective evaluations are discussed. The laboratory exercises involve the evaluation of a variety of foods.

311. CONCENTRATION AND FREEZING PROCESSES

Spring term. Credit four hours. Offered in alternate years. Lectures, M W 11–12:50. Laboratory, M 1:40–4:30. Stocking 120. Professor Jordan.

The principles and practice of condensing, drying, and freezing food products.

313. STERILIZATION PROCESSES

Spring term. Credit three hours. Offered in alternate years. Prerequisites, Chemistry 353 or equivalent, Biological Sciences 394, and Physics 102. Recommended, a course in calculus and a course in biochemistry. Lectures, M W 10. Discussion, F 10. Riley-Robb 225. Laboratory, W 2–4. Riley-Robb 44. Professor Buck.

The principles of food preservation and the fundamentals of food processing from raw materials to finished product. Heat transfer, unit operations, and unit processes employed by the canning industry will be emphasized, but sterilization by any means such as heat, chemicals, physical destruction, and filtration will be demonstrated. The effects of lethal energy treatment of biological fluids and systems on desirable components such as nutritive factors and flavor components will be considered along with the cost of operation. The laboratory involves actual participation in plant operations in the processing and preservation of various food products, and field trips.

[314. MILK AND FOOD SANITATION AND PLANT OPERATIONS]

Spring term. Credit four hours. Offered in alternate years. Prerequisites, Course 100 and Biological Sciences 394. Lectures, M W 11–12:50. Laboratory, M 1:40–4:30. Professor White and assistants. Not offered in 1966–67.

The biological and chemical control of milk and food processing. Federal, state, and local requirements for the production, collection, and processing of milk and food. The control of sanitation, composition, and production in the food plant is outlined with special attention given to the fluid milk industry.

DAIRY AND FOOD MICROBIOLOGY (BIOLOGICAL SCIENCES 394.)

Spring term. Credit four hours. Prerequisite, Biological Sciences 290. Lectures, M W 12. Stocking 119. Laboratory, M W 1:40–4:30. Stocking 301. Professor Naylor.

The major families of microorganisms of importance in dairy and food science are studied systematically with emphasis on the role played by these organisms in food preservation, food fermentations, and public health. The laboratory work includes practice in the use of general and special methods for microbiological testing and control of dairy and food products as well as practice in the isolation and characterization of organisms found in foods.

[401. FOOD FROM FERMENTATIONS]

Fall term. Credit five hours. Offered in alternate years. Prerequisites, Courses 100, 210, dairy and food microbiology and organic chemistry or biochemistry, Lectures and laboratories, T Th 11–12:50 and 1:40–4:30. Professor Kosikowski and Assistant Professor Ledford. Not offered in 1966–67.

The chemistry, microbiology, and technology of fermentations leading to important foods. Emphasis is placed on milk and cheese fermentations but consideration is given to fermentations resulting in major foods from all plant and animal sources.

Line-flow processing and testing practices designed to acquaint the student with principles are carried out in the laboratory.

[403. INTERNATIONAL FOOD DEVELOPMENT]

Fall term. Credit three hours. Offered in alternate years. Permission of instructor required. M W 2–4. Professor Kosikowski. Not offered in 1966–67.

A study of programs, technical problems, and progress associated with

developing acceptable milk and food supplies in critical world areas. Proposals for increasing world protein resources for humans are to be discussed. Special attention is to be directed to the organization, operations, relationships, and contributions of U. N. technical agencies, FAO, UNICEF, WHO, and governmental and non-governmental organizations in the field.

404. CHEMISTRY OF MILK

Fall term. Credit three hours. Offered in alternate years. Prerequisites, qualitative and quantitative analysis and organic chemistry. Hours by arrangement. Stocking 120. Assistant Professor Ledford.

A study of milk constituents and physical properties. Deals with milk enzymes, lactose, milk fat, milk proteins, and minor constituents.

410. FOOD BIOCHEMISTRY

Spring term. Credit three hours. Prerequisite, Biological Sciences 431. Lectures, M W F 11. Warren 131. Associate Professor Shallenberger and staff members from the Department of Food Science and Technology, New York State Agricultural Station, Geneva, New York.

A discussion of some of the important non-microbial changes in foods, such as denaturation and the Maillard browning reaction. Emphasis is placed on the occurrence, significance, and prevention or control of the changes as they effect the color, odor, flavor, texture, or nutritive value of foods.

411. FOOD PROCESSING INSTRUMENTATION

Spring term. Credit three hours. Offered in alternate years. Prerequisite, Course 302. Lectures, M W 9. Riley-Robb 225. Laboratory, F 2–4:30. Riley-Robb 146.

Principles of engineering analysis and judgment are employed in examination of instruments for measurement and control of food processes. Topics include pressure, temperature, and flow measurements, plus selected instruments for measuring physical and chemical properties of foods. Electronic components of electrical instruments are discussed. The use of instruments in the enforcement of food laws is also presented.

413. ANALYTICAL METHODS

Spring term. Credit four hours. Offered in alternate years. Prerequisites, Course 210, one term of either organic chemistry or biochemistry. Lectures, T Th 11. Stocking 119. Laboratory Th 1–5. Stocking 209. Assistant Professor Sherbon.

A study of the analytical methods important to the food industry. The emphasis is on understanding the basic analytical chemistry applied in the various tests. General topics include sampling, gravimetric and volumetric methods, optical methods, electrochemistry, and the use of basic statistics.

[512. INSTRUMENTAL METHODS]

Spring term. Credit five hours. Offered in alternate years. Prerequisite, Course 413 or permission of the instructor. Assistant Professor Sherbon. Not offered in 1966–67.

Deals with instrumental methods widely used in research and industry. The major emphasis is on chromatographic methods, spectroscopy, electrophoresis, and the use of computers in agricultural research. The stress will be on the practical use of the material presented.

[514. THE BIOCOLLOIDAL CHEMISTRY OF FOODS]

Spring term. Credit three hours. Offered in alternate years. Prerequisites, Biological Sciences 431 and 433, or the equivalent. Lectures, M W 10. Discussion, F 2. Laboratory, W 2–4. Professor Buck. Not offered in 1966–67.

The principles of the science of colloidal systems and micelles of importance in biology and agriculture will be introduced; then the amiscropic morphology of cytoplasm, cell walls, plastids, biological gels, and sols will be studied and the data appied to food. Polysaccharides and polypeptides in chain molecules which sometimes reach microscopical lengths, will be intensely studied. Especial attention will be given to the structural arrangement of complex polymers. The physical chemistry of surfaces (including adsorption, ion-exchange, and electric double layer), flocculation, viscosity, swelling, and gel formation will be discussed.

600. SEMINAR

Fall and spring terms. One hour credit may be allowed for those presenting seminars. Required of graduate students in the Department. Upperclassmen welcome. Time to be arranged. Stocking.

Entomology and Limnology

Faculty: Clifford O. Berg, James L. Brann, William L. Brown, Jr., James E. Dewey, Thomas Eisner, John G. Franclemont, George G. Gyrisco, Donald J. Hall, Warren T. Johnson, William T. Keeton, John P. Kramer, Donald J. Lisk, John G. Matthysse, Roger A. Morse, Arthur A. Muka, Richard D. O'Brien, Charles E. Palm, Robert L. Patton, L. L. Pechuman, James T. Pennell, David Pimentel, Edgar M. Raffensperger, W. Arthur Rawlins, Richard B. Root, B. V. Travis, Lowell D. Uhler, Dwight A. Webster, John A. Weidhaas, Jr., Christopher F. Wilkinson, Roger G. Young. Off Campus: J. Alfred Adams, Paul J. Chapman, Alexander C. Davis, Ralph W. Dean, Foster L. Gambrell, Edward H. Glass, Siegfried E. Lienk, Paul C. Lippold, Freeman L. McEwen, George A. Schaefers, Maurie Semel, E. Frederick Taschenberg.

Field Representative: John G. Franclemont, 305A Comstock Hall.

APPROPRIATE MAJOR SUBJECTS	APPROPRIATE MINOR SUBJECTS
Apiculture	Apiculture
Economic Entomology	Economic Entomology
Insect Biochemistry	Entomology
Insect Ecology	Insect Biochemistry
Insect Morphology	Insect Ecology
Insect Pathology	Insect Morphology
Insect Physiology	Insect Pathology
Insect Taxonomy	Insect Physiology
Insect Toxicology	Insect Taxonomy
Insecticide Chemistry	Insect Toxicology
Limnology	Insecticide Chemistry
Medical Entomology	Limnology
Parasitology	Medical Entomology
	Parasitology

Graduate study in the Field of Entomology and Limnology includes all phases of the biology of insects including biochemistry, ecology, morphology,

physiology, and systematics, as well as apiculture and economic entomology. In addition, the Field has strong graduate programs in limnology, toxicology, and parasitology (including insect pathology). General biological concepts are studied using insects and other invertebrates. Insects are ideally suited as experimental animals in a wide variety of biological investigations because of their numbers and ease of manipulation in the laboratory and in nature.

To undertake graduate study, the student should be well prepared in the fundamentals of biology, chemistry, physics, mathematics, and humanities. In completing his graduate study, the student will have a sound foundation in fundamental knowledge and research methodology. Each student will be provided individual guidance by the Field faculty.

Special facilities for study and research include the outstanding Comstock Entomological Library, an extensive insect collection, an insectary, greenhouses, bioclimatic chambers, field stations, natural preserves, and numerous well-equipped laboratories. Brochures describing the facilities and activities are available from the Field Representative.

SPECIAL FIELD FELLOWSHIPS. ALLIED CHEMICAL CORPORATION FELLOWSHIP, $2000 plus tuition and General Fee. Available to candidates in the Field of Entomology and Limnology in 1966–67 and those in the Field of Plant Pathology in 1967–68. Candidates must be U.S. citizens, preferably in final year of the doctorate.

COMSTOCK SCHOLARSHIP. $100 plus tuition and General Fee.
DOW CHEMICAL COMPANY RESEARCH ASSISTANTSHIP. $3090 plus tuition.

SPECIALIZATIONS OF THE FACULTY

Ecology

1. Behavior: Professor Eisner and Morse
2. Ecology: Professors Berg, Palm, Pimentel, Root, and Uhler

Economic Entomology

1. Apiculture: Professor Morse.
2. Application Equipment: Professor Brann.
3. Floricultural Insects: Professor Pennell.
4. Forage Insects: Professor Gyrisco.
5. Forest Insects: Professor Weidhaas.
6. Fruit Insects: Professors Chapman, Dean, Glass, Lienk, Schaefers, and Taschenberg.
7. Household Insects and Insects Affecting Man: Professor Raffensperger.
8. Insects of Ornamentals: Professors Gambrell, Johnson, and Weidhaas.
9. Livestock Insects: Professor Matthysse.
10. Medical Entomology: Professor Travis.
11. Vegetable Insects: Professors Adams, Davis, McEwen, Muka, Rawlins, and Semel.

Limnology

1. Aquatic Entomology: Professors Berg, Hall, Pechuman, and Travis.
2. Limnology: Professors Berg, Hall, Pimental, and Webster.

Morphology

1. Morphology: Professor Eisner.

Parasitology

1. General Parasitology: Professors Kramer and Travis.
2. Insect Pathology: Professor Kramer.

Physiology and Biochemistry

1. Biochemistry: Professor Young.
2. Physiology: Professor Patton.

Systematics

1. Acarology: Professors Matthysse, Travis, and Weidhaas.
2. General Systematics: Professors Brown, Franclemont, Keeton, and Pechuman.
3. Systematics of Ants: Professor Brown.
4. Systematics of Diptera: Professors Berg and Pechuman.
5. Systematics of Lepidoptera: Professor Franclemont.
6. Systematics of Millipeds: Professor Keeton.

Toxicology

1. Analytical Technology: Professors Lippold and Lisk.
2. Bioassay: Professor Dewey.
3. Biochemical aspects: Professor Young.
4. General Toxicology: Professors Lisk, Wilkinson, and Young.
5. Selective Toxicants: Professor O'Brien.
6. Synergists: Professor Wilkinson.

COURSES

General Entomology

210. INTRODUCTORY ENTOMOLOGY

Spring term. Credit three hours. Prerequisite, Biological Sciences 101 and 102 or 103–104, or their equivalent. Lecture, T Th 9. Comstock 245. Laboratory, M T W Th or F 2–4:30. Comstock 100. Associate Professor Raffensperger and assistants.

A survey of the structure, biology, and classification of insects; an introduction to the study of insects as a major segment of the biological community, with attention to representative species of economic importance, the techniques and consequences of their control. Laboratory exercises in the anatomy and biology of insects and practice in the techniques of insect identification.

212. INSECT BIOLOGY

Fall term. Credit three hours. Prerequisite, Biological Sciences 101 and 102, or 103–104 or their equivalent. Lecture, W F 11. Comstock 145. Laboratory, W Th or F 2–4:30 in Comstock 100. Associate Professor Raffensperger and assistants.

Designed to introduce the science of entomology by focusing on the basic principles of the systematics, morphology, physiology, behavior, and ecology of insects. The laboratory in early fall includes special field trips to study and collect insects in their natural environment.

518. TECHNIQUES OF BIOLOGICAL LITERATURE

Fall term. Credit two hours. Given in alternate years. Lectures, T Th 9. Comstock 300. Professor Franclemont.

History of the development of entomological literature and a critical study of the biologists' works of reference and the principles of zoological nomenclature. Practice in the use of indices and bibliographies, and practice in the preparation of the latter.

Insect Morphology

322. INSECT MORPHOLOGY AND HISTOLOGY

Spring term. Credit four hours. Prerequisite, Course 210 or 212 or permission of instructor. Lectures, T Th 11. Laboratories, M W 1:40–4:30. Comstock 270. Associate Professor Eisner.

The principles of morphology, as illustrated by insects. Topics are considered at the anatomical, histological, and cytological levels. Emphasis is placed on special problems in morphogenesis, adaptive radiation, and functional anatomy. The various topics are considered in the light of modern evolutionary theory, and an effort is made to relate them to recent behavioral and physiological work. The laboratory is devoted largely to dissection and histological technique.

Insect Taxonomy

331. INTRODUCTORY INSECT TAXONOMY

Spring term. Credit three hours. Prerequisite, Course 210 or 212. Lecture, Th 10. Laboratory, T Th 2–4:30. Comstock 300. Associate Professor Brown.

An introduction to the systematics and distribution of insects. Laboratory practice in the identification of orders, families, and representative genera of insects; methods of collection and preparation of insect specimens. Field trips are taken in the late spring.

[531. TAXONOMY OF THE SMALLER ORDERS OF INSECTS]

Fall term. Credit three hours. Offered in alternate years. Prerequisite, Course 331. Lecture, F 10. Laboratory, F 2–4:30 and one other by arrangement. Comstock 300. Associate Professor Brown. Not offered in 1966–67.

Lectures on the classification, evolution, and bionomics of the orders and families of insects, exclusive of the larger orders of Holometabola. Laboratory studies on the literature and on the characters and classification of representative genera and species. Continuation of taxonomy of Holometabola is in Courses 532, 533, and 534.

532. TAXONOMY OF THE IMMATURE STAGES OF HOLOMETABOLA

Fall term. Credit three hours. Given in alternate years. Prerequisite, Course 531 or permission of the instructor. Lecture, F 10. Laboratory, F 2–4:30 and one other by arrangement. Comstock 300. Professor Franclemont.

Lectures on the structure and habits of insect larvae. Laboratory studies of the literature, comparative morphology, and identification of the immature stages of the Holometabola.

533. TAXONOMY OF THE COLEOPTERA AND LEPIDOPTERA

Spring term. Credit three hours. Given in alternate years. Prerequisite, Course 331. Lecture, W 10. Laboratories W F 2–4:30. Comstock 300. Professor Franclemont.

Laboratory studies on the literature and on the characters and classification of representative genera and species of these orders.

[534. TAXONOMY OF THE DIPTERA AND HYMENOPTERA]

Spring term. Credit three hours. Offered in alternate years. Prerequisite, Course 331. Lecture, W 12. Laboratory, F 2–4:30 and one other by arrangement. Comstock 300. Associate Professor Brown. Not offered in 1966–67.

Laboratory studies on the literature and on the characters and classification of representative genera and species of these orders.

Economic Entomology

441. GENERAL ECONOMIC ENTOMOLOGY

Fall term. Credit three hours. Prerequisite, Course 210 or 212 or the equivalent. Lectures, T Th 9. Comstock 145. Laboratory, T 2–4:30. Comstock 100. Professor Gyrisco.

Principles and techniques in the control of insects.

545–546. ECONOMIC ENTOMOLOGY

Throughout the year. Credit three hours each term. Prerequisites, Course 210 or 212 and permission to register (see Professor Gyrisco). Open to qualified juniors and seniors but designed primarily for graduate students, particularly those majoring or minoring in entomology. Lecture, T 10–12. Comstock 145. Laboratory, T 2–4:30. Comstock 100. Professors Berg, Brann, Dewey, Glass, Gyrisco, Matthysse, O'Brien, and Pimentel; Associate Professors Eisner, Lisk, McEwen, Morse, Muka, and Weidhaas; and Assistant Professors Johnson and Pennell.

A special topics course dealing with principles and problems of economic entomology such as insect population dynamics, natural control of insects, specificity of insecticides, nature of chemical control, resistance in insects, residues in food crops, attractants and repellants, insect pathology, integrated control, parasites and biocontrol, planning experiments, experimental design, and techniques and other special topics of applied entomology.

Parasitology

351. INTRODUCTORY PARASITOLOGY

Every spring term. Credit four hours. Prerequisite, Biological Sciences 101–102, or 103–104 or their equivalent. Course 210 or 212 is also recommended. Limited to 12 students per section. Lectures, M W 10. Comstock 245. Laboratories, M W 2–4:30, T 10–12:30 or 2–4:30 and Th 10–12:30 or 2–4:30. Comstock 200. Professor Travis.

An introduction to the symbiotic way of life among animals, primarily the protozoan, helminth, and arthropod species of temperate and tropical areas. Special emphasis is given to the recognition of selected symbiotic species and how they live with their hosts.

551. ADVANCED PARASITOLOGY (PROTOZOA AND HELMINTHS)

Fall term. Credit three hours. Given in alternate years. Undergraduates only by permission. Prerequisite, Course 351 or its equivalent. Lecture and one laboratory, T 1–4:30, and Th 2–4:30. Comstock 200. Professor Travis.

A continuation of Course 351 for graduate students interested in the parasitic protozoa and helminths. Practical experience with methods of collection, preparation; detailed studies on recognition and life cycles. Special emphasis is given to the parasites that are transmitted by arthropods in the tropics.

[552. ADVANCED PARASITOLOGY (MEDICAL ENTOMOLOGY)]

Fall term. Credit three hours. Offered in alternate years. Undergraduates only by permission. Prerequisites, Courses 351 and 212 or their equivalent. Lecture and one laboratory, T 1–4:30 and Th 2–4:30. Comstock 200. Professor Travis. Not offered in 1966–67.

A continuation of Course 351 for graduate students interested in medical or veterinary entomology. Practical experience with methods of collection, preparation; detailed studies on recognition, life cycles, and control. Special emphasis is given to causative agents, vectors, and intermediate hosts of disease-producing organisms. The study examples include species of world-wide distribution, especially those of tropical areas.

553. ADVANCED PARASITOLOGY (INSECT PATHOLOGY)

Spring term. Credit three hours. Prerequisites, Courses 210 or 212 and 351 or their equivalents and permission of instructor. By appointment. Associate Professor Kramer.

A survey of microbial and zooparasitic diseases of insects. Topics include the causative agents, diagnosis, pathogenesis, pathogenicity, and epizootiology.

Apiculture

262. BIOLOGY OF THE HONEY BEE

Fall term. Credit one hour. Prerequisite, Biological Sciences 103–104 or the equivalent. Limited to 10 students, registration only by permission. Fifteen laboratories by arrangement in September and October only. Associate Professor Morse.

A laboratory and field course in which the classical experiments on the vision, chemical senses, and language of the honey bee, as described by von Frisch are repeated. Laboratories include demonstration of the sex attractant, swarm orientation, the natural nest, and a study of wasp, bumble bee and other social insect nests.

[560–561. ADVANCED BEEKEEPING]

Throughout the year. Credit three hours a term. Offered in alternate years. Prerequisites, Courses 210 or 212 and 260 and previous beekeeping experience. By appointment. Associate Professor Morse. Not offered in 1966–67.

An advanced course for those specializing in apiculture. Considerable time is devoted to a study of the entire field of beekeeping. Laboraory work covers bee behavior, external and internal anatomy, disease diagnosis, honey and beeswax production and preparation for market, and the management of colonies for pollination service.

562–563. SPECIAL TOPICS IN BEEKEEPING

Throughout the year. Credit three hours a term. Given in alternate years. Registration by permission; open to qualified juniors and seniors. By appointment. Associate Professor Morse.

A technical course designed for advanced students, and covering scientific investigation in all phases of the subject. Special attention is given to improved methods of apiary and honeyhouse management and the preparation of honey for market. Current literature on beekeeping is assigned, reviewed, and evaluated by students. Lectures and discussions are supplemented by field trips.

Ecology and Limnology

GENERAL ECOLOGY (BIOLOGICAL SCIENCES 361)

Fall and spring terms. Credit three hours. See full detailed description under "Biological Sciences."

[271. AQUATIC ENTOMOLOGY AND LIMNOLOGY]

Spring term. Credit three hours. Professor Berg. Not offered in 1966–67.

572. ADVANCED LIMNOLOGY

Fall term. Credit three hours. Prerequisites, Biological Sciences 462 and permission to register. Normally limited to graduate students majoring or minoring in limnology. Lecture and laboratory, T 2–4:30, and one additional laboratory or field trip, by arrangement. Comstock 110. Professor Berg.

Discussions and analyses of current limnological concepts and problems, including the critical study of selected reference works and research papers.

Insect Physiology and Biochemistry

583. INSECT PHYSIOLOGY AND BIOCHEMISTRY

Spring term. Credit six hours. Permission to register is required. Lectures, M W F S 9. Comstock 145. Laboratories, M T 2–4:30 or Th F 2–4:30. Insectary. Professor Patton and Associate Professor Young.

A comprehensive course in the physiology and biochemistry of insects, primarily for graduate students majoring in entomology.

Insect Toxicology and Insecticidal Chemistry

[590. INSECT TOXICOLOGY]

Fall term. Credit four hours. Offered in alternate years. Prerequisites, Course 341, general chemistry, and organic chemistry. Undergraduate students by permission. Lectures, M W 9. Comstock 145. Laboratories, M W 2–4:30 or T Th 9–11:30. Insectary 130. Professor Dewey. Not offered in 1966–67.

A discussion of toxicological factors affecting insects. A study of insecticides including physical factors affecting formulation, toxicity to insects, and the principles of evaluating their effects on insects.

[591. INSECTICIDE CHEMISTRY AND ACTION]

Spring term. Credit three hours. Offered in alternate years. Prerequisites, general chemistry and organic chemistry. Undergraduate students by permission. Lectures, M F 9. Comstock 145. Credit three hours. Laboratory, W 1:30–4:30. Comstock 50 or Pesticide Residue Laboratory. Professor O'Brien and Associate Professor Lisk. Not offered in 1966–67.

The chemistry of insecticides, and their metabolism and mode of action in insects and mammals with emphasis on the relation between structure and activity. Analytical techniques of use in structure elucidation and residue evaluation.

Evolutionary Biology

Faculty: John P. Barlow, William L. Brown, Jr., Robert T. Clausen, W. Storrs Cole, William C. Dilger, W. Robert Eadie, Thomas Eisner, Stephen T. Emlen, Howard E. Evans, Donald J. Hall, William T. Keeton, Richard P.

Korf, James N. Layne, Harold E. Moore, Jr., Laverne L. Pechuman, David Pimentel, Edward G. Raney, Richard B. Root, Charles H. Uhl, Lowell D. Uhler, John R. Vallentyne, John W. Wells.

Field Representative: William T. Keeton, 312 Roberts Hall.

APPROVED MAJOR AND MINOR SUBJECTS

Evolutionary Biology General Biology
Vertebrate Zoology (including herpetology, ichthyology, mammalogy, and ornithology).

REQUIREMENTS. Applicants must present scores on the Graduate Record Examination Aptitude and Advanced Biology Tests.

Language requirement for the Master's degree: none for General Biology; college entrance (or the equivalent) in one language for other major subjects. Language requirement for the Ph.D.: Proficiency in two languages or superior ability (both written and oral) in one.

SPECIAL INTERESTS OF THE FACULTY

Members of the faculty will be especially interested in directing research in the areas mentioned below, although research will not be limited to these areas: J. P. Barlow, Plankton ecology; W. L. Brown, general evolutionary theory, experimental systematics, systematics and biology of insects, especially ants; R. T. Clausen, taxonomy and ecology of vascular plants; W. S. Cole, systematics and paleoecology, with special reference to Foraminifera; W. C. Dilger, the evolution of behavior; W. R. Eadie, mammalogy (ecology and classification); T. Eisner, behavior of invertebrates, the chemical basis of behavior, biocommunication, mimicry; Howard E. Evans, vertebrate morphology and evolution; S. T. Emlen, animal behavior, particularly orientation; D. J. Hall, experimental population and community dynamics, ecological theory, biology of invertebrates; W. T. Keeton, general evolutionary theory and biology of invertebrates, especially noninsect arthropods, behavior (especially homing behavior); R. P. Korf, systematics and evolution of fungi, lichens, and mycetozoa; J. N. Layne, the behavior, ecology, and evolution of mammals; H. E. Moore, evolution and systematics of angiosperms, especially Commelinaceae, Gesneriaceae, and Palmae; L. L. Pechuman, biogeography, insect systematics; D. Pimentel, ecology, population dynamics and theory; E. C. Raney, icthyology, especially the behavior, biosystematics, and evolution of fish; R. B. Root, comparative ecology and community organization; C. H. Uhl, chromosomes and evolution; J. R. Vallentyne, biochemical evolution, paleobiochemistry; J. W. Wells, Devonian paleontology, paleoecology and systematics of fossil and recent corals.

THE GENERAL BIOLOGY MAJOR (available only for the Master's degree). Study toward the Master's degree (M.S.) with General Biology as the major subject is offered for students who are graduates of small colleges, whose subject matter in the biological sciences is limited, and who plan to teach in high schools or small colleges. It involves a continuation of basic courses selected to fill in gaps existing in the students' training. Such students are required to write a standard thesis involving a review of the literature and planned research, or an essay which involves a complete review of the literature on their selected topic. These students usually work under Professor Uhler. Students wishing to study General Biology should also consider the Master of Science for Teachers degree (M.S.T.), with a major in Biology. This is a professional degree (see page 459) based on course work in the

sciences and requiring no thesis. Professor Uhler is the adviser for students in this degree program also. Detailed information concerning the M.S.T. degree may be obtained from the Graduate School.

In addition to those primarily interested in high school science teaching, students who wish to pursue research on a problem of a basic biological nature, while at the same time devoting their course work to obtaining a needed broad background in science, may major in General Biology. These students usually work under Professor Keeton or Professor Eisner. A standard research thesis is required and proficiency in one language is strongly recommended.

Students who plan to do research in some other Field of science may select General Biology as a minor (for either M.S. or Ph.D. degrees) to help round out their background.

COURSES

This is not a final listing of courses. Students should consult with their adviser concerning other offerings.

Biological Sciences

270. BIOLOGY OF THE VERTEBRATES

Spring term. Credit four hours. Prerequisite, a year of biology. Lectures. M W 10. Savage 100. Laboratory, M W or T Th 2–4:30. Fernow 14. Associate Professor Layne.

An introduction to the evolution, systematics, distribution, life-history and ecology, and behavior of vertebrate animals. Laboratory and field work deal with structure, classification, taxonomic methods, and the ecology, behavior and life histories of local species. Special laboratory and field exercises are devoted to selected aspects of vertebrate life.

341. TAXONOMY OF VASCULAR PLANTS

Fall term. Credit four hours. Prerequisite, a course in botany. Lectures and discussions, T Th 9. Plant Science 143. Laboratory, T Th 2–4:30. Mann 464. Professor Clausen.

An introduction to the classification, of vascular plants, with attention to principles, methods of identification, and literature. In the first part of the term, trips are held in laboratory periods.

343. BIOLOGY OF THE ALGAE

Fall term. Credit three hours. Prerequisite, a year of biology or permission of the instructor. Lectures, M W 11. Laboratory, M or F 2–4:30. Plant Science 202. Associate Professor Kingsbury.

Structure, ecology, physiology, relationships, evolution, and economic uses are presented as appropriate to a detailed understanding of the bluegreen, green, yellowgreen, golden brown, and euglenoid algae. Living material of a large number of genera is provided in laboratory to illustrate lecture topics, to demonstrate characteristics of algae of potential value in research on general biological problems, to provide practice in techniques of isolation and culture, and to develop a working familiarity with the local algal flora. Biologically important characteristics of ponds and streams are brought out in relation to the algae populating them.

344. BIOLOGY OF THE ALGAE

Spring term. Credit three hours. Prerequisite, a year of biology or permission of the instructor. Lectures, T Th 11. Laboratory, M or F 2–4:30. Plant Science 202. Associate Professor Kingsbury.

A continuation of 343, covering the diatoms, dinoflagellates, brown and red algae, and emphasizing the characteristics of the marine environment. Need not be preceded by Course 343.

345. PLANT ANATOMY

Fall term. Credit four hours. Prerequisites, a year of biology and preregistration with instructor in charge. Lectures, T Th 8. Warren 145. Laboratory, T Th 10–12:30 or M W 2–4:30. Plant Science 211. Associate Professor Bierhorst.

A detailed study of plant histology with equal emphasis on developmental aspects and mature structure.

361. GENERAL ECOLOGY

Fall or spring term. Credit three hours. Prerequisite, a year of biology or the equivalent. Lectures, T Th 9. Fall term, Comstock 245; spring term, Caldwell 100. Discussion, W or Th 2, 3, or 4. Comstock 145. Professor Pimentel and Assistant Professor Root.

Principles governing the survival of plants and animals in their natural environment are discussed. Population dynamics are studied with attention given to competition, social behavior, predation, parasitism, and other biotic interactions. Consideration is given to the flow of energy and minerals through living systems and to the influence of climate on the abundance and distribution of organisms. The role of species diversity, dispersal, and succession are focused on with regard to natural communities. The organization of species populations and communities is interpreted in the light of modern evolutionary theories.

362. LABORATORY AND FIELD ECOLOGY

Fall or spring term. Credit two hours. Prerequisite, permission of instructor. Laboratory, T Th 2–4:30. Stimson 225. Professor Cole and others.

A laboratory and field course to accompany or follow Biological Sciences 361, for students who intend to concentrate in the area of ecology. Enrollment limited. This course will give the students a first-hand contact with ecological techniques.

371. INVERTEBRATE ZOOLOGY

Fall term. Credit four hours. Prerequisite, at least one year of biological science or permission of instructor. One or two lectures and two laboratories per week; time and place to be arranged. Professor Anderson.

Lectures on selected topics in the development, structure, function, and interrelations of invertebrate animals, with particular attention to phylogeneic aspects. Intensive laboratory work in representative invertebrates, utilizing living or fresh specimens wherever possible. A significant amount of independent work is required of each student, including reports on library research.

374. FIELD MARINE BIOLOGY

Credit two hours. Prerequisite, a full year of college biology. A special course offered on Star Island, off Portsmouth, New Hampshire, in June. Professors

Anderson, Gilbert, Hewitt, and Raney, Associate Professors Barlow and Kingsbury (in charge).

Living material and habitats will be emphasized in introducing students to the major disciplines of marine biology and in rounding out the student's knowledge of these topics as presented at inland locations. For more details, see the Summer Session Announcement, or consult Professor Kingsbury.

[410. PROBLEMS IN FUNCTIONAL VERTEBRATE ANATOMY]

Spring term. Credit four hours. Offered in alternate years. Prerequisites, comparative anatomy and consent of instructor. Lecture, W 9. Discussion period to be arranged. Laboratory, W F 2–5. Stimson 310. Professor Gilbert. Not offered in 1966–67.

This course is intended for a limited number of advanced students who have done exceptionally well in Biological Sciences 311. It is an advanced course, involving dissections and experiments, with emphasis on the structural and functional adaptations of representative vertebrates to their environment. As a supplement to regular laboratory exercises, each student will be expected to select a project and prepare a substantial term report on his work.

421. COMPARATIVE VERTEBRATE ETHOLOGY

Fall term. Credit three hours. Prerequisite, permission of the instructor. Lectures, T Th 9. Rice 300. Laboratory, to be arranged. Associate Professor Dilger.

A survey of the methods and principles of vertebrate ethology for students specializing in this field or for those in other branches of zoology wishing to broaden their knowledge of animal behavior. Emphasis is placed on the causation, function, biological significance, and evolution of species-typical behavior. The laboratories are designed to give first-hand knowledge of the material covered in lectures.

440. CYTOGENETICS

Spring term. Credit three hours. Prerequisites, courses in genetics and cytology or the equivalent. Lectures, M W 9. Plant Science 143. Laboratory, M or W 10–12:30. Plant Science 219. Associate Professor Uhl.

An advanced course dealing mainly with the cellular mechanisms of heredity and including recent research in cytology, cytogenetics, and cytotaxonomy.

442. TAXONOMY AND ECOLOGY OF VASCULAR PLANTS

Spring term. Credit four hours. Prerequisite, Biological Sciences 341. Lectures and discussions, T Th 9. Plant Science 143. Laboratory, T Th 2–4:30. Mann 464. Professor Clausen.

A study of the principles of classification, the fundamentals of geographical distribution, and the evolutionary importance of environmental variation. Laboratory periods in the second half of the term are devoted to study of natural populations in the field.

[444. MORPHOLOGY OF LOWER VASCULAR PLANTS]

Spring term. Credit four hours. Offered in alternate years. Prerequisites, Biological Sciences 345 and preregistration with instructor in charge. Lectures, M W 12. Plant Science 141. Laboratory, M W 2–4:30. Plant Science 211. Associate Professor Bierhorst. Not offered in 1966–67.

An advanced course in the comparative morphology, life histories, and phylogeny of the non-seed-bearing vascular plants, including consideration of structure, development, and morphogenesis as applied to morphological interpretation.

446. MORPHOLOGY OF HIGHER VASCULAR PLANTS

Spring term. Credit four hours. Given in alternate years. Prerequisites, Biological Sciences 345 and preregistration with instructor in charge. Lectures, M W 12. Plant Science 141. Laboratory, M W 2–4:30. Plant Science 211. Associate Professor Bierhorst.

An advanced course in the comparative morphology, life histories, and phylogeny of the seed plants, including consideration of structure, development and morphogenesis as applied to morphological interpretation.

460. MARINE ECOLOGY

Spring term. Credit three hours. Prerequisites, a year of biology and chemistry and physics. Lectures, M W F 9. Rice 300. Associate Professor Barlow.

Introduction to biological oceanography: the sea as an environment; physical and chemical characteristics of marine habitats, relation to biogeography; organic production, biochemical cycles and distribution of non-conservative properties; relation of hydrography to fisheries and distribution of populations, oceanographic aspects of pollution problems.

461. OCEANOGRAPHY

Fall term. Credit three hours. Prerequisites, introductory chemistry and physics. Lectures, T Th 10. Rice 300. Laboratory, Th 12–12:50. Room to be arranged. Associate Professor Barlow.

Introduction to physical and chemical aspects of the oceans: geography and structure of ocean basins; origin and physical properties of seawater; distribution of salinity and temperature, heat and water budgets, formation of water masses; circulation, waves, and tides; shore processes, formation and distribution of sediments; discussion of current problems in oceanography. Laboratory work in organization and analysis of oceanographic observations.

462. LIMNOLOGY

Spring term. Credit four hours. Prerequisites, Biological Sciences 361, organic chemistry, and one year of college physics or permission of instructors. Lecture, W F 11. Plant Science 143. Laboratory, F 2–5; S 9–12. Professor Vallentyne and Assistant Professor Hall.

A study of processes and mechanisms in the biology, chemistry, and physics of inland waters taught from a functional and analytic point of view. Laboratories devoted to both field studies and experiments on model systems.

470. ICHTHYOLOGY

Spring term. Credit four hours. Prerequisite, Biological Sciences 270 or the equivalent. Lectures, M W 9. Warren 145. Laboratory, F 2–4:30 and S 9–11:30. Fernow 14. Professor Raney.

Lectures on the biology of fishes including systematics, ecology, life history, behavior, and literature. Laboratory studies of the orders, major families, and principal genera, and of systematic procedures. Field studies of the ecology and life history of local species.

471. MAMMALOGY

Fall term. Credit four hours. Prerequisites, Biological Sciences 270 or equivalent work in vertebrate biology and permission of instructor. Lectures, T Th

10. Plant Science 37. Laboratory, F 2–4:30 and S 9–11:30. Fernow 210. Associate Professor Layne.

Lectures on various aspects of mammalian biology, including evolution, distribution, systematics, ecology, behavior, and physiology. Laboratory and field work on the ecology, behavior, and life histories of local mammals; the taxonomy of recent mammals, with emphasis on the North American fauna; and special topics.

472. ORNITHOLOGY

Spring term. Credit four hours. Prerequisites, Biological Sciences 270 or equivalent work in vertebrate biology and permission of instructor. Lectures, M W 11. Rice 300. Laboratory, M W 2–4:30. Fernow 210.

Lectures on various aspects of the biology of birds, including structure, classification, adaptations, behavior, distribution, ecology, and physiology. Laboratory and field studies on the identification, ecology, and behavior of local species; classification; structure; molts and plumages; and other aspects of avian biology.

475. EVOLUTIONARY THEORY

Fall term. Credit four hours. Prerequisites, a course in genetics and one of the following courses: Biological Sciences 270, 371, 341, 343, or 344; or Entomology 212; or Plant Pathology 309; or permission of instructor in writing. Lectures, T Th 11. Comstock 245. Discussion, Th 12. Associate Professor Brown.

Lectures and class discussions on organic evolution, with primary emphasis on the mechanisms of speciation and adaptation.

476. ADVANCED INVERTEBRATE ZOOLOGY

Spring term. Credit four hours. Prerequisites, Biological Sciences 371 or equivalent, and permission of instructor. Enrollment limited. Two lectures and two laboratories per week. Time and place to be arranged. Professor Anderson.

Lectures and seminars (involving student participation by means of prepared reports) on significant problems in invertebrate zoology; laboratory and field work on selected invertebrate groups.

480. POPULATION GENETICS

Spring term. Credit three hours. Prerequisite, a course in genetics or the equivalent. Lectures, T Th 11. Plant Science 141. Professor B. Wallace.

A study of factors which influence the genetic structure of Mendelian populations and which are involved in race formation and speciation.

[512. COMPARATIVE PHYSIOLOGY]

Spring term. Credit four hours. Prerequisites, a course in animal physiology and biochemistry or the equivalent. Not offered in 1966–67.

A comparison of the principal physiological functions of vertebrates and invertebrates, with emphasis on their adaptations to different environmental conditions.

516. SPECIAL TOPICS IN COMPARATIVE PHYSIOLOGY

Spring term. Credit four hours. Prerequisite, consent of instructor. Enrollment limited. For advanced students in biological sciences. Lecture, Th 1:40–4:30. Associate Professor McFarland.

Detailed consideration of selected topics in comparative physiology. Preparation of demonstration experiments stressing technique and individual research problems will be included. Topics will vary from year to year.

[561–562. QUANTITATIVE ECOLOGY]

Throughout the year. Credit four hours a term. Offered in alternate years. Prerequisites, one year of biology and permission of instructor. Organic chemistry and some college mathematics are desirable. Lectures, M W 11. Laboratory, W 2–4:30. Professor Cole. Not offered in 1966–67.

A quantitative course on selected ecological topics for advanced undergraduates and graduate students. Topics include the origin and interpretation of habitat differences, toleration and response physiology, population dynamics, construction and uses of life tables, spatial distribution patterns, and approaches to the quantitative analysis of biotic communities.

563. PLANT ECOLOGY

Fall term. Credit four hours. Prerequisite, Biological Sciences 361 or the equivalent. Primarily for graduate students. Lectures, M W F 10. East Roberts 222.

Lectures and seminars on species and community organization, competition, laws of growth, and succession, and on the measurement, analysis and interpretation of biogeochemical cycles and the flow of energy in plant communities.

[564. BIOGEOCHEMISTRY]

Spring term. Credit four hours. Prerequisites, Biological Sciences 361, one year of geological science, organic chemistry, and permission of instructor. Lectures, T Th S 9. Stimson 105. Laboratory, M or T 2–4:30. Professor Vallentyne. Not offered in 1966–67.

An introduction to the geochemical roles of living organisms, including the chemical composition of the organism-environment complex, the influence of living matter on erosional and depositional processes, biogeochemical cycles, fossil organic matter, and biological transformation of minerals. The laboratory is exclusively devoted to the geochemistry of organic matter.

565. SPECIAL TOPICS IN LIMNOLOGY

Fall term. Credit three hours. Primarily for graduate students. Prerequisite, consent of instructor. Hours to be arranged. Professor Vallentyne, Assistant Professor Hall.

A laboratory and seminar course. Advanced discussion and experimentation in specific topics in limnology. Content variable from year to year, but in general dealing with topics related to the production and metabolism of biological associations in inland water.

641. SEMINAR IN TAXONOMY AND ECOLOGY OF VASCULAR PLANTS

Fall term. Credit one hour. Prerequisite, Biological Sciences 442. Lecture and discussion, M 12. Plant Science 143. Professor Clausen.

An examination of primary problems concerned with the classification and environmental relationships of vascular plants.

661. SEMINAR IN POPULATION AND COMMUNITY ECOLOGY

Fall term. Credit one hour. Prerequisites, a course in ecology and permission of instructor. Lecture, M 7:30 p.m. Comstock 145. Assistant Professor Root.

Discussion of recent advances in population and community ecology. The topic for 1966 will be ecological biogeography. Participants will present reports on the determinants of species diversity, convergent evolution, distribution of life-forms, barriers to dispersal, and related subjects. This course may be repeated for credit.

Entomology

331. INTRODUCTORY INSECT TAXONOMY

Spring term. Credit three hours. Prerequisite, introductory entomology. Lecture, Th 10. Laboratory, T Th 2–4:30. Comstock 300. Associate Professor Brown.

An introduction to the systematics and distribution of insects. Laboratory practice in the identification of orders, families, and representative genera of insects; methods of collection and preparation of insect specimens. Field trips are taken in the late spring.

351. INTRODUCTORY PARASITOLOGY

Every spring term. Credit four hours. Prerequisite, a year of biology or equivalent. Course 210 or 212 is also recommended. Limited to 12 students per section. Lectures, M W 10. Comstock 245. Laboratories, M W 2–4:30. T 10–12:30 or 2–4:30 and Th 10–12:30 or 2–4:30. Comstock 200. Professor Travis.

An introduction to the symbiotic way of life among animals, primarily the protozoan, helminth, and arthropod species of temperate and tropical areas. Special emphasis is given to the recognition of selected symbiotic species and how they live with their hosts.

[531. TAXONOMY OF THE SMALLER ORDERS OF INSECTS]

Fall term. Credit three hours. Offered in alternate years. Prerequisite, Course 331. Lecture, F 10. Laboratory, F 2–4:30 and one other by arrangement. Comstock 300. Associate Professor Brown. Not offered in 1966–67.

Lectures on the classification, evolution, and bionomics of the orders and families of insects, exclusive of the larger orders of Holometabola. Laboratory studies on the literature and on the characters and classification of representative genera and species. Continuation of taxonomy of Holometabola is in Courses 532, 533, and 534.

532. TAXONOMY OF THE IMMATURE STAGES OF HOLOMETABOLA

Fall term. Credit three hours. Given in alternate years. Prerequisite, Course 531 or permission of the instructor. Lecture, F 10. Laboratory, F 2–4:30 and one other by arrangement. Comstock 300. Professor Franclemont.

Lectures on the structure and habits of insect larvae. Laboratory studies of the literature, comparative morphology, and identification of the immature stages of the Holometabola.

533. TAXONOMY OF THE COLEOPTERA AND LEPIDOPTERA

Spring term. Credit three hours. Given in alternate years. Prerequisite, Course 331. Lecture, W 10. Laboratories W F 2–4:30. Comstock 300. Professor Franclemont.

Laboratory studies on the literature and on the characters and classification of representative genera and species of these orders.

[534. TAXONOMY OF THE DIPTERA AND HYMENOPTERA]

Spring term. Credit three hours. Offered in alternate years. Prerequisite, Course 331. Lecture, W 12. Laboratory, F 2–4:30 and one other by arrangement. Comstock 300. Associate Professor Brown. Not offered in 1966–67.

Laboratory studies on the literature and on the characters and classification of representative genera and species of these orders.

551. ADVANCED PARASITOLOGY (PROTOZOA AND HELMINTHS)

Fall term. Credit three hours. Given in alternate years. Prerequisite, Course 351 or its equivalent. Lecture and one laboratory, T 1–4:30, and Th 2–4:30. Comstock 200. Professor Travis.

A continuation of Course 351 for graduate students interested in the parasitic protozoa and helminths. Practical experience with methods of collection, preparation; detailed studies on recognition and life cycles. Special emphasis is given to the parasites that are transmitted by arthropods in the tropics.

572. ADVANCED LIMNOLOGY

Fall term. Credit three hours. Prerequisites, Biological Sciences 462 and permission to register. Normally limited to graduate students majoring or minoring in limnology. Lecture and laboratory, T 2–4:30, and one additional laboratory or field trip, by arrangement. Comstock 110. Professor Berg.

Discussions and analyses of current limnological concepts and problems, including the critical study of selected reference works and research papers.

Plant Pathology

[309. COMPARATIVE MORPHOLOGY OF FUNGI]

Spring term. Credit four hours. Offered in alternate years. Prerequisite, a year sequence of Botany or its equivalent, and permission to register. Lecture, M W 9. Plant Science 336. Laboratory, M W 1:40–4:30. Plant Science 326. Professor Korf. Not offered in 1966–67.

An introductory course in mycology. Emphasis is placed on morphology rather than on taxonomy.

549. ADVANCED MYCOLOGY

Fall term. Credit five hours. Offered in alternate years. Prerequisites, Course 309 or its equivalent, a course in genetics, and permission of the professor to register. Lecture, M W 9. Plant Science 336. Laboratory, M W F 1:40–4:30. Plant Science 326. Professor Korf.

Part of a two-course sequence (549 and 559) designed especially for students specializing in mycology or plant pathology. Reading knowledge of scientific French and German is *strongly* recommended. Emphasis is placed on taxonomy and the mechanisms of variation in fungi, but other aspects of mycology are embraced. Practice in identification of specimens is stressed in various groups, as is critical evaluation of keys and monographs. Field work is *required*. Basidiomycetes and Phycomycetes are covered in detail.

559. ADVANCED MYCOLOGY

Spring term. Credit five hours. Offered in alternate years. Prerequisites, Course 549 or its equivalent and permission of the professor to register. Lecture, M W 9. Plant Science 336. Laboratory, M W F 1:40–4:30. Plant Science 326. Professor Korf.

Part of a two-course sequence (549 and 559) described above. Fungi Imperfecti and Ascomycetes are covered in detail.

Vertebrate Zoology

421. COMPARATIVE VERTEBRATE ETHOLOGY

Fall term. Credit three hours. Prerequisites, Biological Sciences 101–102 or 103–104 and permission of the instructor. Lectures, T Th 9. Laboratory, to be arranged. Mr. Dilger.

A survey of the methods and principles of vertebrate ethology for students specializing in this field or for those in other branches of zoology wishing to broaden their knowledge of animal behavior. Emphasis is placed on the causation, function, biological significance, and evolution of species-typical behavior. The laboratories are designed to give firsthand knowledge of the material covered in lectures.

470. ICHTHYOLOGY

Spring term. Credit four hours. Prerequisites, Biological Sciences 270 or the equivalent. Lectures, M W 9. Laboratory, F 2–4:30 and S 9–11:30. Mr. Raney.

Lectures on the biology of fishes including systematics, ecology, life history, behavior, and literature. Laboratory studies of the orders, major families, and principal genera, and of systematic procedures. Field studies of the ecology and life history of local species.

471. MAMMALOGY

Fall term. Credit four hours. Prerequisites, Biological Sciences 270 or equivalent work in vertebrate biology and permission of instructor. Lectures, T Th 10. Laboratory, F 2–4:30 and S 9–11:30. Mr. Layne.

Lectures on various aspects of mammalian biology, including evolution, distribution, systematics, ecology, behavior, and physiology. Laboratory and field work on the ecology, behavior, and life histories of local mammals; the taxonomy of recent mammals, with emphasis on the North American fauna; and special topics.

472. ORNITHOLOGY

Spring term. Credit four hours. Prerequisites, Biological Sciences 270 or equivalent work in vertebrate biology and permission of instructor. Lectures, M W 11. Laboratory, M W 2–4:30.

Lectures on various aspects of the biology of birds, including structure, classification, adaptations, behavior, distribution, ecology, and physiology. Laboratory and field studies on the identification, ecology, and behavior or local species; classification; structure; molts and plumages; and other aspects of avian biology.

Marine Ecology and Oceanography

460. MARINE ECOLOGY

Spring term. Credit three hours. Prerequisites, Biological Sciences 101–102 or 103–104 and chemistry and physics. Lectures, M W F 9. Mr. Barlow.

Introduction to biological oceanography: the sea as an environment; physical and chemical characteristics of marine habitats, relation to biogeography; organic production, biochemical cycles and distribution of non-conservative properties; relation of hydrography to fisheries and distribution of populations, oceanographic aspects of pollution problems.

461. OCEANOGRAPHY

Fall term. Credit three hours. Prerequisites, introductory chemistry and physics. Lectures, T Th 10. Laboratory, Th 12–12:50. Mr. Barlow.

Introduction to physical and chemical aspects of the oceans: geography and structure of ocean basins; origin and physical properties of seawater; distribution of salinity and temperature, heat and water budgets, formation of water masses; circulation, waves and tides; shore processes, formation and distribution of sediments; discussion of current problems in oceanography. Laboratory work in organization and analysis of oceanographic observations.

Floriculture and Ornamental Horticulture

Faculty: James W. Boodley, John F. Cornman, Raymond T. Fox, Robert W. Langhans, Robert G. Mower, Robert J. Scannell, John G. Seeley, Harold B. Tukey, Jr.,

Field Representative: Prof. James W. Boodley, 15C Plant Science Building.

APPROPRIATE MAJOR AND MINOR SUBJECTS

Floriculture and Ornamental Horticulture is appropriate as a major subject for the Ph.D. and for the Master of Science, and as a minor subject for either degree when the major subject is in a Field other than Horticulture.

It is expected that entering graduate students will have adequate preparation in elementary horticulture, botany, plant physiology, genetics, pathology, agronomy, entomology, mathematics, chemistry, and physics.

LANGUAGE REQUIREMENTS. There is no language requirement for the Master's degree. For the Ph.D., a student must have a reading proficiency (at a high level) in one language other than his native language. French, German or a substitute approved by his Special Committee may be selected.

The thesis for the Master's degree is to be based on results of a research project. Requirements for the Ph.D. include selection of 2 minor subjects, passing a Qualifying Examination usually given before the termination of the 3rd residence unit, an Examination for Admission to Candidacy normally given upon conclusion of course work, and a final examination on the thesis and related material.

Members of the staff are concerned with greenhouse crops (Professors Boodley, R. W. Langhans), nursery crops (Professor H. B. Tukey, Jr.), turfgrass (Professor J. F. Cornman), and plant materials (Professor R. G. Mower).

Studies relating to physiology, propagation, nutrition, and culture may be undertaken as research for an advanced degree and should be approached from the standpoint of the basic sciences. Consequently it is appropriate to select minor subjects from physiology, anatomy, morphology, taxonomy, pathology, genetics, agronomy, entomology, agricultural economics, agricultural engineering, etc.

For graduate course listings, consult the pertinent Field listings in this Announcement. The Department of Floriculture and Ornamental Horticulture does not offer courses for graduate students only.

Food and Nutrition

Faculty: Gertrude D. Armbruster, Richard H. Barnes, Elizabeth A. Donald, E. Elizabeth Hester, Edwin J. Kuta, Karla Longrée, Leo Lutwak, Nell Mondy, Mary A. Morrison, Katherine J. Newman, Jerry M. Rivers, Jean T. Snook, André G. van Veen, Charlotte M. Young.

Field Representative: Elizabeth A. Donald, 377 Martha Van Rensselaer Hall.

APPROPRIATE MAJOR SUBJECTS	APPROPRIATE MINOR SUBJECTS
Food	Food
Food and Nutrition	Food and Nutrition
Nutrition	Nutrition

ADMISSION REQUIREMENTS. A candidate who wishes to major in this Field and whose previous studies include preparation in basic courses in food science and human nutrition, biochemistry, bacteriology, and physiology, may begin graduate studies toward an advanced degree immediately. A student whose preparation is deficient in one or more areas will be required to make up the deficiencies. Preparation in organic and analytical chemistry, physics, and mathematics is strongly recommended.

LANGUAGE REQUIREMENTS. The Field makes no language requirement. The members of the special committee will ask that a student attain a degree of proficiency in language and/or in some other subject matter area in which some degree of competence is important to his educational goals.

EXAMINATIONS. The Comprehensive Examination, which admits a student to Ph.D. candidacy, is given to judge competency in subject matter. It may be oral or oral and written. A final oral examination is required in defense of the thesis. A conference of the student and members of his Special Committee is arranged shortly after his admission to the Field to assess the competence of the student, to discuss his interests and goals, and to plan the direction of future work.

RESEARCH AND STUDY OPPORTUNITIES. Students with a major or minor in the Field of Food and Nutrition may select from a variety of courses, seminars, and experiences in independent study. Each student plans his program in consultation with his Special Committee after consideration of his previous background and purpose in graduate study. For students with a major in the Field of Food and Nutrition, minor subjects should be selected with the candidate's educational goals and professional interest in mind. Suggested minors in addition to those within the Field include biochemistry, physiology, bacteriology, botany, statistics, anthropology, sociology, education, and other areas of home economics. At least one minor chosen by candidates for the Ph.D. degree must be in a basic science related to the major.

SPECIAL INTERESTS OF THE FACULTY

Human nutrition with Professors Barnes, Donald, Lutwak, Morrison, Newman, Rivers, Snook, van Veen, Young.

Special interests: Professor Barnes, experimental animal nutrition; Professor Donald, human requirements for vitamin B_6; Professor Lutwak, mineral and energy metabolism; Professor Morrison, utilization of protein and amino acids; Professor Newman, nutrition as related to chemical and physical growth; Professor Rivers, ascorbic acid metabolism; Professor Snook, effects of diet on pancreatic enzymes; Professor van Veen, fermented foods; Professor Young, body composition studies.

Food science with Professors Armbruster, Hester, Kuta, Longrée, Mondy.

Special interests: Professor Armbruster, interrelationships of plant tissue properties and product quality; Professor Hester, protein — polysaccharide complexes; Professor Kuta, lipoprotein chemistry; Professor Longrée, quantity food sanitation; Professor Mondy, enzyme and lipid chemistry in plants.

Inquiries should be addressed to the Graduate Representative, Food and Nutrition, Martha Van Rensselaer Hall, Cornell University.

COURSES

Following is a recent, but not a final, listing of courses. Students should check with departments as to definite offerings, times, plans, etc.

441. NUTRITION AND DISEASE

Fall. Credit three hours. Prerequisite, F.N. 332 or equivalent. Miss Rivers. Discussion, M W F 9. Room 3-M-11.

Study of the physiological and biochemical anomalies in certain diseases and the principles underlying nutritional therapy. Independent survey of the technical literature in this field.

[442. ADVANCED HUMAN NUTRITION]

Fall. Credit two hours. Prerequisite, F.N. 332 or equivalent. Miss Morrison. M W 10. Room 339. Recent advances in nutrition. Emphasis on human nutrition. Not offered in 1966–67.

446. SCIENCE OF FOOD

Fall. Credit three (lectures only) or four hours. Prerequisite, F.N. 236 or 246, and a college course in organic chemistry or biochemistry. Students who have had limited laboratory experience in comparative foods should register for four hours. Misses Hester and Armbruster. Lecture, T Th S 9. Room 339. For students registered for four credit hours, Laboratory, Th 2–4. Room 358.

Scientific principles underlying modern food theory and practice. The relation to food quality and to recommended methods of food preparation of (a) the physical and chemical properties of proteins, fats, starches, sugars, leavening agents, and pigments; (b) the properties of true solutions and principles of crystallization; (c) colloidal systems-gels, sols, foams, emulsions. Laboratory experiments designed to illustrate the effect of varying ingredients and preparation procedures on the quality of food products.

447. SCIENCE OF FOOD — LABORATORY

Fall. Credit one hour. Prerequisite or parallel, F.N. 446. Miss Armbruster. Laboratory, T 1:40–4:20. Room 358.

Laboratory experiments designed to illustrate the physiochemical behavior of colloidal and crystalline systems and chemical reactions of the food components.

456. EXPERIMENTAL FOOD METHODS

Spring. Credit three hours. Prerequisite, F.N. 446. A course in statistics and F.N. 447 are desirable but not required. Miss Armbruster. Laboratory, M F 1:30–4:30. Room 358.

Application of the scientific method in the design and performance of experimental food problems and in the interpretation and evaluation of results. Independent laboratory problems.

500. SPECIAL PROBLEMS FOR GRADUATE STUDENTS

Fall and spring. Credit and hours to be arranged. Department faculty. For graduate students recommended by their chairman and approved by the instructor in charge for independent, advanced work. Experience in research laboratories in the department may be arranged.

501–504. ADVANCED NUTRITION SERIES

A series of nutrition courses offered jointly by the Department of Food and Nutrition, College of Home Economics; the Departments of Animal and of Poultry Husbandry, College of Agriculture; and the Graduate School of Nutrition. Prerequisites: courses in nutrition, physiology, and biochemistry to include intermediary metabolism, or with permission of instructor.

The biochemical and physiological bases of digestion, absorption, transport, and metabolism of nutrients; species differences where applicable; historical as well as current concepts in nutrition.

501. PROTEINS AND AMINO ACIDS

Fall. Credit two hours. Miss Morrison. M W 10. Room 339. Register in Food and Nutrition 501.

502. LIPIDS AND CARBOHYDRATES

Fall. Credit two hours. Mr. Young. F 10, T 11. Room 339. Register in Animal Husbandry 502.

503. NUTRITIONAL ENERGETICS

Spring. Credit two hours. Mr. Reid. M W 10. Morrison 342. Register in Animal Husbandry 503.

504. MINERALS AND VITAMINS

Spring. Credit two hours. Mr. Scott. F 10, T 11, Morrison 342. Register in Animal Husbandry 504.

512. NUTRITION AND GROWTH

Fall. Credit two hours. Prerequisite, F.N. 332 or equivalent. Signature of instructor required for undergraduate students. Miss Newman. T Th 10. Room 301.

Information on growth which is of particular interest to nutritionists. Survey of methods used in studying physical and chemical growth. Relation between nutrition and growth. Offered in fall term of even-numbered years.

514. READINGS IN NUTRITION

Spring. Credit three hours. Prerequisite, F.N. 332 or equivalent. Mrs. Snook. T Th 11–12:30. Room 301.

Critical review of literature on selected topics in the field of nutrition. Emphasis on human nutrition. Topics are changed each term so the course may be repeated for credit with permission of the instructor.

516. READINGS IN FOOD

Fall. Credit two hours. Prerequisite, F.N. 446 or equivalent. Department faculty. T Th 11. Room 301.

Critical review of selected topics in the current literature. Emphasis on experimental data basic to the scientific principles underlying modern theory and practice in food preparation.

524. RESEARCH METHODS IN HUMAN METABOLIC STUDIES

Spring. Credit three hours. Prerequisites, F.N. 332 or equivalent, laboratory experience in biochemistry or quantitative analysis, and permission of instructor. Department faculty. Lecture and laboratory, T Th 1:30–4:00. Room 426.

Principles of human metabolic research; experimental design of human studies; dietary considerations; methods of collecting and analyzing biological

material; and evaluation. Laboratory will include planning and management of a metabolic study, collection and the appropriate analyses of blood, urine, and feces.

599. MASTER'S THESIS AND RESEARCH

Fall and spring. Credit and hours to be arranged. Registration with permission of the instructor. Misses Armbruster, Donald, Hester, Longrée, Mondy, Morrison, Newman, Rivers, and Young; Mrs. Snook; Messrs. Barnes, Kuta, Lutwak, and van Veen.

602. SEMINAR IN NUTRITION

Fall. Credit one hour. Mrs. Snook and department faculty. T 4:30. Room 339.

606. SEMINAR IN FOOD

Spring. Credit one hour. Miss Mondy and department faculty. T 4:30. Room 339.

699. DOCTOR'S THESIS AND RESEARCH

Fall and spring. Credit and hours to be arranged. Registration with permission of the instructor. Misses Armbruster, Donald, Hester, Longrée, Mondy, Morrison, Newman, Rivers, and Young; Mrs. Snook; Messrs. Barnes, Kuta, Lutwak, and van Veen.

Food Science and Technology

Faculty: Robert C. Baker, Paul A. Buck, Robert K. Finn, John D. Hartman, Robert F. Holland, F. M. Isenberg, William K. Jordan, Frank V. Kosikowski, Vladimir N. Krukovsky, Edwin J. Kuta, Richard Ledford, Nell Mondy, H. Brooks Naylor, John W. Sherbon, William F. Shipe, Jr., Laura Lee Smith, Ora Smith, Robert M. Smock, James R. Stouffer, Andre G. van Veen, Jeremiah J. Wanderstock, George H. Wellington, J. C. White. *At Geneva:* Malcolm C. Bourne, Daniel F. Farkas, L. Ross Hackler, David B. Hand, Robert L. LaBelle, Frank A. Lee, Louis M. Massey, Jr., Leonard R. Mattick, James C. Moyer, Willard B. Robinson, Robert S. Shallenberger, Don F. Splittstoesser, John R. Stamer, Keith H. Steinkraus, Jerome P. Van Buren, Walter F. Wilkens.

Field Representative: R. C. Baker, 112 Rice Hall.

APPROVED MAJOR AND MINOR SUBJECT

Food Science and Technology

Excellent opportunities are offered in the Field of Food Science and Technology for graduate study. A wide variety of courses are offered as well as excellent research facilities. The members of this Field are associated with many different departments of the university. Research on meats, for example, is carried on in the Department of Animal Science or the Department of Poultry Science; research on potato processing takes place in the Department of Vegetable Crops. All course work is taken on the Ithaca campus, but doctoral candidates may elect to conduct their research at the Experiment Station in Geneva where a new pilot plant and laboratories are available. A smaller pilot plant is located on the Ithaca campus which supplements the very adequate research facilities of the department specializing in the various raw materials.

Students planning graduate work in Food Science and Technology should have preparation in the following: food science, chemistry, microbiology, biochemistry, or engineering.

A Qualifying Examination is required in the Field of Food Science and Technology to determine the student's need for future course work. An early date for this examination is considered essential, and it should take place soon after one term of course work is completed. The Qualifying Examination for the doctorate may be combined with the final examination for the Master's degree if approved by the Special Committee.

There is no language requirement for the Field of Food Science and Technology. Language needs for the student, if any, will be decided by the Special Committee.

Candidates for the degree of M.S. are required to register for one major and one minor subject. Candidates for the degree of Ph.D. are required to register for a major and at least one minor subject.

Two separate programs are available at the Master's level. Students may be admitted to candidacy for the general degree (M.S.) or for the professional degree, Master of Food Science (M.F.S.). The M.F.S. program places less emphasis on research and more emphasis on course work. A listing and description of courses in the M.F.S. program are to be found in the *Announcement of the Graduate School of Nutrition*. A brochure describing the facilities and activities of the Field of Food Science and Technology is available from the Field Representative.

COURSES

Courses Available Only to Graduate Students

404. CHEMISTRY OF MILK

Fall term. Credit three hours. Offered in alternate years. Prerequisites, qualitative and quantitative analysis and organic chemistry. Hours by arrangement. Stocking 120. Assistant Professor Ledford.

A study of milk constituents and physical properties. Deals with milk enzymes, lactose, milk fat, milk proteins, and minor constituents.

[512. INSTRUMENTAL METHODS]

Spring term. Credit five hours. Offered in alternate years. Prerequisite, Course 413 or permission of the instructor. Assistant Professor Sherbon. Not offered in 1966–67.

Deals with instrumental methods widely used in research and industry. The major emphasis is on chromatographic methods, spectroscopy, electophoresis and the use of computers in agricultural research. The stress will be on the practical use of the material presented.

[514. THE BIOCOLLOIDAL CHEMISTRY OF FOODS]

Spring term. Credit three hours. Offered in alternate years. Prerequisites, Biological Sciences 431 and 433 or the equivalent. Lectures, M W 10. Discussion, F 2. Laboratory, W 2–4. Professor Buck. Not offered in 1966–67.

The principles of the science of collodialsystems and micelles of importance in biology and agriculture will be introduced; then the amiscropic morphology of cytoplasm, cell walls, plastids, and biological gels and sols will be studied and the data applied to food. Polysaccharides and polypeptides in chain molecules which sometimes reach microscopical lengths, will be intensively studied. Especial attention will be given to the structural arrangement of complex

polymers. The physical chemistry of surfaces (including adsorption, ion-exchange, and electric double layer), flocculation, viscosity, swelling, and gel formation will be discussed.

Courses Available to Juniors and Seniors and Graduate Students

302. DAIRY AND FOOD ENGINEERING

Fall term. Credit four hours. Offered in alternate years. Prerequisites, Physics 101 and 102 or the equivalent and Course 100. Lectures, M W F 10. Laboratory, M 2–4:30. Stocking 119. Professor Jordan.

Engineering aspects of dairy and food plant operations.

303. FATS AND OILS

Fall term. Credit three hours. Open to upperclassmen and graduate students. Lecture demonstrations, W F 11. Stocking 120. Laboratory practice, F 1:40–4:30. Stocking 209. Professor Krukovsky.

Certain phases of chemistry and quantitative analysis as applied to the quality control and improvement in the palatability and nutritional values of milk and other fat-containing food products, including the influence of the plant and animal.

310. SENSORY QUALITIES AND EVALUATIONS OF FOODS

Spring term. Credit two hours. T Th 8:30–9:50. Stocking 120. Professor Shipe and assistants.

Deals with the factors affecting the color, odor, flavor, and texture of foods and the evaluation of these qualities. The techniques and interpretations of both objective and subjective evaluations are discussed. The laboratory exercises involve the evaluation of a variety of foods.

311. CONCENTRATION AND FREEZING PROCESSES

Spring term. Credit four hours. Offered in alternate years. Lectures, M W 11–12:50. Laboratory, M 1:40–4:30. Stocking 120. Professor Jordan.

The principles and practice of condensing, drying and freezing food products.

313. STERILIZATION PROCESSES

Spring term. Credit three hours. Offered in alternate years. Prerequisites, Chemistry 353 or equivalent, Biological Sciences 394, and Physics 102. Recommended, a course in calculus and a course in biochemistry. Lectures, M W 10. Discussion, F 10. Riley-Robb 225. Laboratory, F 2–4, Riley-Robb 44. Professor Buck.

The principles of food preservation and the fundamentals of food processing from raw materials to finished product. Heat transfer, unit operations and unit processes employed by the canning industry will be emphasized, but sterilization by any means such as heat, chemicals, physical destruction, and filtration will be demonstrated. The effects of lethal energy treatment of biological fluids and systems on desirable components such as nutritive factors and flavor components will be considered along with the cost of operation. The laboratory involves actual participation in plant operations in the processing and preservation of various food products, and field trips.

[314. MILK AND FOOD SANITATION AND PLANT OPERATIONS]

Spring term. Credit four hours. Offered in alternate years. Prerequisites, Course 100 and Biological Sciences 394. Lectures, M W 11–12:50. Laboratory, M 1:40–4:30. Professor White and assistants. Not offered in 1966–67.

The biological and chemical control of milk and food processing. Federal, state, and local requirements for the production, collection, and processing of milk and food. The control of sanitation, composition, and production in the food plant is outlined with special attention given to the fluid milk industry.

[401. FOOD FROM FERMENTATIONS]

Fall term. Credit five hours. Offered in alternate years. Prerequisites, Courses 100, 210, dairy and food microbiology, and organic chemistry or biochemistry. Lectures and laboratories, T Th 11–12:50 and 1:40–4:30. Professor Kosikowski and Assistant Professor Ledford. Not offered in 1966–67.

The chemistry, microbiology and technology of fermentations leading to important foods. Emphasis is placed on milk and cheese fermentations but consideration is given to fermentations resulting in major foods from all plant and animal sources.

Line-flow processing and testing practices designed to acquaint the student with principles are carried out in laboratory.

[403. INTERNATIONAL FOOD DEVELOPMENT]

Fall term. Credit three hours. Offered in alternate years. Permission of instructor required. M W 2–4. Professor Kosikowski. Not offered in 1966–67.

A study of programs, technical problems, and progress associated with developing acceptable milk and food supplies in critical world areas. Proposals for increasing world protein resources for humans are to be discussed. Special attention is to be directed to the organization, operations, relationships, and contributions of U. N. technical agencies, FAO, UNICEF, WHO, and governmental and non-governmental organizations in the Field.

410. FOOD BIOCHEMISTRY

Spring term. Credit three hours. Prerequisite, Biological Sciences 431. Lectures, M W F 11. Warren 131. Associate Professor Shallenberger and staff members from the Department of Food Science and Technology, New York State Agricultural Experiment Station, Geneva, New York.

A discussion of some of the important non-microbial changes in foods, such as denaturation and the Maillard browning reaction. Emphasis is placed on the occurrence, significance, and prevention or control of the changes as they affect the color, odor, flavor, texture, or nutritive value of foods.

411. FOOD PROCESSING INSTRUMENTATION

Spring term. Credit three hours. Offered in alternate years. Prerequisite, Course 302. Lectures, M W 9. Riley-Robb 225. Laboratory, F 2–4:30. Riley-Robb 146.

Principles of engineering analysis and judgment are employed in examination of instruments for measurement and control of food processes. Topics include pressure, temperature and flow measurements, plus selected instruments for measuring physical and chemical properties of foods. Electronic components of electrical instruments are discussed. The use of instruments in the enforcement of food laws is also presented.

413. ANALYTICAL METHODS

Spring term. Credit four hours. Offered in alternate years. Prerequisites, Course 210, one term of either organic chemistry or biochemistry. Lectures, T Th 11. Stocking 119. Laboratory, Th 1–5. Stocking 209. Assistant Professor Sherbon.

A study of the analytical methods important to the food industry. The emphasis is on understanding the basic analytical chemistry applied in the various tests. General topics include sampling, gravimetric and volumetric methods, optical methods, electrochemistry and the use of basic statistics.

Courses Available to Graduate Students Given in Other Departments

(See the respective Fields for course descriptions.)

APPLIED AND INDUSTRIAL MICROBIOLOGY (Biological Sciences 393)

DAIRY AND FOOD MICROBIOLOGY (Biological Sciences 394)

MEAT SELECTION AND GRADING (Animal Science 394)

MEAT TECHNOLOGY (Animal Science 490)

POULTRY MEAT AND EGG TECHNOLOGY (Poultry Science 450)

POTATO PRODUCTION AND PROCESSING (Vegetable Crops 222)

VEGETABLE DISTRIBUTION, PROCESSING AND QUALITY MEASUREMENT, ADVANCED COURSE (Vegetable Crops 412)

MARKETING (Agricultural Economics 240)

PRICING AND DISTRIBUTION OF MARKET MILK (Agricultural Economics 442)

FOOD INDUSTRY MANAGEMENT (Agricultural Economics 443)

SPECIAL TOPICS IN FOOD INDUSTRY MANAGEMENT (Agricultural Economics 444)

FIELD STUDY OF FOOD INDUSTRIES (Agricultural Economics 445)

Genetics

Faculty: Joseph M. Calvo, Gerald R. Fink, Ross J. MacIntyre, Richard L. Russell, Adrian M. Srb, Harry T. Stinson, Charles H. Uhl, Bruce Wallace, and Stanley A. Zahler.

Field Representative: Bruce Wallace, 158 Plant Science Building.

APPROVED MAJOR AND MINOR SUBJECT

Genetics

Applicants are urged to submit scores of the Graduate Record Examination and Advanced Biology Tests.

FOREIGN LANGUAGE REQUIREMENTS: Ph.D. (major), two; Ph.D. (minor), one; M.S., none. Any foreign language in which a sizeable genetics literature exists is acceptable. Candidates for the M.S. in genetics who intend to continue for the Ph.D. are urged to satisfy the requirement for one language.

Faculty members in the Field of Genetics have widely different research interests ranging from molecular through cytological, physiological, and evolutionary genetics. The student should choose a professor whose interests coincide with his own. Nevertheless, candidates in this Field are primarily geneticists and only secondarily specialists in one of the several branches of genetics.

COURSES

280. HUMAN GENETICS*

Spring term. Credit three hours. Prerequisite, Biological Sciences 101–102 or 103–104. Students who have had Biological Sciences 281 may register only with the permission of the instructor. Lectures, M W 10. Warren 145. Discussion, F 10. Room to be arranged. Professor Srb.

An introduction to biological heredity through consideration of the genetics of man. Advances in the science of genetics are having a profound effect on man's understanding of himself and on his potential for influencing his present and future well-being. The course is intended primarily to contribute to the student's general education in these matters, and although certain aspects of genetics will be considered with some rigor, the course is not designed to serve as a prerequisite to advanced courses in genetics.

281. GENETICS

Fall or spring term. Credit four hours. Prerequisite, Biological Sciences 101–102 or 103–104. Students who have had Biological Sciences 280 may register only with the permission of the instructor. Lectures, M W F 8. Plant Science 233. Laboratory, M T W Th or F 2–4, or T or Th 8–10. Plant Science 41. Professor Stinson and assistants.

A general study of the fundamental principles of genetics. Discussions of gene transmission, gene action and interaction, gene linkage and recombination, gene structure, gene and chromosome mutations, genetic aspects of differentiation, genes in populations, breeding systems, extrachromosomal inheritance. Animals, plants and microorganisms are used in the laboratory, which also includes, as independent study, inheritance in *Drosophila*.

347. CYTOLOGY

Fall term. Credit four hours. Prerequisite, Biological Sciences 101–102 or 103–104 or the equivalent. Lectures M W 9. Plant Science 143. Laboratory, M W or T Th 10–12:30. Plant Science 219. Associate Professor Uhl.

The principal topics considered are protoplasm, cells and their components, nuclear and cell division, meiosis and fertilization, and the relation to these to the problems of development, reproduction, taxonomy, and heredity. Both plant and animal materials are used.

440. CYTOGENETICS

Spring term. Credit three hours. Prerequisites, Biological Sciences 347 and 281 or the equivalent. Lectures, M W 9. Plant Science 143. Laboratory, M or W 10–12:30. Plant Science 219. Associate Professor Uhl.

* Not generally regarded as graduate courses, but may be so regarded in special cases.

An advanced course dealing mainly with the cellular mechanisms of heredity and including recent researches in cytology, cytogenetics, and cytotaxonomy.

480. POPULATION GENETICS

Spring term. Credit three hours. Prerequisite, Biological Sciences 281 or the equivalent. Lectures, T Th 11. Plant Science 141. Professor B. Wallace.

A study of factors which influence the genetic structure of Mendelian populations and which are involved in race formation and speciation.

482. PHYSIOLOGICAL GENETICS

Spring term. Credit three hours. Prerequisites, Biological Sciences 281 and a course in organic chemistry. Lectures, M W 8. Plant Science 143. Professor Srb.

The nature and activities of chromosomal and nonchromosomal genetic material are considered in relation to the functional attributes of organisms.

489. RESEARCH IN GENETICS AND DEVELOPMENT*

Fall or spring term. Credit and hours to be arranged. Prerequisite, permission of the professor under whom the work is to be taken. Staff.

Practice in planning, conducting, and reporting independent laboratory and/or library research programs.

495. MICROBIAL GENETICS

Fall term. Credit four hours. Prerequisites, Biological Sciences 281 and 290 or permission of the instructor. For upperclassmen and graduate students. Lecture, W 7:30–9:30 p.m. Stocking 218. Laboratory, T 1:40–4:30 and other hours to be arranged. Stocking 321. Associate Professor Zahler.

Genetics of bacteria and their viruses, with emphasis on the mechanisms of genetic phenomena.

495A. MICROBIAL GENETICS, LECTURES

Fall term. Credit two hours. Prerequisites, Biological Sciences 281 and 290 or 290A. For upperclassmen and graduate students. Lecture, W 7:30–9:30 p.m. Stocking 218. Associate Professor Zahler.

The course is the same as the lecture portion of Biological Sciences 495.

See also courses in the Fields of Animal Breeding and Physiology, Biochemistry, Plant Breeding, and Poultry Science.

* Not generally regarded as graduate courses, but may be so regarded in special cases.

Horticulture

There is no department of Horticulture. Instead it is divided into the separate departments of Floriculture and Ornamental Horticulture, Pomology, and Vegetable Crops.

Medical Sciences (Graduate School of Medical Sciences)

(See page 457.)

Microbiology

Faculty: Martin Alexander, Eugene A. Delwiche, Robert K. Finn, Jane Gibson, Russell E. MacDonald, H. Brooks Naylor, Harry W. Seeley, Jr., Paul J. VanDemark, Stanley A. Zahler. At Geneva: Donald F. Splittstoesser, John R. Stamer, Keith H. Steinkraus.

Field Representative: Paul J. VanDemark, 311 Stocking Hall.

APPROVED MAJOR AND MINOR SUBJECT

Microbiology (See also Pathogenic Bacteriology, page 330).

Applicants for admission are required to submit scores for the Graduate Record Examination Aptitude Test.

Students planning graduate study in the Field of Microbiology should have preparation in general chemistry, qualitative and quantitative analysis, organic chemistry, physics, and introductory courses in the biological sciences. In addition, training in physical chemistry and calculus is desirable. Deficiency in any of the subjects listed does not necessarily preclude admission but may increase the time necessary to earn a degree.

The language requirement in Microbiology may be satisfied by demonstration of (a) a reading proficiency in two languages, including French, German, Japanese, or Russian, by passing the Graduate School Foreign Language Test given by the Educational Testing Service, or (b) proficiency in one language including French, German, Japanese, or Russian (or other language approved by the candidate's Special Committee) at a level of achievement sufficient to pass the CEEB college language test.

Field requirements for candidates for the doctorate degree are those of the Graduate School as outlined on pages 8–11.

Well-equipped laboratories are available. Those branches of microbiological research in which the staff is experienced and especially interested include bacteriophagy, genetics, morphology and cytology, physiology and biochemistry, and systematic and applied microbiology.

RESEARCH AND STUDY OPPORTUNITIES

Some research and study opportunities related to the specializations of the various faculty members are as follows:

Bacterial photosynthesis, J. Gibson.
Bacteriophagy, H. B. Naylor.
Food microbiology, H. B. Naylor, D. F. Splittstoesser, J. R. Stamer, K. H. Steinkraus.
Industrial fermentations and bioengineering, E. A. Delwiche, R. K. Finn.
Microbial ecology, M. Alexander, E. A. Delwiche, H. W. Seeley, Jr.
Microbial genetics and differentiation, S. A. Zahler.
Microbial nutrition, H. W. Seeley, Jr., P. J. VanDemark.
Microbial physiology, E. A. Delwiche, J. Gibson, R. E. MacDonald, H. W. Seeley, Jr., P. J. VanDemark.
Soil microbiology, M. Alexander.

COURSES

390A. BACTERIOLOGY. ADVANCED BACTERIOLOGY.

Fall term. Credit 3 hours. Prerequisite, permission of the instructor. Lectures, T Th S 9 a.m. Stocking 119. Associate Professor MacDonald.

A study of the comparative physiological and ecological relationships among bacteria and some related organisms. A number of groups of bacteria will be discussed in detail as well as factors which influence their ability to survive in nature. This course and course 410 constitute a two semester sequence pertaining to the ecology of microorganisms. In addition, a number of lectures will be devoted to the history of bacteriology and to the theory and development of bacterial classification.

390B. BACTERIOLOGY. ADVANCED BACTERIOLOGY LABORATORY

Fall term. Credit 3 hours. Prerequisite, permission of the instructor. Hours to be arranged. Associate Professor MacDonald.

Techniques for the isolation, cultivation, and detailed study of selected groups of organisms. Some of the more standard techniques of physiological study will be introduced.

[495. MICROBIAL GENETICS]

Fall term. Credit 4 hours. Prerequisite, permission of the instructor. For upperclassmen and graduate students. Lecture, W 7:30–9:30 p.m. Stocking 218. Laboratory T 1:40–4:30 and other hours to be arranged. Stocking 321. Associate Professor Zahler. Not offered in 1966.

Genetics of bacteria and their viruses, with emphasis on the mechanisms of genetic phonemena.

[495A. MICROBIAL GENETICS, LECTURES]

Fall term. Credit 2 hours. Prerequisite, permission of the instructor. For upperclassmen and graduate students. Lecture. W 7:30–9:30 p.m. Stocking 218. Associate Professor Zahler. Not offered in 1966–67.

This course is the same as the lecture portion of Biological Sciences 495.

496. CHEMISTRY OF MICROBIAL PROCESSES

Spring Term. Credit 2 hours. Prerequisite, permission of the instructor. Course intended for upperclassmen and graduate students. Lectures, M W 11. Stocking 119. Professor Delwiche.

Selected topics pertaining to the energy metabolism, oxidative and fermentative abilities, and biosynthetic capacities of microorganisms. Where possible and appropriate the subject matter deals with the various microbial forms in a comparative sense.

[498. VIROLOGY]

Spring Term. Credit 3 hours. Given in alternate years. Prerequisite, permission of the instructor. Lectures, T Th S 11. Stocking 218. Professor Naylor, assisted by Professor Ross and Associate Professor Carmichael. Not given in 1966–67.

A study of the basic physical, chemical, and biological properties of plant, animal, and bacterial viruses.

590. METHODS IN ADVANCED BACTERIOLOGY

Spring Term. Credit 4 hours. Given in alternate years. Primarily for graduate students. Prerequisite, permission of the instructor. Limited enrollment. Hours to be arranged. Professor MacDonald.

Intended to acquaint advanced students with some of the more important techniques used in the study of bacterial physiology. Emphasis will be placed on the use of radioisotopes; growth, structure, and function of cells.

(506. AGRONOMY) ADVANCED SOIL MICROBIOLOGY

699. MICROBIOLOGY SEMINAR

Fall and Spring Terms. Without credit. Th 4:15. Stocking 119. Staff.

Required of graduate students majoring in microbiology and open to all who are interested.

It is to be emphasized that in addition to a creditable performance in the formal program of courses leading to a broad knowledge of microbiology and related studies, the graduate student registered for an advanced degree is expected to demonstrate ability to plan and conduct independent and original research. The successful culmination of a worthy research project is considered the most important requirement for the Ph.D. degree.

Neurobiology and Behavior

Faculty: William C. Dilger, Steven T. Emlen, Thomas Eisner, Perry W. Gilbert, Edgar L. Gasteiger, Bruce P. Halpern, William T. Keeton, Richard D. O'Brien, Frank Rosenblatt, Miriam M. Salpeter, Fred Stollnitz, Daniel N. Tapper, Ari van Tienhoven, Robert R. Zimmerman.

Field Representative: Prof. R. D. O'Brien, Stocking Hall.

APPROVED MAJOR AND MINOR SUBJECTS

Neurobiology (includes neurophysiology, neurochemistry, sensory physiology, neuroanatomy, theory of brain functions)

Behavioral Biology (includes ethology)

Applicants must present scores on the Graduate Record Examination Aptitude Test and one of the Advanced Sciences Tests.

RESEARCH AREAS

Members of the faculty in the Field of Neurobiology and Behavior will be especially interested in directing research in the following areas, although research will not be limited to these areas: W. C. Dilger, the evolution of behavior; T. Eisner, behavior of invertebrates and the chemical basis of behavior and biocommunication; S. T. Emlen, animal behavior including orientation; E. L. Gasteiger, neurophysiology; P. W. Gilbert, animal behavior especially of elasmobranchs; B. Halpern, sensory physiology, especially chemical senses and central mechanisms; W. T. Keeton, animal behavior, especially orientation; R. D. O'Brien, neurochemistry and neuropharmacology; F. Rosenblatt, mathematical and physiological studies of brain mechanisms; M. M. Salpeter, ultrastructure of the nervous system; F. Stollnitz, primate behavior especially discrimination learning; D. N. Tapper, sensory physiology especially cutaneous reception; A. van Tienhoven, neuroendocrinology; R. R. Zimmerman, primate behavior and comparative development.

A prospective student is urged to correspond with the professor in the above list whose interests are nearest his own.

COURSES

421. COMPARATIVE VERTEBRATE ETHOLOGY

Fall term. Credit three hours. Prerequisites, Biological Sciences 101–102 or

103–104 and permission of the instructor. Lectures, T Th 9. Laboratory, to be arranged. Mr. Dilger.

A survey of the methods and principles of vertebrate ethology for students specializing in this field or for those in other branches of zoology wishing to broaden their knowledge of animal behavior. Emphasis is placed on the causation, function, biological significance, and evolution of species-typical behavior. The laboratories are designed to give firsthand knowledge of the material covered in lectures.

PHYSIOLOGICAL PSYCHOLOGY

(See Psychology 323.)

COMPARATIVE PSYCHOLOGY

(See Psychology 326.)

MATHEMATICAL BEHAVIOR THEORY

(See Psychology 465.)

520. COMPARATIVE NEUROLOGY

Spring term. Credit four hours. Prerequisite, permission of instructor. Lecture, T Th 12. Laboratory, M or W 2–4:30.

A comparative study of the vertebrate nervous system with emphasis upon the primate. Studies include dissections of the brain and the identification of nuclei and tracts in sections of the brain and spinal cord. Functional aspects of anatomical relations are stressed.

521–522. BRAIN MECHANISMS AND MODELS

Throughout the year. Credit four hours a term. Prerequisites, calculus, introductory biology or psychology, graduate or advanced undergraduate standing, and consent of instructor. Acquaintance with modern algebra and probability theory is desirable. Lecture, M 3–4:30, Th 3–4:30. Mr. Rosenblatt.

Fall semester: review of fundamentals of neurophysiology; psychological and physiological criteria for brain models; computers and digital automata in relation to brain mechanisms; review of representative models; theory of elementary perceptrons. Spring semester: theory of multi-layer and cross-coupled perceptrons; recognition of temporal patterns; problems of figure organization, cognitive sets, sequential programs, and other problems of advanced models; contemporary theories of memory.

FUNCTIONAL ORGANIZATION OF THE NERVOUS SYSTEM

(Veterinary Medicine 924.)

Fall term. Credit three hours for lecture, two hours for laboratory. Lectures M W F 10. Laboratory, W 1–5 bi-weekly. Prerequisites, physiology, organic chemistry, physics, and/or consent of instructor. Physical chemistry and neuroanatomy desirable. Professor Gasteiger.

Function of the nervous system will be considered primarily from an electrophysiological viewpoint. Where appropriate, important studies of reflexology, chemical and feedback control, and comparative anatomy will be utilized. Laboratory studies will include electrical activity of cells, reflexes, decerebrate rigidity, acoustic microphonic response, subcortical stimulation, and evoked and spontaneous cortical activity.

In addition, a course in Introductory Neurobiology and Behavior (Prof. Eisner and Staff) will be offered in the Spring of 1967 and a graduate seminar "Chemical Communication in Animals" (Prof. Eisner) in the Fall of 1967.

Other courses planned for 1967 and 1968 will include Comparative Neurology and courses in Neurochemistry (Prof. O'Brien) and Animal Orientation (Prof. Emlen).

Nutrition

Applicants wishing to study toward an M.S. or Ph.D. in the general area of Nutrition should consult Animal Nutrition on page 256. Food and Nutrition on page 289 and Food Science and Technology on page 293. A professional degree of Master of Nutritional Science is administered by the Graduate School of Nutrition. Students interested in the latter program should consult the Announcement of the Graduate School of Nutrition and direct their correspondence to Dean Richard H. Barnes, 124 Savage Hall. Also see page 461 of this Announcement.

Plant Breeding

Faculty: Ronald E. Anderson, Loy V. Crowder, Herbert L. Everett, Walter T. Federer, Clarence O. Grogan, Neal F. Jensen, Alvin A. Johnon, Carl C. Lowe, Henry M. Munger, Royse P. Murphy, Robert L. Plaisted, Douglas S. Robson, J. Neil Rutger, Robert R. Seaney, Shayle R. Searle, Adrian M. Srb, Harry T. Stinson, N. Scott Urquhart, Bruce Wallace, Donald H. Wallace. At Geneva: Donald W. Barton, John Einset, Robert C. Lamb, Gerald A. Marx, Donald K. Ourecky, Richard W. Robinson, George L. Slate, Roger D. Way.

Field Representative: Neal F. Jensen, 162 Plant Science Building.

APPROPRIATE MAJOR SUBJECTS	APPROPRIATE MINOR SUBJECTS
Plant Breeding*	Plant Breeding
Plant Genetics*	Plant Genetics
Biometrics	Biometrics
Genetics*	Genetics

The language requirement for each student will be detemined by the Field following a recommendation from the Chairman of the student's Special Committee. All students must pass an English proficiency examination as specified by the Field.

Students who are interested in crop improvement through breeding, the genetics of higher plants, and population and quantitative inheritance studies of higher plants, will register in Plant Breeding. Problems for research may involve studies of breeding methods, the application of genetic principles to breeding, and the correlation of knowledge from other fields such as biochemistry and statistics in attacks on problems such as yield, quality, adaptability, and disease and insect resistance. The Department now has active research projects with most of the important field and vegetable crops of New York, and certain materials from these projects are available for graduate students' problems. For students who will register in genetics, the research problems generally will involve analysis of hereditary and evolutionary phenomena. Almost any suitable biological materials can be utilized, but the most readily available ones will be those currently being studied by the departmental staff in genetic investigations. For those students to whom problems of experimental techniques and mathematical analysis of biological data hold the greater appeal, registration will be in biometry.

* Except that plant breeding, plant genetics, and genetics cannot be major-minor combinations.

It is advisable that the student entering upon graduate work in this Field be well grounded in the fundamentals of the natural sciences. He should have had courses in advanced chemistry, biology, calculus, and physics. Students intending to specialize in biological statistics will find it to their advantage to have additional training in mathematics.

Students majoring in plant breeding or genetics will find it necessary to remain in Ithaca during the summer, or to make satisfactory arrangements elsewhere for growing and studying the material used in connection with their research problems.

Research Areas

Members of the staff will be especially interested in directing research in the areas listed, although research will not be limited to those areas.

Biometry: W. T. Federer, statistics and experimental design; D. S. Robson and S. R. Searle, statistics and biometrical genetics; N. S. Urquhart, statistics and multivariate analysis.

Genetics: A. M. Srb, microbial genetics, physiological genetics; H. T. Stinson, genetics and cytogenetics of Oenothera and maize; B. Wallace, population, evolutionary, and radiation genetics. Staff listed under Plant Breeding direct thesis research on the genetics of the crop plants with which they are primarily concerned. Staff listed under Biometry direct theses on various aspects of statistical and mathematical genetics.

Plant breeding: R. E. Anderson, sugarbeets; C. C. Lowe, R. P. Murphy, and R. R. Seaney, forage crops; L. V. Crowder, A. A. Johnson, and J. Neil Rutger, extension and pure seed programs; C. O. Grogan, corn; N. F. Jensen, small grains; H. M. Munger and D. H. Wallace, vegetable crops; R. L. Plaisted, potatoes.

Prospective students will find it to their advantage to correspond with the staff members whose interests are most closely related to their own some months in advance of the time they wish to apply, since only a limited number of students can be accommodated.

COURSES

Plant Breeding

503. METHODS OF PLANT BREEDING

Fall term. Credit three hours. Primarily for graduate students, but open to properly qualified seniors who expect to engage in plant breeding. Prerequisites, Biological Sciences 101–102 or 103–104 and 281, and a course in at least one of the following: Field crops, vegetable crops, floriculture, or pomology. Lectures, T Th 8. Plant Science 141. Laboratory, T 2–4:30. Professor Munger.

A study of the principles and practices of plant breeding. Lectures, supplemented by periods in the greenhouse and experimental fields.

505. PLANT BREEDING — APPLIED METHODS AND TECHNIQUES

Spring term. Credit one hour. Prerequisites, same as for Course 503 or consent of the instructor. Laboratory, T 2–4:30. Plant Science 107. Associate Professor Crowder.

Designed to acquaint students with the field, greenhouse, and laboratory techniques used in plant breeding research. Will include experience in the planning and conduct of field experiments; also acquaintance with useful methods from related fields of agricultural research.

506. PRINCIPLES OF SEED PRODUCTION, TECHNOLOGY, AND DISTRIBUTION

Spring term. Credit two hours. Prerequisite, Course 503. Lecture and laboratory, M 8–10. Plant Science 107. Associate Professor Crowder.

Designed to develop an appreciation for the responsibilities related to seed production, processing, and merchandising. Topics covered will include: geographical areas of seed increase, production methods as related to crop type, techniques involved in harvesting, cleaning and storing, various aspects of seed usage, movement through seed channels, and relationships of seed improvement — local seed certification agencies, national and international organizations. Students will have an opportunity to become familiar with seed grading and identification. Three field trips will be taken.

512. EXPERIMENTAL METHODS

Spring term. Credit two hours. Prerequisite, Course 511 or consent of instructor. Lectures, M W F. Time to be arranged. Plant Science 141. Professor Lowe. (Not given in 1967–68.)

Use of statistical methods and application of experimental designs and plot techniques to problems in plant breeding and related agricultural research.

[515. STATISTICS FOR QUANTITATIVE GENETICS]

Spring term. Credit two hours. Prerequisites, Courses 511 and 503 or their equivalents. Lectures, T Th 8. Plant Science 141. Professor Plaisted. Not offered in 1966–67.

An introduction to statistical methods currently used in research in quantitative genetics and plant breeding.

519. STATISTICAL GENETICS

Spring term. Credit three hours. Prerequisites, Course 514 and Mathematics 371. Time and place of lectures to be announced. Professor Robson.

An introduction and application of the theory of Markov chains to mating systems including selfing, sibbing, backcrossing, and random mating, with a discussion of genetic variance component analysis and Monte Carlo simulation of such systems on high-speed computers.

Departmental Seminar and Research

622. SEMINAR

Fall and spring terms. Without credit. Time and place to be announced. Members of the departmental staff.

Seminars of specific interest to the areas of genetics, plant breeding, and biometrics meet separately each week.

Statistics and Biometry

407. COMPUTER TECHNIQUES FOR STATISTICS

Fall term. Credit two hours. Prerequisite, an introductory course in statistics. May be taken concurrently. Lecture, M 11. Warren 245. Associate Professor Searle.

Introduction to uses of computers in statistics: calculation of elementary statistical analyses, techniques of sampling and simulation, and availability of library programs. CORC, the Cornell Computing language, will be

taught and used for problems solving; use will also be made of some of the CUSTAT (Cornell University Statistics) library programs.

408. ALGEBRA FOR STATISTICS I

Fall term. Credit two hours. Prerequisite, a course in statistical methods. May be taken concurrently. Lecture, W F 11. Warren 245.

Algebra and associated topics related to the statistical procedures of Course 510 and other introductory statistics courses on campus such as Mathematics 370 and Course 410.

409. ALGEBRA FOR STATISTICS II

Spring term. Credit two hours. Prerequisite, Course 408. Lectures, W F 11. Warren 245.

Continuation of 408, at the level of Course 511.

410. MATHEMATICAL AND STATISTICAL MODELS IN BIOLOGY

Fall term. Credit three hours. Prerequisites, Mathematics 112 and Biological Sciences 281 or permission of the instructor. Lectures, M W F 10. Warren 345. Discussion period to be arranged. Professor to be appointed.

An introduction to the use of mathematical and statistical models in the study of biological phenomena. Elementary concepts of probability theory are introduced in developing models of Mendelian genetics and models of simple genetic experiments. Concepts and methods of statistical inferences, including point estimation, interval estimation, model testing and hypothesis testing, or presented in the context of drawing genetic inferences from experimental observations. The planning of genetic experiments is studied as a problem of achieving both statistical identifiability and statistical efficiency.

Other biological phenomena are examined which lead to discrete probability models of the Poisson, negative binomial, and logarithmic distributions and compounds of these distributions. Continuous models are derived as limiting forms of discrete models and as models representing quantal response. Methods of statistical inference are developed for each model considered, including exact, small sample procedures and approximate, large sample procedures. Standard statistical techniques covered in this course are maximum likelihood estimation, binomial and normal interval estimation, Students' t-test, the chi-square goodness-of-fit test, least squares regression, logit and probit analysis.

[411. STOCHASTIC MODELS IN BIOLOGY]

Spring term. Credit three hours. Offered in alternate years. Prerequisite, Course 410. Lectures, M W F 10. Warren 345. Discussion period to be arranged. Professor to be appointed. Not offered in 1966–67.

An introduction to stochastic processes in biology. The necessary mathematics and statistics will be introduced as needed. Recurrent events, random walk models, Markovian processes, birth-and-death processes, epidemic processes, competition and predation, diffusion processes, and other models currently used in biological theory will be discussed and applied. Special emphasis will be given the various processes applied to genetics.

412. DETERMINISTIC MODELS IN BIOLOGY

Spring term. Credit three hours. Given in alternate years. Prerequisite, Course 410. Lectures, M W F 10. Warren 345. Discussion period to be arranged. Professor to be appointed.

An introduction to deterministic mathematical models in biology. The application will be from the biological viewpoint. The necessary mathematics will be introduced as needed. Finite differences, differential equations, logistics, growth and decay, and other deterministic models corresponding to those introduced in 411 will be discussed.

417. MATRIX ALGEBRA IN BIOLOGY AND STATISTICS

Fall term. Credit three hours. Prerequisite, the equivalent of one year of college algebra. Lectures, M W F 9. Warren 160. Associate Professor Searle.

Elements of matrix algebra with applications in biology and statistics. Arithmetic procedures and other matrix operations; rank and linear independence, latent roots and vectors, solving linear equations, generalized inverses, direct sums and products. Use of matrices in regression analysis and linear statistical models.

510. STATISTICAL METHODS I

Fall term. Credit three hours. Prerequisite, graduate standing or permission of instructor. T Th S 10. Warren 345. Laboratory to be arranged. Assistant Professor Urquhart.

The distributions of statistics encountered in biological and other fields are considered from the point of view of elementary probability notions and by sampling from known populations. The results, with principles of experimentation, are applied to the conducting of experiments and interpretation of results. The nature and validity of experimental error are treated. Topics include point and interval estimation, tests of hypotheses, the simpler experimental designs and their analyses of variance, linear regression, correlation, and methods involving rank order and rank sum procedures.

511. STATISTICAL METHODS II

Spring term. Credit three hours. Prerequisite, Course 510 or the equivalent. T Th S 10. Warren 345. Laboratory to be arranged. Assistant Professor Urquhart.

The work of Course 510 is continued. Topics include factorial experiments, individual degrees of freedom, analysis of covariance, analysis of variance of two-way classifications with disproportionate numbers, multiple and curvilinear regression, curve fitting, the treatment of discrete data, some recent developments in statistics.

513. DESIGN OF EXPERIMENTS I

Fall term. Credit one, three, or four hours. Prerequisites, Courses 409 and 511, or the equivalent. M W F 8. Plant Science 141. Discussion period to be arranged. Professor Federer.

Principles and techniques of experimentation, extensions and variations of the completely randomized, randomized complete block, latin square designs, the factorial experiment and confounding, fractional replication including response surface designs, lattice designs, crossover designs, augmented and other designs, covariance analyses, error rates, tests for ranked means, sample size, variance component analyses, and unequal number analyses.

514. DESIGN OF EXPERIMENTS II

Spring term. Credit three hours. Prerequisite, Course 513. M W F 8. Warren 201. Discussion period to be arranged. Professor Federer.

A continuation of the work in Course 513. A discussion from selected topics on long-term experiments, combination of results from several ex-

periments, sequential experimentation, variance component analyses, estimation procedures, linear hypotheses, heritability studies, multivariate analyses, unequal numbers analyses, and related topics.

[517. LINEAR ESTIMATION AND TESTS OF HYPOTHESES]

Spring term. Credit three hours. Prerequisite, Courses 417 and 511. Time and place of lectures to be arranged. Professor Robson. Not offered in 1966–67.

The material of this course is essentially that given in F. Graybill's book, *An Introduction to Linear Statistical Models.*

[518. SPECIAL TOPICS IN SEQUENTIAL SAMPLING, BIOASSAY, NONPARAMETRIC STATISTIC, ETC.]

Spring term. Credit three hours. Prerequisite, Course 511 or the equivalent. Time and place of lectures to be arranged. Professor Robson. Not offered in 1966–67.

Topics include the principles and methodology of bioassay, discriminant functions, sequential analysis, nonparametric methods, mark-recapture methods, and path analysis.

Biological Sciences

480. POPULATION GENETICS

Spring term. Credit three hours. Prerequisite, Biological Sciences 281 or the equivalent. Lectures, T Th 11. Plant Science 141. Professor B. Wallace.

A study of factors which influence the genetic structure of Mendelian populations and which are involved in race formation and speciation.

482. PHYSIOLOGICAL GENETICS

Spring term. Credit three hours. Prerequisites, Biological Sciences 281 and a course in organic chemistry. Lectures, M W 8. Plant Science 143. Professor Srb.

The nature and activities of chromosomal and nonchromosomal genetic material are considered in relation to the functional attributes of organisms.

Plant Pathology

Faculty: Durward F. Bateman, Carl W. Boothroyd, Robert S. Dickey, A. Watson Dimock, Kenneth D. Hickey, Warren T. Johnson, Edward D. Jones, George C. Kent, Richard P. Korf, James W. Lorbeer, William F. Mai, Charlie A. Martinson, Roy L. Millar, Kenneth G. Parker, Lester C. Peterson, William F. Rochow, A. Frank Ross, Otto E. Schultz, Arden F. Sherf, Wayne A. Sinclair, Leon J. Tyler, Robert E. Wilkinson; *at Geneva:* Alvin J. Braun, Willard F. Crosier, Robert M. Gilmer, James M. Hamilton, John J. Natti, William T. Schroeder, Michael Szkolnik; *at Farmingdale:* Martin B. Harrison, Charles E. Williamson; *at Poughkeepsie:* DeForest H. Palmiter; *at Riverhead:* Robert C. Cetas.

Field Representative: Dr. A. W. Dimock, 357 Plant Science Building.

APPROVED MAJOR OR MINOR SUBJECTS. Plant Pathology or Mycology

ADMISSION REQUIREMENTS. Admission to graduate study in plant pathology or mycology is based on satisfactory completion of a baccalaureate degree in science or agriculture. Broad training in the biological and physical sciences is essential; course work or experience in plant pathology is not required.

Admission is based on quality of undergraduate work and promise as a graduate student, rather than on numbers and types of courses completed.

LANGUAGE REQUIREMENTS. There is no general foreign language requirement for the M.S. and Ph.D. degrees; however, competence in one or more foreign languages may be required by the Chairman of the Special Committee.

EXAMINATIONS. All students majoring in plant pathology and mycology are expected to take an oral, or oral and written, Qualifying Examination within the first 12 months after registration. This examination, required by the Field, will be administered by the Special Committee and is designed to assist the student and his committee in charting the student's program of study. Candidates for the M.S. degree will be held for a terminal Thesis and Subject Matter Examination, to be administered by members of the Special Committee. Students in the Ph.D. program must pass a Comprehensive Examination before admission to Ph.D. candidacy. This examination, required by the Graduate School, is designed to test the student on his knowledge of subject matter pertinent to the doctoral degree. It may be oral or oral and written, and will be administered by the Special Committee. A Final Examination is required for the Ph.D. degree. It will be an oral examination on the thesis and will be administered by the Special Committee.

RESEARCH AND STUDY OPPORTUNITIES

Excellent opportunities for graduate study and research are offered in all phases of plant pathology. Students become familiar with the basic principles of disease as caused by the major groups of plant pathogens (bacteria, fungi, nematodes, and viruses). Excellent equipment and facilities are available for research under the guidance of specialists in the department. Field trips with staff members during the summer give students experience in diagnosing disease and in observing up-to-date control practices. Each student is given a chance to assist with teaching in the elementary course in plant pathology and to become familiar with extension techniques.

Students electing plant pathology as a specialization may work with any of several staff members in crop-oriented research, e.g., diseases of forage, fruit, ornamentals, potatoes, vegetables, shade trees and shrubs, small grains, corn, and turf grasses, or they may specialize in research programs in specific areas of plant pathology, e.g., bacteriology, epiphytology, nematology, physiology of disease, and virology. Students will also find a stimulating program of research and teaching in mycology. Major students may concentrate their research in cytology, genetics, morphology, physiology, or taxonomy.

When the major is in either mycology or plant pathology, the faculty usually does not advise selection of a minor in the other subject.

An outstanding mycological and plant pathological herbarium, unexcelled library facilities, excellent controlled-environment facilities, modern equipment, and cooperation with faculties of related fields enable students to follow broad research programs.

A number of fellowships and scholarships are available, and several assistantships are awarded by the department.

Further information concerning the Field is given in a brochure, *Graduate Study in Mycology and Plant Pathology at Cornell*, which may be obtained by writing the Field Representative.

The major interests of the staff members are as follows: D. F. Bateman, teaching and research, disease and pathogen physiology, root diseases. C. W. Boothroyd, teaching, general plant pathology; research, corn diseases, soil-

borne pathogens. R. S. Dickey, teaching, phytobacteriology; research, phytopathogenic bacteria. A. W. Dimock, research, in diseases of florist and ornamental crops, epidemiology, soil-borne pathogens, relation of environmental factors to disease development and disease control. K. D. Hickey, extension — diseases of fruits. W. T. Johnson, extension, pests of trees and shrubs on home grounds, 4-H Club work. E. D. Jones, extension and research, diseases of potatoes, potato certification, foundation seed programs. G. C. Kent, teaching, advanced plant pathology, research, diseases of cereal crops, pathological histology, epidemiology, epiphytology. R. P. Korf, teaching, mycology, research, taxonomy, morphology, cytology, ecology, and physiology of fungi. J. W. Lorbeer, research, diseases of vegetables, soil-borne pathogens, fungal genetics, epidemiology, fungicide evaluation. W. F. Mai, teaching, nematology, research — etiology and control of diseases caused by nematodes, nematode physiology and taxonomy. C. A. Martinson, research, root diseases and soil-borne pathogens. R. L. Millar, teaching, general plant pathology, research, physiology of infection, diseases of forage crops. K. G. Parker, research, virus diseases of stone fruits, bacterial and nematode diseases of tree fruits, fungicide application equipment. L. C. Peterson, research, development of disease-resistant potatoes, potato diseases, diseases caused by Phycomycetes. W. F. Rochow, research, virus diseases of cereal crops, aphid transmission and physiological apects of plant viruses. A. F. Ross, teaching, plant virology, research, viruses and virus diseases, interaction of plant viruses. O. E. Schultz, extension, diseases of potatoes, grain, and forage crops. A. F. Sherf, extension, vegetable diseases, diseases caused by soil-borne organisms, disease complexes. W. A. Sinclair, teaching, extension, and research, diseases of trees and shrubs in public and commercial plantings. L. J. Tyler, teaching, disease control, research — foot rots and stem rots of cereals, smut and smut fungi. R. E. Wilkinson, research, diseases of vegetable crops, virus diseases, disease control.

Off-campus: A. J. Braun, research, small fruit diseases; nematology, virology, fungicides. R. C. Cetas, research, vegetable and potato diseases; fungicides, breeding for resistance. W. F. Crosier, research, seed pathology; seed treatment chemicals. R. M. Gilmer, deciduous fruit diseases, virology; J. M. Hamilton, orchard fruit diseases; fungicides, intratherapy, M. B. Harrison, research, diseases caused by nematodes; turf diseases, soil fumigation; J. J. Natti, research, vegetable diseases; fungicides, breeding for resistance. D. H. Palmiter, research, fruit diseases; virology, fungicides. W. T. Schroeder, research, vegetable diseases; fungicides, breeding for resistance. M. Szkolnik, research, fruit diseases; fungicides, systemics. C. E. Williamson, research, diseases of florist crops; nematology, soil fumigation.

COURSES

301. ELEMENTARY PLANT PATHOLOGY

For graduates who have had no formal course in plant pathology.
Every fall and alternate spring terms. Credit three hours. Prerequisite, Biological Sciences 101–102 or 103–104, or the equivalent. Lecture, T Th 11. Plant Science 37. Laboratory, T W Th or F 2–4:30. Plant Science 341. Conferences to be arranged. Professor Boothroyd.

An introductory course dealing with the nature, cause, and control of disease in plants. Representative diseases of cultivated crops are studied in the laboratory.

309. COMPARATIVE MORPHOLOGY OF FUNGI

For graduates who have had no formal courses in mycology.
Spring term. Credit four hours. Offered in alternate years. Prerequisite, a year

sequence of Botany or its equivalent, and permission to register. Lecture, M W 9. Plant Science 336. Laboratory, M W 1:40–4:30. Plant Science 326. Professor Korf. Not offered in 1966–67.

An introductory course in mycology. Emphasis is placed on morphology rather than on taxonomy.

501. ADVANCED PLANT PATHOLOGY

Fall term. Credit four hours. Prerequisite, a course in introductory plant pathology and permission to register. Lecture, T Th 11. Plant Science 336. Laboratory, T Th or W F 2–4:30. Plant Science 342. Associate Professor Millar.

Designed to acquaint the student with the basic principles and techniques of the science of phytopathology and to provide an adequate foundation for successful prosecution of research in this Field.

502. PRINCIPLES OF PLANT DISEASE CONTROL

Spring term. Credit three hours. Offered in alternate years. Graduate students only. Enrollment limited to 24. Prerequisite, Course 501 or its equivalent and permission to register. Lecture, T 11. Plant Science 336. Laboratory and discussion, T Th 2–4:30. Plant Science 342. Professor L. J. Tyler.

For graduate students who expect to teach and/or perform research in educational institutions, experiment stations, or agricultural chemical companies in connection with the development and use of plant disease control materials and methods. Emphasis is placed upon the philosophies underlying the four principles of plant disease control: exclusion, eradication, protection, and immunization. Attention is given to the existing body of knowledge upon which present disease control practices are based. Objectives are to help the student interested in plant protection equip himself not only to apply existing methods and materials but to enable him to improve upon them by developing new ideas, etc., especially in situations where control of plant diseases requires new approaches.

505. PLANT VIROLOGY

Fall term. Credit three hours; in special cases, permission may be obtained to enroll for lectures only (two hours credit). For graduate students with majors or minors in plant pathology and, in special cases, to other graduate students interested in virology. Prerequisite, Course 501 or permission to register. Lecture, T Th 10. Plant Science 336. Laboratory, F 1:40–4:30. Plant Science Greenhouse. Professor Ross.

Designed to provide advanced graduate students with basic information on the nature and properties of plant viruses and on the diseases they cause.

[506. PLANT NEMATOLOGY]

Spring term. Credit three or five hours. Offered in alternate years. For graduate students with majors or minors in plant pathology and, in special cases, other students interested in nematology. Prerequisite, Course 501 or permission to register. Two lectures and one or three two-hour morning laboratory periods per week. Hours to be arranged. Lectures, Plant Science 336. Laboratory Virology-Nematology Laboratory. Professor Mai. Not offered in 1966–67.

Anatomy, morphology, and taxonomy of plant parasitic forms and nonparasitic soil-inhabiting forms of nematodes are studied. Plant pathogenic forms also are considered from the standpoint of host-pathogen relationships, host ranges, life cycles, and the symptoms they cause. Principles and methods of control are discussed.

507. BACTERIAL PLANT PATHOGENS

Spring term. Credit two hours. Offered in alternate years. For graduate students with majors or minors in plant pathology; others by permission only. Prerequisite, Course 501 or permission to register. Lecture, F 9. Plant Science 336. Laboratory, F 2–4:30. Plant Science 304. Associate Professor Dickey.

Designed to provide students with basic information on bacterial plant diseases and phytopathogenic bacteria. The laboratory will include some of the more important techniques used in the study of bacterial plant pathogens.

[508. DISEASE AND PATHOGEN PHYSIOLOGY]

Fall term. Credit three hours. Offered in alternate years. For graduate students with majors or minors in plant pathology; others by permission only. Prerequisites, Course 501, Biological Sciences 433 and 544, and permission to register. Lecture, F 9. Plant Science 336. Laboratory, F 1:40–4:30 and one to be arranged. Plant Science 344. Associate Professor Bateman. Not offered in 1966–67.

Designed to provide students with insight into the mechanisms of pathogenesis and altered metabolism of diseased plants.

531. SPECIAL PROBLEMS IN MYCOLOGY OR PLANT PATHOLOGY

Fall or spring term, or both. Credit three or five hours each term. For graduate students only. Registration by permission. Three to five weekly laboratory periods of three hours each. Staff members.

For work in mycology, modern techniques and the experimental approach are stressed in areas such as physiology, developmental morphology, genetic systems, or cytotaxonomy.

For work in plant pathology for minor thesis or problems, or for students wishing to develop familiarity with modern techniques in some phase of the science.

541. PHILOSOPHY OF PLANT PATHOLOGY

Fall term. Credit two hours. Designed for Ph.D. students majoring in plant pathology. Prerequisites, Courses 501, 529, and at least two other courses from 502, 505, 506, 507, and 508, or permission to register. Conferences M W 8–10. Plant Science 422. Professor Kent.

A conference with advanced graduate students examining the concepts of plant pathology as they relate to the approach to basic and applied research problems, teaching, and extension.

549. ADVANCED MYCOLOGY

Fall term. Credit five hours. Offered in alternate years. Prerequisites, Course 309 or its equivalent, a course in genetics, and permission of the professor to register. Lecture, M W 9. Plant Science 336. Laboratory, M W F 1:40–4:30. Plant Science 326. Professor Korf.

Part of a two-course sequence (549 and 559) designed especially for students specializing in mycology or plant pathology. Reading knowledge of scientific French and German is strongly recommended. Emphasis is placed on taxonomy and the mechanisms of variation in fungi, but other aspects of mycology are embraced. Practice in identification of specimens is stressed in various groups, as is critical evaluation of keys and monographs. Field work is required. Basidiomycetes and Phycomycetes are covered in detail.

559. ADVANCED MYCOLOGY

Spring term. Credit five hours. Offered in alternate years. Prerequisites, Course 549 or its equivalent and permission of the professor to register. Lecture, M W 9. Plant Science 336. Laboratory, M W F 1:40–4:30. Plant Science 326. Professor Korf.

Part of a two-course sequence (549 and 559) described above. Fungi Imperfecti and Ascomycetes are covered in detail.

645–654. CURRENT TOPICS

Fall and spring terms. Credit to be arranged. For graduate students with special interests in the particular area. Prerequisite, permission to register. Time to be arranged. Plant Science 422.

Weekly discussions of current topics in special areas of plant pathology and mycology. Students will be required to do extensive reading of current literature and to present oral and written reports.

645. PLANT VIROLOGY

Professors Ross and Rochow.

646. PLANT NEMATOLOGY

Professor Mai and Associate Professor Harrison.

647. BACTERIAL PLANT PATHOGENS

Associate Professor Dickey.

648. PHYSIOLOGY OF PLANT DISEASES

Associate Professor Bateman and Associate Professor Millar.

649. MYCOLOGY

Professor Korf.

650. DISEASES OF VEGETABLE CROPS

Professor Sherf, Associate Professor Wilkinson, and Assistant Professor Lorbeer.

653. PATHOLOGY OF TREES AND SHRUBS

Assistant Professor Sinclair.

654. DISEASES OF FLORIST CROPS

Professor Dimock.

661. SEMINAR

Fall and spring terms. Credit one hour. Required of all graduate students taking work in the department. T 4:30–5:30. Plant Science Seminar Room. Professor Peterson.

671. PLANT PATHOLOGY COLLOQUIUM

Fall and spring terms. Credit one hour. First and third Thursdays 7:45–9:45 P.M. Plant Science Seminar Room. Staff and graduate students.

VIROLOGY. (Biological Sciences 498)

Pomology

Faculty: G. D. Blanpied, L. L. Creasy, L. J. Edgerton, M. B. Hoffman, G. H. Oberly, L. E. Powell, Jr., R. M. Smock, J. P. Tomkins. At Geneva: K. D. Brase, J. C. Cain, O. F. Curtis, Jr., F. G. Dennis, Jr., J. Einset, C. G. Forshey, R. C. Lamb, D. K. Ourecky, N. J. Shaulis, G. L. Slate, R. D. Way.

Visiting Professor: E. Hansen, Oregon State University, Corvallis, Oregon.

Faculty Representative: L. J. Edgerton, 120 Plant Science Building.

APPROVED MINOR SUBJECTS. Students generally are not permitted to minor in either vegetable crops or floriculture, but most other Fields bearing some relationship to pomology are allowed such as: plant physiology, biochemistry, organic chemistry, statistics, soil science, plant anatomy, plant breeding, plant pathology, entomology, and agricultural economics.

GENERAL REQUIREMENTS. To enter upon graduate work in Pomology it is not necessary for the student to have done his undergraduate work in horticulture. It is important, however, that the student have a good background in the basic sciences, and an interest in fruit plants. A knowledge of botanical and chemical subjects is particularly helpful. It is expected that a student will become well acquainted with the Field of Pomology during the course of his graduate work, and with other Fields closely allied to his thesis problem.

There is no foreign language requirement for the M.S. A Ph.D. candidate must show a reading proficiency in one language other than his native tongue before he takes his examination for admission to Ph.D. candidacy. The choice of this language must be approved by the chairman of the student's Special Committee.

Candidates for the M.S. degree are required to pass a Final Examination. Students who are registered in a Ph.D. program must take a Qualifying Examination in addition to the examinations required by the Graduate School.

Cornell University has two pomology departments under its jurisdiction — one on the main Ithaca campus, and one on its Geneva campus 50 miles away, at the New York State Agricultural Experiment Station. Members of these Departments are currently engaged in a great variety of research projects concerning growth regulating substances, post harvest physiology, mineral nutrition, cold hardiness, rest period, root initiation, rootstocks, fruit set and development, fruit breeding, plant pigments, and general cultural practices. Students satisfy their course work requirements at Ithaca, but depending on their thesis problem, may conduct their research at either the Ithaca or Geneva campus. Ordinarily one to two years are required to meet the requirements of a Master's degree, and three to four years for the Ph.D., although individual students may progress faster or slower than the time periods listed.

COURSES

401. ADVANCED POMOLOGY

Fall term. Credit three hours. Offered in alternate years. Prerequisites, Courses 101 and 102 and Botany 235. Lectures M W F 8. Plant Science 114. Professor Hoffman.

A comprehensive study of the sources of knowledge and opinions as to practices in pomology. The results of experiences and research pertaining to

pomology are discussed, with special reference to their application in the solution of problems in commercial fruit growing.

501. SPECIAL TOPICS IN EXPERIMENTAL POMOLOGY

Spring term. Credit three hours. Offered in alternate years. Hours to be arranged. Professors Edgerton and Smock and Associate Professors Oberly and Powell.

The student is expected to review critically and to evaluate the more important original papers relating to various phases of pomological research. Recent experimental methods applicable to the topic are fully considered.

502. RESEARCH

Fall, spring, or both terms. Credit two or more hours a term. Prerequisite, Course 401. Professors Edgerton, Hoffman and Smock; Associate Professors Blanpied, Oberly, Powell, and Tomkins; Associate Professor Creasy.

600. SEMINAR

Fall and spring terms. Without credit. Required of students taking Course 502 and graduate students in pomology. T 11. Plant Science Seminar Room. Members of the departmental staff.

Poultry Science

Faculty: Robert C. Baker, Andre Bensadoun, J. Herbert Bruckner, Randall K. Cole, Malden C. Nesheim, Milton L. Scott, Ari van Tienhoven, Robert J. Young.

Field Representative: J. H. Bruckner, 215 Rice Hall.

APPROPRIATE MAJOR AND MINOR SUBJECTS

MAJOR SUBJECT	MINOR SUBJECT
Poultry Science (M.S. only)	Poultry Science (M.S. or Ph.D.)

(a) ADMISSION REQUIREMENTS. Candidate for admission to this Field must meet the general requirements for admission to the Graduate School. In addition, they should be well prepared in the basic sciences. It is desirable, but not essential, that the student should have had some training and experience in poultry husbandry.

(b) LANGUAGE REQUIREMENTS. There is no language requirement for the Master's degree in this Field. Students who expect to become candidates for the doctorate should study one or more foreign languages, preferably German, Russian, or French.

(c) RESEARCH AND STUDY OPPORTUNITIES. Students expecting to continue their graduate program beyond the Master's degree in this area should consider selecting a major in Animal Nutrition, Animal Breeding, Animal Physiology, or Food Science where they will work under the direction of faculty members in the Department of Poultry Science. Further information regarding these Fields will be found elsewhere in this Announcement.

The department has excellent research facilities in the above disciplines and strong research programs are maintained in each. The faculty and their primary interests are as follows: Animal Breeding, J. H. Bruckner, R. K. Cole. Animal Nutrition, M. C. Nesheim, M. L. Scott, R. J. Young. Animal Physiology, A. Bensadoun, A. van Tienhoven. Food Science, R. C. Baker.

(d) COURSES

POULTRY SCIENCE 420. POULTRY GENETICS

Spring term. Credit three hours. Offered in alternate years. Prerequisite, permission of instructor. Lectures, M W F 9. Rice 201. Professor Cole.

A survey of inherited characters in domestic birds, cytology, linkage, inbreeding, hybrid vigor, resistance to disease, genetic principles in poultry breeding, physiology of avian reproduction, infertility, embryonic mortality and avian endocrinology.

POULTRY SCIENCE 425. COMPARATIVE PHYSIOLOGY OF REPRODUCTION OF VERTEBRATES

Spring term. Credit three hours. Prerequisites, Animal Science 427 and consent of the instructor. Lectures, M W 10. Laboratory to be arranged. Rice 300. Associate Professor van Tienhoven.

Sex and its manifestations, endocrinology of reproduction, interactions between endocrine and nervous systems. The laboratory will provide an opportunity for students to design and execute experiments, with limited objectives, independently.

POULTY SCIENCE 440. ANATOMY OF THE FOWL

Fall term. Credit three hours. Offered in alternate years. Prerequisites, Biological Sciences 102 or 104 and permission of the instructor. Lectures, T Th 8. Rice 201. Laboratory, F 2–4:15. Rice 101. Professor Cole.

The lectures, supplemented by laboratory periods for study and dissection, are designed to acquaint the student with the anatomy of the fowl.

POULTRY SCIENCE 450. POULTRY MEAT AND EGG TECHNOLOGY

Spring term. Credit three hours. Offered in alternate years. Prerequisites, Chemistry 303, or its equivalent, and Biological Sciences 290. Lectures, T Th 9. Laboratory, M 2–4. Rice 101. Professor Baker.

A discussion and study of some of the important microbial and nonmicrobial changes in poultry meat and eggs as well as the chemical composition and preservation of these products. Development of new products is also emphasized.

POULTRY SCIENCE 511. RESEARCH IN NUTRITION

Fall or spring term. Credit and hours to be arranged. For graduate students only. Registration by permission of staff member concerned. Professors R. J. Young and M. L. Scott. Associate Professor Nesheim.

For students desiring experience in planning, conducting, and reporting independent research projects in poultry nutrition.

POULTRY SCIENCE 609. SEMINAR IN POULTRY BIOLOGY

Fall and spring terms. For graduate students. Th 4:15. Rice 300. Members of the departmental staff.

A survey of recent literature and research in poultry biology.

POULTRY SCIENCE 619. SEMINAR ON ANIMAL NUTRITION

Fall term. Credit one hour. Open to graduate students with major Field of study in animal nutrition. Registration by permission. T 4:30. Morrison 348. Animal Nutrition staff.

A critical review of the literature and other topics of special interest to graduate students in animal nutrition.

Psychology

Faculty: Moshe Anisfeld, Leonard Berkowitz, Harley A. Bernbach, Urie Bronfenbrenner, Richard B. Darlington, William C. Dilger, Charlotte L. Doyle, Eleanor J. Gibson, James J. Gibson, Bruce P. Halpern, William W. Lambert, Harry Levin, Robert B. MacLeod, Leo Meltzer, Bernard C. Rosen, Thomas A. Ryan, Fred Stollnitz, Robert R. Zimmermann.

Field Representative: T. A. Ryan, Morrill Hall.

APPROPRIATE MAJOR AND MINOR SUBJECTS

Appropriate Major Subjects:

Comparative Psychology
Differential Psychology and Psychological Tests
Experimental Psychology
Experimental Psychopathology
History of Psychology and Systematic Psychology
Industrial Psychology
Mathematical Psychology
Personality and Social Psychology
Physiological Psychology
Psycholinguistics

Appropriate Minor Subjects (in addition to the above list the following are available only as minor subjects):

General Psychology
Clinical Psychology

Applicants for admission in psychology are required to submit scores for the Graduate Record Examination (Advanced Test in Psychology and Aptitude Test) and for the Miller Analogies Test. An undergraduate major in psychology is desirable, but not required. Records of applicants are judged in terms of performance in mathematics and natural sciences as well as in psychology.

LANGUAGE REQUIREMENT FOR THE MASTER'S DEGREE. Proficiency in French, German, or Russian before the final examination. A reading knowledge of two languages is required for the Ph.D.

EXAMINATION REQUIREMENTS. A final examination for the Master's degree combines a defense of the thesis with a general examination on the major and minor subjects.

During the first year of graduate work, each student is required to take a series of written examinations designed to test the student's undergraduate preparation in the major Fields of Psychology. A Qualifying Examination on the major and minor subjects, both written and oral, is administered at the end of the first year of graduate work.

The Examination for Admission to Candidacy is normally taken during the third year of graduate work.

All oral examinations are administered by the Special Committee with the addition of a member appointed by the Field Representative.

RESEARCH TRAINING AND FACILITIES

RESEARCH FACILITIES. The headquarters of the Department of Psychology are located in the top two floors of Morrill Hall which contains offices, classrooms, and over 30 research rooms of various sizes and purposes. A small animal laboratory is located in Morrill Hall.

Additional laboratories for graduate and faculty research are housed at the University's Industrial Research Park. Most experimental research using

human subjects is carried on in this facility. A large newly-equipped shop is located here.

Research facilities in White Hall provide special rooms for research in problems of perception and cognition and well-equipped one-way observation rooms for social psychology experiments. Through the cooperation of local industrial plants, opportunities are available outside the laboratory for research experience in industrial psychology. Similar cooperation at the local schools permits field research in the area of developmental psychology.

The former Cornell Behavior Farm has been renamed the "Howard S. Liddell Laboratory of Comparative and Physiological Psychology." Modernization and expansion of this research facility for the study of the behavior of laboratory animals was completed recently. Approximately 6000 square feet of space is available for animal maintenance and research. The facility includes a shop, darkroom, surgery, histology, and equipment for the maintenance of infant and adult monkeys, and most other small laboratory animals. In addition the location of the laboratory permits housing and research with animals that usually could not be accommodated in traditional centralized facilities.

Approximately 15 to 20 infant monkeys are born at the laboratory each year and are available for all research projects that do not directly conflict with committed research proposals. Substantial colonies of rats and pigeons will also be maintained for research purposes.

AREAS OF SPECIALIZATION

Comparative Psychology (W. Dilger, F. Stollnitz and R. R. Zimmermann)

This Field includes the study of basic animal behavior and of general principles derived from animal behavior. There are several research facilities at Cornell, both within and outside the Department, where students may pursue work on different species. Students selecting this area as a major subject must develop skills in related areas of Biology and have a firm understanding of evolutionary theory. Developmental and/or physiological psychology are strongly recommended as minor subjects. Staff research interests include: comparative animal memory, genetic and environmental determinants of non-learned behavior, development of learning and perception in monkeys, effects of malnutrition on growth and development, and the responsiveness of organisms to stimuli of apparent ecological importance to a number of species.

Differential Psychology and Psychological Tests (R. Darlington)

Training within the Field of Psychology emphasizes psychometric theory — test theory, scaling, and factor analysis — and its applications both in psychological research and in practical settings. Excellent relations are maintained with the Fields of Education and of Child Development, where training in the use of specific tests is offered.

Experimental Psychology (M. Anisfeld, H. A. Bernbach, C. L. Doyle, E. J. Gibson, J. J. Gibson, B. P. Halpern, H. Levin, R. B. MacLeod, T. A. Ryan, F. Stollnitz, and R. R. Zimmermann)

The study of basic processes — sensitivity, perception, action, thinking, emotion and motivation. Both experimental methods and the facts and theories derived from experimental observation are stressed. An individual student will usually develop a special interest in one of these basic processes although he should be familiar with the whole Field. Some of the problems now undergoing intensive investigation are connected with the nature of discrimination,

the selection of sensory information, the perceiving of the environment, perceptual learning and development, the transmission of (visual) information, the control of skilled action, the development of concepts, the functions of social stimuli, the relation of motives to perceived values, the essential meaning of experiments on conditioning, association, and retention, and the ability to respond to symbols.

Experimental Psychopathology

This program is designed to familiarize the student with pertinent research areas in abnormal and clinical psychology and prepare him to undertake research in these areas. Courses are available in Main Concepts of Abnormal Psychology, Experimental Psychopathology, Procedures in Clinical Psychology, and Theories of Personality. Seminars on related topics are also presented annually. Special emphasis in this course of study is given to the experimental analysis of anxiety, stress, emotion, and physiological functioning in both humans and animals. The more traditional methods for evaluation and assessment of abnormal processes are also studied. A student majoring in experimental psychopathology is encouraged to pursue related work in areas such as physiological psychology, experimental psychology, personality, and measurement and tests. Opportunities also exist for the student to study related topics in the Departments of Child Development and Family Relations, and Education.

History and Systems of Psychology (R. B. MacLeod)

This is listed as both a major and a minor subject, but it is usually elected as a minor. All candidates for the doctorate, irrespective of their Fields of concentration, are expected to have a good orientation in the history of psychology as represented by a careful reading of, for example, Boring's *History of Experimental Psychology*, and an understanding of contemporary theoretical systems — Behaviorist, Gestaltist, Freudian, etc. Specialists in history and systems are expected to develop sufficient competence to enable them to teach courses in these areas. Minors are expected to do a substantial piece of research which is worthy of publication, and are required to present a critical essay on some historical or theoretical problem.

Industrial Psychology (T. A. Ryan)

This area covers the investigation of the nature of work, the development and evaluation of methods of selecting and placing personnel, the study of efficiency of performance in the psychological sense, psychological scaling and rating, methods of training personnel, correlates of satisfaction, and problems in the design of equipment and methods of work. The emphasis is upon techniques and theory, in preparation for research or consulting work and not upon the training of personnel administrators. Students majoring in industrial psychology are usually urged to study experimental psychology as a minor subject because of the close relationship of both method and subject matter. A thorough groundwork in statistics is also required.

Mathematical Psychology (H. A. Bernbach)

The major program in mathematical psychology is intended for students with a central interest in the application of mathematics to psychology, primarily in the area of mathematical behavior theory. Such applications take the form of mathematical models of behavior that draw on the full range of modern mathematics, and are appropriate to many content areas within psychology. Students are expected to develop competence in mathematical psychology and in a specific psychological content area. Thus, students will

generally take a minor in mathematics, and perform an empirical dissertation rather than a purely methodological one.

The minor program in mathematical psychology is intended to give students the mathematical tools necessary to support their major area of interest. Courses in mathematics will generally be recommended in addition to departmental courses in mathematical behavior theory and methodology.

Personality and Social Psychology (L. Berkowitz, U. Bronfenbrenner, W. W. Lambert, H. Levin, and L. Meltzer)

Students may devote varying emphases to personality and to social psychology according to their interests, even concentrating exclusively upon one or the other aspect if they wish. Staff research interests in Personality include: aggressive behavior, anxiety and defenses, experimental psychodynamics, personality assessment, and emotional communication. Social Psychology is taught jointly by members of the graduate Fields of Psychology and Sociology. Majors who are admitted via Psychology often choose one of their minors within Sociology. Other relevant minors include Anthropology, Child Development, Organizational Behavior, or Statistics. Some current research interests of the faculty in Social Psychology include: character development in the Soviet Union, interaction of group and individual variables, new approaches to observation methodology, social exchange theory, attitude change, attitude measurement, psycholinguistics, and cross-cultural studies of socialization. A brochure describing this area may be obtained upon request to Dr. Leo Meltzer, McGraw Hall, Cornell University.

Physiological Psychology (B. P. Halpern and F. Stollnitz)

To study this area, the student must be prepared to develop his skill in a variety of biological techniques as well as to become firmly grounded in the experimental analysis of behavior. Students are advised to have one of their minor subjects in physiology, bio-chemistry, neurology, or physics. Research interests include brain behavior relationships and sensory psychophysiology.

Psycholinguistics (M. Anisfeld, H. Levin, and R. B. MacLeod)

This area combines aspects of psychology and linguistics in the study of the nature of the psychological representation of language, the processes involved in language acquisition, and its use in cognition and communication. Some of the interests currently pursued in the Department are: the effects of linguistic structure on linguistic and non-linguistic behavior, the generality of language processing mechanisms in other mental operations, the nature of the switching mechanisms in dialect and language choice, and the genesis of language processing devices investigated by means of developmental and comparative methods.

Students majoring in psycholinguistics are expected to select general linguistics as a minor. Public Health traineeships in psycholinguistics are available.

Clinical Psychology

This area may be elected only as a minor subject and only when the major is in some other area of Psychology. Courses in procedures in clinical psychology are available as well as courses in abnormal and experimental psychopathology. As there are no practicum facilities available in Ithaca the aim of this area is to acquaint the student with the area and make him aware of significant research problems rather than to train him to undertake clinical practice.

COURSES

313. COGNITIVE PROCESSES

Fall term. Credit four hours. Prerequisites, six hours of psychology and upperclass standing or honors standing (in any department), or consent of instructor. M W F 12. Mr. Anisfeld.

An examination of the mental processes involved in language learning and use, concept formation, problem solving, and the relation between language and thinking. Students are required to carry out a supervised experimental or observational study.

Only regular registrants admitted, no auditors.

323. PHYSIOLOGICAL PSYCHOLOGY

Fall term. Credit four hours. Prerequisites, laboratory course in psychology, one year of biology or zoology or physiology, and one term of statistics; one of the prerequisites may be taken concurrently. M W 3–4 and four laboratory hours to be arranged.

A survey of research on the physiological bases of behavior.

324. PSYCHOBIOLOGY

Spring term. Credit four hours. Prerequisites, a grade of at least B in Psychology 323 and consent of instructor. Two hours of group work and six hours per week of individual laboratory work to be arranged.

The laboratory work will permit the student to master techniques, repeat important experiments, or conduct original work in physiological psychology.

326. COMPARATIVE PSYCHOLOGY

Fall term. Credit four hours. Prerequisites, upperclass standing or consent of instructor. A laboratory course in the behavioral or biological sciences is desirable but not necessary. Lectures, T Th 11–1. Laboratory hours to be arranged. Mr. Zimmermann.

An attempt to uncover the evolutionary and ecological processes at work molding the behavior of animals. Principles will be advanced and used to design representative types of behavior in hypothetical animals. Detailed consideration will then be given to the analysis of the behavior of existing insects, birds, and mammals. Psychological and ethological theories of animal behavior will be discussed, especially the views of these theories toward the evolution of behavior.

332. INDUSTRIAL PSYCHOLOGY: PROBLEMS OF PEOPLE AT WORK

Spring term. Credit four hours. Prerequisites Psychology 101, 206, or consent of instructor. M W F 12 and laboratory hours to be arranged.

A survey of the external and internal factors which affect the efficiency, speed, and accuracy of human work, and the feelings which accompany it. Consideration will be given to sedentary or "mental" work in relation to fatigue, monotony, rest, sleep, and the effects of noise, light, temperature, incentives, and social factors. The effects of the task itself, as in "automated" work, will be considered. The class will obtain experience in such techniques as job evaluation and merit rating, and evaluation of fatigue and effort. Analysis of data and presentation of experimental reports.

333. INDUSTRIAL PSYCHOLOGY: SELECTION AND PLACEMENT

Fall term. Credit four hours. Prerequisite, 332 or consent of instructor. M W F 11 and laboratory hours to be arranged.

Principles of constructing and evaluating selection and placement measures, including development of criteria of performance, analysis of reliability, methods of item-analysis, validation of tests, interviews, and personal history data. Analysis of data and presentation of written reports. Class members will construct and evaluate a specific predictor or criterion measure during the term, and will receive practice in interviewing and administration of aptitude tests.

345. THEORIES OF PERSONALITY

Fall term. Credit four hours. Prerequisite, Psychology 101 or consent of instructor. M W F 12. Mr. Lambert.

A critical survey of the concept of personality in literature, the social sciences, and psychology. A number of the modern specialists will be discussed at some length, and recent empirical and experimental work that has grown out of their thought will be analyzed. The empirical relation of personality notions to some philosophical beliefs and literary production will be considered. The emphasis will be mainly upon "normal" personality.

SOCIAL PSYCHOLOGY (Sociology 381)

Fall term. Credit four hours. Prerequisites, 3 hours of psychology and 3 hours of sociology.

Analysis of the history, concepts, methods, and theories used to describe and conceptualize the ways in which people react to one another. Students will work in teams on projects utilizing experimental or other empirical methods. The topics for investigation in student projects and in lectures will include such processes as attitude change, communication, interpersonal influence, conformity, leadership, and interpersonal affect.

GROUP DYNAMICS (Sociology 384)

Spring term. Credit four hours. Prerequisites, written permission of the instructor. 3 hours of psychology and 3 hours of sociology. M W F 2, and M 3 or W 3.

401. PSYCHOLOGICAL TESTING I

Fall term. Credit four hours. Prerequisites, 6 hours in psychology, including 201 or a course in elementary statistics. T Th S 11. Mr. Darlington.

Emphasis is on the logical and mathematical problems in the interpretation, evaluation, and construction of tests. A brief introduction to the major personality tests will be included. No training in administering tests.

402. PSYCHOLOGICAL TESTING II

Spring term. Credit four hours. Prerequisite, Psychology 401 or consent of instructor. T Th S 11. Mr. Darlington.

A more advanced treatment of the topics discussed in Psychology 401.

410. INDIVIDUAL DIFFERENCES AND PERSONALITY

Spring term. Credit four hours. Prerequisites, nine hours of psychology, upperclass standing, or consent of instructor. T Th 8:30–10.

Survey of current theory and research in the field of individual differences and personality. A number of lines of investigation will be studied in detail with some emphasis on technique.

412. RESEARCH DESIGN IN PERSONALITY AND SOCIAL PSYCHOLOGY

Spring term. Credit four hours. Open to junior or senior psychology majors, or consent of instructor. M W F 11. Mr. Darlington.

Considers the major problems and techniques in designing research on human behavior. Considers both laboratory and non-laboratory research.

416. PSYCHOLOGY OF LANGUAGE

Spring term. Credit four hours. Prerequisite, Psychology 313 or consent of instructor. M W 3:00–4:30. Mr. Anisfeld.

An advanced treatment of the nature of the human capacity for language, the reading process, social and psychological aspects of bilingualism, speech perception and production. Instruction will be supplemented by experimental exercises.

426. EXPERIMENTAL PSYCHOPATHOLOGY

Spring term. Credit four hours. Prerequisite, Psychology 325 or consent of instructor. M W 10 plus two-hour laboratory to be arranged.

The application of experimental methods to behavior disorders. A survey of current investigations of etiology and treatment with special emphasis upon a scientific approach to pathology.

COMPARATIVE VERTEBRATE ETHOLOGY (Biological Sciences 421)

Fall term. Credit three hours. Prerequisites, Biological Sciences 101–102, or 103–104 and permission of instructor. T Th 9 and laboratory to be arranged. Primarily for graduate students; upperclassmen will be accepted to capacity of laboratory. Mr. Dilger.

447. LABORATORY STUDY OF INTERPERSONAL INTERACTIONS

Spring term. Credit four hours. Prerequisites, Psychology 342 or 381, or graduate student status, or permission of instructor. T 1:40–4:30 and one additional hour.

Topics in the study of interpersonal behavior are reviewed. Selected problems within these topic areas are empirically researched. Analyses include laboratory and field researches carried out by the students.

452. INDIVIDUAL AND SOCIETY IN THE SOVIET UNION

Spring term. Credit four hours. Prerequisite, consent of instructor. Will be conducted as a seminar. Hours to be arranged. Mr. Bronfenbrenner.

461. HUMAN LEARNING AND MEMORY

Fall term. Credit four hours. Prerequisites, Psychology 101, 201 or 306, upperclass standing. Mr. Bernbach.

462. ADVANCED LEARNING LABORATORY

Spring term. Credit four hours. Prerequisite or corequisite, Psychology 461 or permission of the instructor. For upperclassmen and graduate students. M W F 11.

465. MATHEMATICAL BEHAVIOR THEORY

Spring term. Credit four hours. Prerequisite, one year of calculus. Mr. Bernbach.

The purpose of this course is to give a brief overview of current developments in mathematical psychology and to develop techniques for the applica-

tion of mathematics to psychological theory. Topics covered include choice behavior, decision theory, psychophysics, memory and learning theory, and information processing models of behavior.

466. THEORIES OF VISION

Spring term. Credit four hours. Prerequisite, consent of instructor. T Th S 11.

471–472. STATISTICAL METHODS IN PSYCHOLOGY

Throughout the year. Credit four hours each term. Prerequisites, Psychology 101 or C.D. 115, 201, or consent of the instructor. Psychology 471 is prerequisite to 472. Fall term, M W F 2; Spring term, M W F 2. Mr. Ryan.

An analysis of the methods for treating various kinds of psychological data. Fall term: tests of significance and confidence limits, analysis of variance and correlation. Spring term: complex designs in analysis of variance, analysis of trends and co-variance, multiple and curvilinear correlation, introduction to factor analysis.

476. RESEARCH METHODS IN PSYCHOLOGY—EXPERIMENTAL AND LABORATORY

Fall term. Credit four hours. Prerequisite, consent of instructor. Hours to be arranged.

Instrumentation for the behavioral sciences.

477. RESEARCH METHODS IN PSYCHOLOGY—INDUSTRIAL AND FIELD

Spring term. Credit four hours. Prerequisite, Psychology 333 or consent of instructor. T 3–5 plus laboratory hours to be arranged.

An advanced course in research techniques, focused toward measurement of human behavior in the working situation. Projects in local factories and business institutions and in the laboratory are conducted as exercises in such areas as test construction, analysis of the reliability and validity of tests, studies of the interview process, of morale, learning, methods, and fatigue. Stress will be placed upon both descriptive and evaluative measures, including rating, scaling, and the psychophysical methods, and upon design and sampling for maximal generality of results. Subject matter emphasis to be decided by seminar members.

EXPERIMENTAL GROUP DYNAMICS (Sociology 481)

Fall term. Credit four hours. Prerequisites, a course in statistics and a course in social or experimental psychology. Hours to be arranged.

A practicum. Supervised research experience in the design, execution, and analysis of experimental research on topics such as group cohesiveness, group pressures, group goals, leadership, group performance, and interpersonal influence and communication. Students will read and discuss experimental studies as well as pertinent theoretical articles.

Seminars

Approximately five graduate courses or seminars will be offered each term, the selection to be determined by the needs of the students. During the preregistration period, the list of courses and seminars for the following term will be posted, specifying instructors, topics to be covered, and hours of meeting.

501–502. GENERAL SEMINAR FOR BEGINNING GRADUATE STUDENTS
Either term. Credit three hours.

511–512. PERCEPTION
Either term. Credit four hours.

513–514. LEARNING
Either term. Credit four hours.

515–516. MOTIVATION
Either term. Credit four hours.

517–518. THINKING
Either term. Credit four hours.

521–522. PSYCHOBIOLOGY
Either term. Credit four hours.

523–524. PHYSIOLOGICAL PSYCHOLOGY
Either term. Credit four hours.

531–532. HISTORY OF PSYCHOLOGY
Either term. Credit four hours.

541–542. STATISTICAL METHODS
Either term. Credit four hours.

543–544. PSYCHOLOGICAL TESTS
Either term. Credit four hours.

545–546. METHODS OF SOCIAL ANALYSIS
Either term. Credit four hours.

547–548. METHODS OF CHILD STUDY
Either term. Credit four hours.

561–562. HUMAN DEVELOPMENT AND BEHAVIOR
Either term. Credit four hours.

571–572. PROSEMINAR IN SOCIAL PSYCHOLOGY
Either term. Credit four hours.

PERSPECTIVES IN SOCIAL PSYCHOLOGY
(See Sociology 581.)

573–574. SOCIAL PSYCHOLOGY
Either term. Credit four hours.

THEORY AND RESEARCH IN SOCIAL PSYCHOLOGY
(See Sociology 611.)

SEMINAR IN SOCIAL PSYCHOLOGY
(See Sociology 682.)

575–576. PERSONALITY
Either term. Credit four hours.

581–582. INDUSTRIAL PSYCHOLOGY
Either term. Credit four hours.

591–592. EDUCATIONAL PSYCHOLOGY
Either term. Credit four hours.

595–596. THE TEACHING OF PSYCHOLOGY
Either term. Credit four hours.

Statistics

(See page 210.)

Vegetable Crops

Staff: Elmer E. Ewing, John D. Hartman, Francis M. R. Isenberg, William C. Kelly, Philip A. Minges, Henry M. Munger, Jim L. Ozbun, George J. Raleigh, Roger F. Sandsted, Raymond Sheldrake, Ora Smith, Robert D. Sweet, Leonard D. Topoleski, Donald H. Wallace. At Geneva: Donald W. Barton, Michael H. Dickson, Gerald A. Marx, Nathan H. Peck, Richard W. Robinson, Stanton Shannon, Morrill T. Vittum. At Riverhead: Stewart L. Dallyn, Richard L. Sawyer.

Field Representative: Robert D. Sweet, 114 E. Roberts Hall.

ADMISSION to the Field is based on the quality and nature of the applicant's prior training as well as on letters of recommendation. It is not necessary for the previous training to have been in horticulture. More important is a good background in biological and agricultural sciences together with an interest in economic plants. Farm experience is an advantage.

LANGUAGE. Although there is no specific foreign language requirement by the Field, the Special Committee may recommend or require proficiency in foreign language in individual instances depending on the candidate's objectives, previous training, etc.

EXAMINATIONS. For the Ph.D. degree the Field requires a minimum of two special examinations. In certain cases, however, the Special Committee may require additional examinations. Customarily an Admission to Candidacy Examination is given early in the graduate program, before registering for the third term. It assists the Special Committee in determining the probable success of the student in pursuing his graduate career, and in addition aids in planning his future course of study and thesis investigation. A Final Examination is given on the completion of the thesis and covers both it and the course work.

RESEARCH AND STUDY

Research and Study in the Field of Vegetable Crops involves the application of scientific knowledge and methods to the solution of problems in the production, handling, processing, and marketing of vegetables including potatoes and dry beans. The graduate program provides training not only in research but also in teaching and extension. Many staff members do teaching and/or

extension in addition to research. They may be selected as Special Committee chairmen or members. Assistantships are available for training and experience in research, teaching or extension.

Members of the staff are competent to direct research in many subjects and problems. The following is a partial listing of their interests: Professors Kelly, Minges, and Sandsted, vegetable crop physiology and production; Professors Barton, Dickson, Marx, Munger, Robinson, and Wallace, breeding genetics, and variety performance; Professor Sweet, chemical weed control; Professor Isenberg, postharvest physiology, biological aspects of handling and marketing vegetables; Professor Hartman, biological and food technological aspects of marketing, objective and subjective measurement of color, flavor, and texture; Professor Sheldrake, plant growing structures and methods; Professor Smith, potatoes: physiology of production and storage, factors affecting and methods of measuring cooking and processing quality; Professor Topoleski, youth extension work; Professor Vittum, climatology and soil-plant-water relationships; Professor Peck, mineral nutrition, fertilization, and cultural practices; Professors Ozbun and Shannon, biochemistry, nutrition, and physiology; Professor Raleigh, mineral nutrition, muck studies, breeding; Professors Dallyn and Sawyer, potatoes: blackspot, storage, sprout inhibitors, cooking quality; other vegetables: cultural methods, fertilization, irrigation, chemical weed control; Professor Ewing, potatoes: seed value, sprouting abnormalities, irrigation, physiology of disease resistance.

COURSES

Specific course requirements are determined on an individual basis by the Special Committee. The courses listed below are usually taken by Ph.D. degree candidates. For those with little specialized course work in vegetable crops, additional courses at the 100–200 level are suggested. (See the *Announcement of the College of Agriculture* for details.)

401. VEGETABLE CROP PHYSIOLOGY

Fall term. Credit four hours. Prerequisites, Course 211 and Biological Sciences 240 or their equivalent. Lecture, M W F 11. East Roberts 222. Laboratory, M 2–4:30. Professor Kelly.

The physiological bases of cultural practice and the application of these principles to problems in vegetable production. Original literature is used to illustrate the principles involved. Experimental material is studied in the laboratory to amplify lecture topics. Subjects discussed include: mineral nutrition as influenced by fertilization programs and crop sequence; nutrient interactions and induced deficiencies; growth and development; flowering; fruit setting; growth correlation; senescence; sex expression; photoperiodism; vernalization; and environmental factors affecting growth.

412. HANDLING AND MARKETING VEGETABLES, ADVANCED COURSE

Fall term. Credit four hours. Lectures, T Th 11. East Roberts 222. Laboratory, T or W 2–4:30. East Roberts 223. One-hour conference to be arranged. Professor Hartman.

(Students registered for the Tuesday laboratory are scheduled to go on a field trip at 9:30 a.m., Wednesday, the day on which classes officially begin at noon in the fall term.)

This course has the same lecture, laboratories, and field trips as Course 212. Much more outside reading of research and trade publications in the area covered by the course is required in Course 412 than in Course 212, and different examinations are given for the two courses.

413. KINDS AND VARIETIES OF VEGETABLES

Fall term. Credit three hours. Given in even-numbered years. Prerequisite, Course 103 or 211 or permission to register. Lecture and laboratory, Th F 2–4:30. Laboratory work preceding the beginning of regular instruction is required September 19–20. Report at East Ithaca Gardens at 8:00 a.m., Monday, September 19. If possible, please notify the instructor of intention to take this course early in September. Professor Minges.

Designed to help students achieve proficiency in the evaluation of vegetable varieties through study of their origin, characteristics, adaptation, and usage. An important part of the course is the study of crops in the field. The vegetable seed industry is also discussed.

[429. SPECIAL TOPICS IN PLANT SCIENCE EXTENSION]

Spring term. Credit one hour. (Additional credit by special arrangement.) Offered in alternate years. Lecture, F 8. Discussion period, F 2–4. East Roberts 223. Professors Minges and A. A. Johnson. Not offered in 1966–67.

Designed for graduate students and advanced undergraduates in the several plant science fields who wish to acquire a knowledge of extension activities in preparation for careers in extension and associated work, such as research and technical work in both public and commercial organizations. Topics are related to extension in other countries as well as in the United States. Staff members from other plant science departments collaborate in teaching the course.

501. RESEARCH METHODS IN VEGETABLE CROPS

Spring term. Credit three hours. Given in alternate years. Prerequisite, Course 401. It is recommended that Plant Breeding 510 and 511 precede or accompany this course. Lectures, M W F 9. East Roberts 223. Professor Kelly.

A study of research techniques peculiar to vegetable crops.

601. SEMINAR

Fall and spring terms. Required of graduate students taking either a major or minor in this department. Undergraduates are welcome. Th 4:30. East Roberts 222. Members of departmental staff.

Veterinary Medicine

Faculty: Marion Anders, Arthur L. Aronson, James A. Baker, John Bentinck-Smith, Emmett N. Bergman, Clyde I. Boyer, Jr., Dorsey W. Bruner, Bruce W. Calnek, Leland E. Carmichael, Mrs. Alison P. Casarett, Cyril L. Comar, Peter H. Craig, A. Gordon Danks, Donald D. Delahanty, Alexander deLahunta, Alan Dobson, Howard E. Evans, Julius Fabricant, Francis H. Fox, Edgar L. Gasteiger, Jay R. Georgi, James H. Gillespie, Robert E. Habel, Robert F. Kahrs, Robert M. Kenney, Robert W. Kirk, Lennart P. Krook, Kyu M. Lee, Frederick W. Lengemann, Ellis P. Leonard, Philip P. Levine, Kenneth McEntee, Louis L. Nangeroni, Neil L. Norcross, Harvey J. Olander, Malcolm C. Peckham, George C. Poppensiek, Charles G. Rickard, Stephen J. Roberts, O. Wolfgang Sack, Alvin F. Sellers, Ben E. Sheffy, Charles E. Stevens, Daniel N. Tapper, John C. Thompson, Jr., Robert H. Wasserman, John H. Whitlock, Alex Winter, John F. Wootton.

Field Representative: J. H. Gillespie, C320 Veterinary College.

APPROVED MAJOR AND MINOR SUBJECTS

Animal Physiology
Immunochemistry
Parasitology
Pathogenic Bacteriology
Physical Biology (including Radiation Biology)
Veterinary Anatomy
Veterinary Medicine
Veterinary Obstetrics and Diseases of the Reproductive Organs
Veterinary Pathology
Veterinary Pharmacology
Veterinary Surgery
Veterinary Virology

Applicants for graduate study from countries other than the United States and Canada are requested to include in their credentials the results of the Graduate Record Examination (Aptitude) Test except in cases where his examination is not given in reasonable proximity to the student's home. When the Graduate Record Examination is not available, the student is requested to submit, instead, the results of the College Entrance Board Examination (Scholastic Aptitude Tests).

For the Master's degree a reading knowledge of an appropriate language is desirable but not required.

A candidate for the degree of Ph.D. must demonstrate reading ability in at least one language other than English at the minimum level established by the Language Board of the Graduate Faculty. This language requirement must be completed before the Examination for Admission to Candidacy. The student's Special Committee selects the language appropriate to his area of study and can require additional languages or a higher degree of proficiency in language in order to achieve professional competence.

Facilities for graduate study and research in all areas of basic and applied veterinary medicine offer many unique opportunities. In addition to the excellent University libraries, the College has a specialized collection of over 33,000 volumes and 570 current periodicals. A large and varied clinic representing all domesticated animals is available as a source of material. In addition to the animal quarters, pastures, and laboratories on the main campus, the College operates several farms and research facilities within close proximity. These include the virus disease laboratories, poultry disease facilities, sheep and cattle disease farms, and the radiation biology laboratory.

Graduate students may work for the M.S., Ph.D., or D.Sc. in V.M. (Doctor of Science in Veterinary Medicine). The latter degree is characterized by a professional rather than a research objective. (See the *Announcement of the Veterinary College* for a full description of the requirements.) A student who holds the D.V.M. degree from a recognized college in the U.S. or Canada may transfer one year's residence credit for that work toward the Ph.D. degree. In the clinical areas only candidates with the D.V.M. degree are accepted for graduate work.

COURSES

Anatomy

Professors de Lahunta, Evans, Habel, Sack.

Facilities are provided for graduate study in all branches of the science of anatomy as they pertain to domestic and laboratory animals and wild vertebrates. Study and research are encouraged in other fields of veterinary science and animal biology which employ morphological techniques in the determination of experimental results. Graduate students have the opportunity to gain valuable experience and stimulation by taking part in teaching activities.

The basic requirements for a major in veterinary anatomy include: (1) satisfactory completion of the professional courses in gross, microscopic, developmental, and neuroanatomy of the domestic animals, or equivalent formal instruction; (2) participation in the departmental seminars; (3) advanced course work selected from the offerings of the University to suit the special objectives of the student; (4) a thesis which gives evidence of a thorough review of the literature and a competent treatment of the research problem.

505. NEUROANATOMY

First year, spring term. Credit two hours. Lecture, Th 10. Laboratory, F 10–12:30. Professor de Lahunta, Assistant Gray.

A morphological and functional study of the central nervous system of the domestic animals.

507. DEVELOPMENTAL ANATOMY AND HISTOLOGY

First year, fall term. Credit four hours. Lectures, T Th 9. Laboratory, W F 2–4:30. Associate Professor Aitken; Assistant Professor de Lahunta; Assistant Gray. Prerequisites, course work equivalent to that required for admission to the Veterinary College, plus completion of or concurrent registration in Veterinary Anatomy 501 or 900, or Zoology 321. A limited number of non-veterinary students will be admitted by permission of the instructor.

Students are provided with serial sections of the chick and pig for laboratory use. The biology of the cells and tissues is illustrated with material taken from the domestic animals.

508. MICROSCOPIC ANATOMY

First year, spring term. Credit four hours. Lectures, M W 9. Laboratory, M W 10–12:30. Associate Professor Aitken; Assistant Gray. Prerequisites, Veterinary Anatomy 507 plus completion of or concurrent registration in Veterinary Anatomy 502 or 900 or Zoology 322. A limited number of non-veterinary students will be admitted by permission of the instructor.

The microscopic structure of the organs and the morphologic evidence of their function are described and illustrated with preparations from the domestic animals.

ADVANCED ANATOMY

605. Fall term. Hours and credit to be arranged.
606. Spring term. Hours and credit to be arranged.

Professors Habel and Evans; Associate Professor Sack; Assistant Professor de Lahunta. Prerequisites Anatomy 501, 502, 507, and 508 or similar preparation in comparative anatomy and histology.

An opportunity for advanced study under personal direction.

900. VERTEBRATE MORPHOLOGY

Fall term. Credit three hours. Lecture, W 1–2. Laboratory, W F 2–4:30. Professor Evans. Prerequisite, zoology or biology.

Designed primarily for graduate students in animal husbandry, nutrition, conservation, and zoology, although undergraduates may register by permission. Laboratory assignments include the dissection of the dog, cow, and chicken.

Avian Diseases

Professors Calnek, Fabricant, Levine, Peckham.

The facilities for research in Avian Diseases on the campus include offices,

diagnostic and general laboratories and a disease isolation building holding 41 tight pens. A poultry disease research farm located on Snyder Hill, 3 miles from the campus contains a well-equipped laboratory building and many small isolation buildings for work with less contagious diseases. A disease free breeding flock is also maintained for production of chickens and fertile eggs. Field material from the Ithaca and the four regional branch diagnostic laboratories is readily available.

The Veterinary College in cooperation with the Long Island Duck Research Cooperative Incorporated operates a fully equipped diagnostic and research laboratory for duck diseases at Eastport, Long Island. Living quarters at the laboratory are available for graduate students and investigators.

750. DISEASES OF POULTRY

Third year, spring term. Credit 3 hours. T Th 10, F 2–4:30. Professor Levine.

Required of veterinary students. Diseases of domestic poultry and other birds are studied with special emphasis on differential diagnosis and control. Fresh and preserved specimens from the Poultry Diagnostic Clinic are presented during the laboratory period.

CLINICS ANCILLARY

896. Fall term, fourth year.

897. Spring term, fourth year.

A poultry disease diagnostic clinic open five and one-half days per week receives specimens from the surrounding area submitted by poultrymen, veterinarians, and poultry service men. Post mortem examinations and microbiological techniques are employed to arrive at a diagnosis and to render assistance for disease control on the farm.

ADVANCED WORK

Graduate students taking a minor in Avian Diseases may take advanced work with hours and credits to be arranged.

Large Animal Medicine, Obstetrics, and Surgery

Professors Danks, Delahanty, Fox, Kahrs, Kenney, McEntee, Norcross, Roberts, Winter.

Courses are offered covering the general subjects of medicine, obstetrics, radiology, and surgery. The patients in the Ambulatory Clinic, the Large Animal Surgical Clinics, and the Mastitis Control Program supply an abundant source of valuable research material that is studied in cooperation with other departments in the College. This is particularly true in bacteriology, virology, parasitology, pathology, neurology, and metabolic diseases.

The department has strong research programs in mastitis, especially in the field of immunochemistry, and in reproductive disease of cattle. Two experimental herds of cattle are available for research in these areas.

The graduate program is designed to provide training in research methods in preparation for a career in teaching or research.

Advanced Work in Reproductive Pathology and Bacteriology, Medicine, Obstetrics and Surgery

Professors K. McEntee, A. Winter, S. J. Roberts, F. H. Fox, D. D. Delahanty, Associate Professors W. Loomis and R. Kenney and Research Associate H. Dunn.

970. Fall term. Credit one to three hours, by appointment.

971. Spring term. Credit one to three hours, by appointment.

Properly prepared students may undertake special problems or receive special assignments in the field of reproductive pathology, microbiology, medicine, obstetrics, and surgery.

Reproductive Pathology

Professor K. McEntee, Associate Professor R. Kenney.

938. Fall term. Credit two hours. Lecture and laboratory, hours to be arranged. Prerequisite courses, 630, 631, 632 and 633.

This is an advanced course in reproductive pathology of both male and female domestic animals with equal emphasis on gross and microscopic lesions of their genital tracts.

Epidemiological Methods

740. Third Year, fall term. Credit 2 hours, F S 10. Asst. Prof. Kahrs.

A lecture course dealing with health and disease from a herd, flock, community, or population standpoint and emphasizing the use of knowledge about etiology, transmission, and distribution of disease in the development of preventive measures and control programs.

Immunochemistry

944. Spring term. Credit three hours. Lecture and laboratory. Hours to be arranged. Associate Professor Norcross.

Lectures include quantitative aspects of the antibody-antigen reaction, physical and chemical properties of antibodies and antigens, the mechanisms of hypersensitivity, and tissue immunity. Laboratory experiments illustrate the phenomena covered in the lectures and familiarize the student with selected immunochemical techniques. Registration by permission.

The remainder of the courses offered by the Department of Large Animal Medicine, Obstetrics, and Surgery are primarily designed for the veterinary undergraduate student. Since most of these students are in at least their fifth or sixth year of college, the offerings are at a graduate level. Most of these courses require as prerequisites many basic undergraduate courses offered in the Veterinary College; they are not generally open to non-veterinary students in the Graduate School. See the *Announcement of the New York State Veterinary College* or consult the professors offering the courses for more detailed information on the following courses.

570. History of Veterinary Medicine

670. Fundamentals of Roentgenology

671, 770. Obstetrics and Genital Diseases

773, 774, 775. General and Special Surgery and Surgical Exercises

872. Jurisprudence, Ethics, and Business Methods

771, 772, 870, 871. Diseases of Large Animals

Microbiology

Professors Baker, Bruner, Carmichael, Gillespie, Lee, Poppensiek, Sheffy.

The laboratories are well equipped with modern apparatus providing opportunity for advanced work, for those students who are properly prepared, in pathogenic microbiology, immunity, immunochemistry, and virology.

340. PATHOGENIC BACTERIOLOGY

Spring term of odd years. Credit 4 hours. T Th 1:40–5. Professor Gillespie and Associate Professor Winter. Includes microbiology, virology, and immunology.

941. SEROLOGY

Spring term of even years. Credit 2 hours. One hour, 2–4:30 and one hour to be arranged. Professor Bruner. Limited to eight students, with preference given to graduate students. Permission to register must be obtained before the end of the preceding (fall) term. Prerequisites, Courses 340 or 640, and 641. Includes complement fixation, conglutination complement absorption, hemagglutination inhibition, precipitation, neonatal isoerythrolysis, and the antigenic analysis of Salmonella cultures.

ADVANCED WORK IN BACTERIOLOGY, VIROLOGY, OR IMMUNOLOGY

942. Fall term. Credit one to three hours, by arrangement.
943. Spring term. Credit one to three hours, by arrangement. Properly prepared students may undertake special problems or receive special assignments.

944. IMMUNOCHEMISTRY

Spring term. Credit 3 hours. Lecture and lab. Hours to be arranged. Associate Professor Norcross. Registration by permission. Lectures include quantitative aspects of the antibody-antigen reaction, physical and chemical properties of antibodies and antigens, the mechanisms of hypersensitivity, and tissue immunity. Laboratory experiments illustrate the phenomena covered in the lectures and familiarize the student with selected immunochemical techniques.

945. ANIMAL VIROLOGY

Spring term of odd years. Credit 3 hrs. Two lectures and one discussion section. Hours to be arranged. Associate Professor Carmichael and staff. Veterinary courses 340 or 630 and 640 are considered prerequisites, except under special circumstances. Permission to register required. Lectures will include the biology of animal viruses with emphasis on topics of general significance.

946. MICROBIOLOGY SEMINAR

Fall and spring terms. No credit. W 12–1. Associate Professor Winter. Required of all graduate students. Undergraduate students are admitted.

Pathology

Professors Bentinck-Smith, Boyer, Georgi, Krook, Olander, Rickard, Whitlock.

The laboratories are well equipped for advanced work in pathological anatomy, histochemistry, parasitology, tissue culture, and electron microscopy. The department operates diagnostic facilities in which a large number of

specimens for pathological, microbiological, and serological examinations are submitted. Principal emphasis is placed on necropsy and clinical pathology, nutritional pathology, parasite ecology, laboratory animal disease, and cancer research.

230. HEMATOLOGY

Spring term. Credit one hour. W 10–12:30 or 2–4:30. Professor Bentinck-Smith. Morphological studies of blood, cerebrospinal fluid, transudates, exudates, and urine.

630. GENERAL PATHOLOGY LECTURES

Second year, fall term. Credit two hours. M F 9. Professor Rickard. Prerequisites, Anatomy 507 and 508 or equivalent. In addition, it is desirable that the student shall have had at least one year's work in anatomy and physiology. In special cases of students who are majoring in biology and expect to take no further work in pathology, these prerequisites may be waived in part. When this is done, the course will not be accepted as a prerequisite for other courses.

631. GENERAL PATHOLOGY LABORATORY

Second year, fall term. Credit two hours. Section I, M 10–12:30, F 10–12:30. Section II, W 10–12:30, S 9–11:30. Professor Rickard. Course 630 must be taken simultaneously or have been completed previously.

632. SPECIAL PATHOLOGY LECTURES

Second year, spring term. Credit two hours. T Th 9. Associate Professor Olander. Prerequisite, Course 631.

633. SPECIAL PATHOLOGY LABORATORY

Second year, spring term. Credit three hours. Section I, T W F 2–4:30, F 10–12:30. Section II, W F 10–12:30, T 2–4:30. Associate Professor Olander. Course 632 must be taken simultaneously or have been completed previously. Work in hematology is included.

635. ANIMAL PARASITOLOGY

Second year, spring term. Credit two hours. Th 11, 2–4:30. Professor Whitlock. Prerequisites, zoology or biology.

A systematic study of the helminth and arthropod parasites of domestic animals with particular emphasis on the identification and bionomics of the forms of veterinary importance.

Applied Parasitology

731. Third year, fall term. Credit two hours. Lecture M 10, Laboratory, T 2–4:30.

732. Third year, spring term. Credit one hour. Section I, M 2–4:30; Section II, S 10–12:30.

Associate Professor Georgi. Open only to veterinary students. Prerequisite, Course 635.

An organized study of the parasitic diseases of domestic animals with particular emphasis on the features of diagnostic importance. Special attention will be given to the laboratory and post-mortem techniques that are of value in applied parasitology.

930. PATHOLOGY SEMINAR

Fall and spring terms. No credit. Required of all gradaute students in Pathology. Undergraduate students are admitted.

931. PATHOLOGY OF NUTRITIONAL DISEASES

Spring term. Credit three hours. Lecture and laboratory. Hours to be arranged. Professor Krook. Designed primarily for graduate students of nutrition. Prerequisites, 630 and 631.

Advanced Work in Animal Parasitology

932. Fall term. Credit one to three hours, by arrangement.

933. Spring term. Credit one to three hours, by arrangement.

Professor Whitlock and Associate Professor Georgi. Prerequisite, Course 635. For advanced undergraduate and graduate students.

Special problems concerned with the parasites of domestic animals.

Advanced Work in Pathology

936. Fall term. Credit one to three hours, by appointment.

937. Spring term. Credit one to three hours, by appointment.

Properly prepared students may undertake special problems or receive special assignments.

938. REPRODUCTIVE PATHOLOGY

Fall term. Credit two hours. Lecture and laboratory. Hours to be arranged. Professor McEntee. Prerequisites, Courses 630, 631, 632, and 633.

Physical Biology

Professors Casarett, Comar, Craig, Gasteiger, Georgi, Lengemann, Tapper, Thompson, Wasserman.

Master's degree and doctoral candidates may be accepted with a major in physical biology or radiation biology. Emphasis is given to the development of methods and application of physical concepts to problems of normal and abnormal metabolism. Excellent facilities are available for work with laboratory and domestic animals and especially in all aspects of the use and effects of radiation. Some of the areas presently under active research include: fission product metabolism; biological effects of radiation, mineral metabolism; transport processes; central nervous system physiology; receptor physiology; use of radioisotopes in biological and clinical research; problems of radioactive contamination of the food chain.

Candidates are expected to have a strong background in biological sciences and either to have had, or to be in a position to take, one year of the following courses: physical chemistry, physics, biometry, and calculus.

It is recommended that those candidates for the Master's degree who expect to become candidates for the Doctorate, study one or more foreign languages.

920. ELEMENTS OF PHYSICAL BIOLOGY

Fall term. Credit three hours. T Th F 11. Prerequisites, basic courses in physics, chemistry, biology, calculus, or consent of the instructor. Professor Comar and staff. Lectures on atomic, molecular, and cellular aspects of matter; physio-chemical concepts in biology; membrane phenomena; mathe-

matical approaches, compartmental analysis; tissue culture; informational macromolecules; biological coding and control.

921. RADIOISOTOPES IN BIOLOGICAL RESEARCH – PRINCIPLES AND PRACTICE

Spring term. Credit four hours. Lectures, T Th 11. Laboratory M T 1:30–5. Prerequisites, a course in quantitative chemistry and permission of instructor. Professor Lengemann and staff. Lectures, demonstrations, and laboratory on the fundamentals of atomic energy procedures and applications to biological research.

922. BIOLOGICAL EFFECTS OF RADIATION

Fall term. Credit 3 hours. T Th 10. Lab. Th 1:30–5. Assistant Professor Casarett.

Lectures and demonstrations on radiation physics, radiation chemistry, radiation effects at the cellular level, radiation effects in multicellular organisms, genetic effects of radiation, and radioprotective and radiomimetic substances.

923. BIOLOGICAL MEMBRANES AND NUTRIENT TRANSFER

Spring term. Credit two hours. Lectures T Th 8. Prerequisites, animal or plant physiology, quantitative and organic chemistry, physics, and consent of instructor. Cellular physiology and elementary physical chemistry desirable. Professor Wasserman.

An introduction to elementary biophysical properties of biological membranes, theoretical aspects of permeability and transport, and mechanism of transfer of inorganic and organic substances across intestine, placenta, kidney, erythrocytes, bacteria, and other biological systems. Offered every other year.

924. FUNCTIONAL ORGANIZATION OF THE NERVOUS SYSTEM

Fall term. Credit three hours for lecture, two hours for laboratory. Lectures M W F 10. Laboratory W 1–5 biweekly. Prerequisites, physiology, organic chemistry, physics, and/or consent of instructor. Physical chemistry and neuroanatomy desirable. Professor Gasteiger.

Function of the nervous system will be considered primarily from an electrophysiological viewpoint. Where appropriate, important studies of reflexology, chemical and feedback control, and comparative anatomy will be utilized. Laboratory studies will include electrical activity of cells, reflexes, decerebrate rigidity, acoustic microphonic response, subcortical stimulation, and evoked and spontaneous cortical activity.

926. PHYSICAL BIOLOGY GRADUATE SEMINAR

Fall and Spring terms. Credit one hour. Professor Comar and staff.

927. SEMINAR – SPECIAL TOPICS IN PHYSICAL AND RADIATION BIOLOGY

Fall and Spring terms. Credit one hour. Assistant Professor Casarett.

Physiology

Professors Anders, Aronson, Bergman, Dobson, Nangeroni, Sellers, Stevens, Wootton.

Opportunities are offered for pursuit of graduate study toward the M.S. and Ph.D. degrees in the areas of physiological chemistry, physiology, and

pharmacology. Areas of active research include enzyme kinetic studies, absorption from the digestive tract, carbohydrate and fat metabolic studies in ruminants, chelation of heavy metals in the animal body, chelate toxicity, electro- and chemical narcosis, electrolyte metabolism in digestive tract disease in ruminants, and gastric blood flow.

The M.S. degree is advised prior to undertaking work for the Ph.D. in the majority of instances. The minor subjects for the Masters' and Ph.D. degrees are taken in departments outside the Field of the major.

511. Spring. 3 hours. T Th S 8. Physiology of cells, muscle, nerve, nervous system, digestive system, urine secretion, and temperature regulation. Prerequisites (see *Announcement of the Veterinary College*).

610. Fall. 3 hours. T Th S 8. Physiology of blood, lymph, circulation, respiration, endocrine organs, and reproduction. Prerequisite: 511.

910. Special Problems in Physiology. Fall. Hours and credits arranged.

911. Special Problems in Physiology. Spring. Hours and credits arranged.

912. Research. Fall. Hours and credits arranged.

913. Research. Spring. Hours and credits arranged.

914. Spring, alternate years; 3 hours. Experimental Physiology Laboratory. Prerequisites (see *Announcement of The Veterinary College*).

Small Animal Medicine and Surgery

Professors Kirk, Leonard.

Graduate students may elect to work for the M.S. degree, the Ph.D. degree, or for the D.Sc. in V.M. Special subjects of study include general and advanced canine medicine, general canine surgery, canine orthopedic surgery, and breeding diseases of small animals. Basic work in any one of these special areas will be reviewed, and advanced work will be given on an assignment basis. Minor subjects are required in one or more areas of the basic sciences.

Because of the close integration of the Small Animal Clinic with the department, it is possible for the graduate student to have access to research material for whatever project he might like to undertake. The facilities are adequate for graduate study and research through the cooperation of other departments within the College.

Only candidates with the degree of D.V.M. or its equivalent are accepted, and the language requirement for the various degrees is the same as that required in the general Field of Veterinary Medicine.

Water Resources

(See pages 455–456.)

Zoology

Faculty: John M. Anderson, Antonie W. Blackler, LaMont C. Cole, Perry W. Gilbert, Samuel L. Leonard, William N. McFarland, John R. Vallentyne, William A. Wimsatt.

Field Representative: John R. Vallentyne, 216 Stimson Hall.

APPROPRIATE MAJOR SUBJECTS

Biogeochemistry
Comparative and Functional Anatomy
Comparative and Cellular Physiology
Ecology
Endrocrinology
Histology and Embryology
Invertebrate Zoology

APPROPRIATE MINOR SUBJECTS

Animal Cytology

ADMISSION REQUIREMENTS. Applicants for admission to graduate study in Zoology must submit scores of the Graduate Record Examination Aptitude and Advanced Biology Tests. It is important that the examination be taken as early as possible in the year of application and that scores be submitted not later than mid-February.

All applicants should have completed the equivalent of a well-rounded college major in zoology and should have some foundation in the particular phase of zoology they desire to pursue. Courses in organic chemistry, elementary physics, and calculus should also have been completed. Although an exceptional student may be admitted without having finished one or more of these requirements, he should then expect to remain in residence beyond the minimum period to make up the deficiencies.

LANGUAGE REQUIREMENTS. For the Master's degree, proficiency is required in French, German or Russian. The requirement for the Ph.D. degree is *either* (a) proficiency in any two of French, German or Russian, *or* (b) a higher level of proficiency in any one of these. For foreign students whose native language is not English there is no language requirement for the Master's degree, and proficiency in only one of French, German or Russian is required for the Ph.D. degree.

The Field of Zoology offers excellent opportunities for graduate study and research in all phases of zoology, but particularly in the descriptive and experimental aspects of the following special subjects: (1) comparative and human anatomy, with emphasis on the functional approach, (2) comparative and cellular physiology, (3) general ecology, (4) endocrinology, (5) histology and embryology, (6) invertebrate zoology, and (7) limnology and biogeochemistry. Members of the staff are especially qualified to direct research in the subjects listed, but research need not be limited to these subjects. The research interests of the members of the staff are broad; in general, they may be summarized as follows: J. M. Anderson, general and comparative anatomy of invertebrates, with emphasis on the functional histology and histochemistry of organ systems; A. W. Blackler, origin of sex cells and nucleo-cytoplasmic interaction in development; L. C. Cole, general ecology with special emphasis on population phenomena and the mathematical theory of populations; P. W. Gilbert, vertebrate functional anatomy, i.e., correlation of habits and activities of vertebrates with their morphology, biology of elasmobranch fishes with special emphasis on reproductive patterns and sense organs; S. L. Leonard, general endocrinology with special emphasis on the anatomical, physiological, and biochemical aspects of the mechanisms of hormone action, reproduction, growth, and metabolism; W. N. McFarland, comparative physiology, osmotic and ionic regulation, respiration with special emphasis on its relationship to environmental control, and the physiology of fishes; J. R. Vallentyne, limnology, biogeochemistry of organic matter, and the origin of life; W. A. Wimsatt, histology, histophysiological and histochemical approach to problems of reproduction, comparative placentation, and hibernation.

For summer research grants and assistantships in zoology at the Museum of Northern Arizona consult the Field Representative.

COURSES

Biological Sciences

[410. PROBLEMS IN FUNCTIONAL VERTEBRATE ANATOMY]
Spring term. Credit four hours. Offered in alternate years. Prerequisites, Biological Sciences 311 and consent of instructor. Lecture W 9; also discussion period to be arranged. Laboratory, W–F 2–5. Mr. Gilbert. Not offered in 1966–67.

This course is intended for a limited number of advanced students who have done exceptionally well in Biological Sciences 311. It is an advanced course, involving dissections and experiments, with emphasis on the structural and functional adaptations of representative vertebrates to their environment. As a supplement to regular laboratory exercises, each student will be expected to select a project and prepare a substantial term report on his work.

412. SPECIAL HISTOLOGY: THE BIOLOGY OF THE ORGANS
Spring term. Credit four hours. Offered in alternate years. Prerequisites, Biological Sciences 313, or consent of instructor. Enrollment limited to 18 students. Lectures, W F 9. Laboratory, W F 2–4:30. Mr. Wimsatt.

A continuation of Biological Sciences 313. The microscopic and ultrastructural organization of the principal vertebrate organ systems are studied in relation to their development, functional interaction, and special physiological roles. Biological Sciences 313 and 412 together present the fundamental aspects of the microscopic and submicroscopic organization of the vertebrate body from a physiological perspective. The organization of the course involves student participation in "lecture-seminars." and the prosecution of independent project work supplementary to the regular work of the laboratory. The latter enables students to gain practical experience with histological and histochemical preparative techniques.

476. ADVANCED INVERTEBRATE ZOOLOGY
Spring term. Credit four hours. Prerequisites, Biological Sciences 371 or equivalent, and permission of instructor; enrollment limited. Lectures, W F 11. Laboratory, W F 2–4:20. Mr. Anderson.

Lectures and seminars (involving student participation by means of prepared reports) on significant problems in invertebrate zoology; laboratory and field work on selected invertebrate groups.

511. CELLULAR PHYSIOLOGY LECTURES
Fall term. Credit three hours. Prerequisites, previous courses in animal or plant physiology and biochemistry desirable. Lectures, M W 11.

An introduction to basic aspects of animal cell function including structural and functional organization of cells, permeability and active transport, transcellular secretion, ionic mechanisms underlying excitability phenomena in neurons and receptor cells, contractility, and bioluminescence.

511A. CELLULAR PHYSIOLOGY LABORATORY
Fall term. Credit two hours. Prerequisite, consent of the instructor. Enrollment is limited. Laboratory, W or Th 1:40–4:30.

The laboratory emphasizes a number of biophysical approaches to cellular activities.

[512. COMPARATIVE PHYSIOLOGY]

Spring term. Credit four hours.
Prerequisites, Biological Sciences 413 or 414 and biochemistry or the equivalent. Not offered in 1966–67.

513. EXPERIMENTAL ENDOCRINOLOGY

Fall term. Credit two or three hours. Prerequisites, a year of zoology or its equivalent, organic chemistry, physiology and consent of instructor. Primarily for graduate students, open to undergraduates for two credits. Lectures, M F 11. Laboratory, M or F 2–4:30. Mr. Lo nard.

Lectures on the anatomy and physiology of the vertebrate endocrine glands, glandular interrelationships, mechanisms of hormone action, chemical and physiological properties of the hormones, assay methods. Laboratory includes small animal surgery, micro technique for the endocrines, illustrative experiments on the effects of hormones.

516. SPECIAL TOPICS IN COMPARATIVE PHYSIOLOGY

Spring term. Credit four hours. Prerequisite, consent of instructor. Enrollment limited. For advanced students in biological sciences. Lecture, Th 1:40–4:30. Associate Professor McFarland.

Detailed consideration of selected topics in comparative physiology. Preparation of demonstration experiments stressing technique and individual research problems will be included. Topics will vary from year to year.

[561–562. QUANTITATIVE ECOLOGY]

Throughout the year. Credit four hours a term. Offered alternate years. Prerequisites, one year of biology and permission of the instructor. Organic chemistry and some college mathematics are desirable. Lectures, M W 11. Laboratory, W 2–4:30. Mr. Cole. Not offered in 1966–67.

A quantitative course on selected ecological topics for advanced undergraduates and graduate students. Topics include the origin and interpretation of habitat differences, toleration and response physiology, population dynamics, construction and uses of life tables, spatial distribution patterns, and approaches to the quantitative analysis of biotic communities.

563. PLANT ECOLOGY

Fall term. Credit four hours. Prerequisite, Biological Sciences 361 or the equivalent. Primarily for graduate students. Lectures, M W F 10.

Lectures and seminars on species and community organization, competition, laws of growth and succession, and on the measurement, analysis and interpretation of biogeochemical cycles and the flow of energy in plant communities.

[564. BIOGEOCHEMISTRY]

Spring term. Credit four hours. Prerequisites, Biological Sciences 361, one year of geological science, organic chemistry, and permission of instructor. Lectures, T Th S 9. Laboratory, M or T 2–4:30. Mr. Vallentyne. Not offered in 1966–67.

565. SPECIAL TOPICS IN LIMNOLOGY

Fall term. Credit three hours. Prerequisite, consent of instructor. Hours to be arranged. Mr. Vallentyne and Mr. Hall.

A laboratory and seminar course designed primarily for graduate students.

Advanced discussion and experimentation in specific topics in limnology. Content variable from year to year, but in general dealing with topics related to the production and metabolism of biological associations in inland waters.

584. EXPERIMENTAL EMBRYOLOGY

Spring term. Credit three hours. Prerequisite, Biological Sciences 385. Enrollment limited. Lecture, T 11. Laboratory T Th 2–4:30. Mr. Blackler.

An advanced course in animal development in which stress is laid on practical manipulations carried out by the students. Every student will have an opportunity to repeat for himself some of the classical and modern experiments and techniques.

PHYSICAL SCIENCES

Fields of: Aerospace Engineering, Agricultural Engineering, Applied Mathematics, Applied Physics, Astronomy and Space Sciences, Chemical Engineering, Chemistry, Civil Engineering, Computer Science, Electrical Engineering, Geological Sciences, Industrial Engineering and Operations Research, Materials Science and Engineering, Mathematics, Mechanical Engineering, Nuclear Science and Engineering, Physics, Theoretical and Applied Mechanics, and Water Resources.

Aerospace Engineering

Faculty: Peter L. Auer, P. C. Tobias deBoer, Albert R. George, Geoffrey S. S. Ludford, Edwin L. Resler, Jr., William R. Sears, A. Richard Seebass, Shan-fu Shen, Donald L. Turcotte.

Field Representative: Edwin L. Resler, Jr., 290 Grumman Hall.

APPROPRIATE MAJOR SUBJECTS	APPROPRIATE MINOR SUBJECTS
Aerospace Engineering	Aerospace Engineering
	Aerodynamics

The requirement for admission in this Field is a Bachelor's degree in engineering or the physical sciences. It is not recommended that candidates apply for admission at midyear, except in unusual cases.

The language requirement for the Ph.D. is reading proficiency in Russian, or in both German and French, or substantially higher proficiency in either French or German.

In this Field of graduate study emphasis is placed on the aerospace sciences rather than proficiency in present-day techniques. Consequently, graduate students having aerospace engineering as their major subject will be urged to select as their minor subjects the basic sciences, such as chemistry, mathematics, mechanics, and physics. There are several special fellowship awards supported by the Cornell Aeronautical Laboratory available to students in this Field.

Much of the research carried out in this Field at Cornell is concerned with fundamental problems in the dynamics of fluids, including plasmas and chemical reactions at high temperature. Whenever possible, these investigations combine the techniques of theory and laboratory experiment, making use of the experimental facilities of the Graduate School of Aerospace Engineering on the campus. In every investigation, an attempt is made to correlate theory with observation and practical experience.

A group working under the direction of Professors de Boer and Resler is investigating the dynamics of gases at extreme temperatures. Generally speaking, their interests lie in matters in which the sciences of physics and chemistry are finding application to the aerodynamics of propulsion systems and to flight of missiles and space vehicles.

The branch of fluid mechanics called magnetohydrodynamics now forms an essential part of the School's activities; Professors Resler, Sears, and Turcotte are engaged in this research, both in theory and in the laboratory. Professor Ludford of the Department of Theoretical and Applied Mechanics is exploring the mathematical theory of this phase of fluid mechanics. Professor Auer is concerned with those aspects of plasma physics concerned with the higher temperature collisionless regime appropriate to possible fusion applications. This interest brings the School into close contact with several other departments of the University (including the Center for Applied Mathematics and the Center for Radiophysics and Space Research). Professors George, Seebass, and Shen and their students are pursuing investigations in the area of rarefied-gas dynamics, hypersonics, basic fluid mechanics, and advanced aerodynamics, which are related to the other aspects of real-gas dynamics and air chemistry mentioned above. Close contact is maintained with the work in Thermal Engineering, which is housed in Upson Hall adjacent to this School. The School also maintains active interest and research in subjects basic to modern space vehicle and propulsion-system design, including problems of missile dynamics, trajectories, and orbits. Research in chemical kinetics is conducted with the cooperation of Professor S. H. Bauer of the Chemistry Department, and research in structures and materials is carried out in cooperation with the Field of Theoretical and Applied Mechanics and the Materials Sciences Center. This brief description is, of course, not all-inclusive and other topics of research are under study; further details may be obtained by writing to the Director of the Graduate School of Aerospace Engineering.

Candidates for an advanced degree with a major in this Field who do not already hold the Master's degree are encouraged to matriculate first as candidates for the professional degree, Master of Engineering (Aerospace), under the jurisdiction of the Graduate School of Aerospace Engineering. Information concerning this School and the degree of Master of Engineering (Aerospace) will be found in the *Announcement of Engineering Courses and Curricula*.

COURSES

7101. ADVANCED KINETIC THEORY

Credit three hours. Fall.

The Boltzmann equation. Solution for gas in equilibrium. Collision frequency and mean free path calculations. Conservation equations. Review of Enskog-Chapman theory of transport coefficients. Grad's thirteen moment equations. The BGK equation. The BBGKY theory. Mr. de Boer.

7102. GASDYNAMICS

Credit three hours. Spring.

Strong shock waves and their use in the production and study of high temperature gases. High temperature chemical kinetics and its application to hypersonic external flows, rocket internal flows, and other phenomena of current interest. Chemical relaxation effects on flow fields and the method of characteristics including chemical reactions. Experimental techniques. Mr. Resler.

7103. DYNAMICS OF RAREFIED GASES

Credit three hours. Spring. Prerequisites, 7101, 7102.

Flow regimes according to the Knudsen number. Theories of the shock structure at high Mach numbers. Boundary conditions at a solid wall. Slip-flow conditions. Free-molecule flows. Eigen function expansion of the linearized Boltzmann equation. Full-range and half-range moment methods. The model equation approach and recent developments for handling the transition regime. Mr. Shen.

7104 ADVANCED TOPICS IN HIGH TEMPERATURE GASDYNAMICS

Credit three hours. Either term. Prerequisites, 7101, 7102.

Current topics relating to present engineering practice and/or research interests of the faculty and staff.

7201. MAGNETOHYDRODYNAMICS I

Credit three hours. Fall.

Review of electromagnetic theory. Derivation of plasma conservation equations and an Ohm's law. Important parameters in magnetohydrodynamics and Alfvén waves. The pinch effect and hydromagnetic instabilities. Flow problems in magnetohydrodynamics. Hydromagnetic shock waves. Mr. Turcotte.

7202. MAGNETOHYDRODYNAMICS II

Credit three hours. Spring.

The three fluid model. Plasma oscillations. Tensor conductivity. The Saha equation, mean free paths, collision times. Diffusion and mobility, discharges. Excess electron temperature, collisionless effects. Mr. Turcotte.

7203. ADVANCED TOPICS IN PLASMA-DYNAMICS I

Credit three hours. Fall. Prerequisites: 7201, 7202.

Large amplitude disturbances and non-linear wave motion in plasmas. Collision-free shocks, wave mixing, and plasma turbulence. A unified treatment will be developed by means of the Vlasov Equations. Mr. Auer.

7204. ADVANCED TOPICS IN PLASMA-DYNAMICS II

Credit three hours. Spring. Prerequisite: 7201, 7202.

The major topic to be considered is the interaction of radiation with plasmas. The scattering and radiation of electro-magnetic waves, the interaction with electrostatic waves, mode conversion and the effect of non-uniform distributions are among topics to be treated. Mr. Auer.

7301. FLUID MECHANICS I

Credit three hours. Fall.

The continuum and the stress tensor. Vectors and tensors. Hydrostatics. Strain and rate-of-strain tensors. The ideal elastic continuum. Equilibrium and compatibility equations, boundary conditions. Plane stress and strain. The stress function. Elastic energy, Castigliano theorem and St. Venant's principle. The Newtonian fluid, viscosity and bulk viscosity Navier-Stokes equations. Poiseuille flow, Rayleigh and Stokes problems. The concept of the boundary layer. The ideal-fluid approximation. Kelvin and Helmholtz theorems. Irrotational flows. Mr. Sears.

7302. FLUID MECHANICS II

Credit three hours. Spring.

Laplace's equation. Source, sink, and doublet. Vortices. Biot-Savart theorem, the flow field of a vortex. Spherical and cylindrical harmonics. Methods of singularity distributions. Complex-variable methods. Wing theory. Acoustics. Compressible flows, subsonic and supersonic. Shock waves. Hypersonic flow. Rotational flows. Magnetohydrodynamics. Flow in the boundary layer, Prandtl theory. Heat transfer, separation. Mr. Sears.

7303. FLUID MECHANICS III

Credit three hours. Fall. Prerequisites 7301, 7302.

Aerodynamics of compressible fluids. Brief review of linear theories. Improvements on linear theory. Role of entropy in supersonic flows. Shock wave interactions. Exact theories: method of characteristics for rotational flows; hodograph transformation; conical flows. Transonic flow theory and similitude. Viscous effects in compressible flows. Other topics of current interest. Mr. George.

7304. THEORY OF VISCOUS FLOWS

Credit three hours. Fall. Prerequisites, 7301, 7302.

Exact solutions of the Navier-Stokes equations. The small Reynolds number approximation. The boundary layer theory and the techniques for its solution. Compressibility effects. Stability of laminar flows. Turbulence. Mr. Shen.

7305. HYPERSONIC FLOW THEORY

Credit three hours. Spring. Prerequisites, 7301, 7302.

Hypersonic small disturbance theory and the related similitude; blast wave analogy; entropy layers. Newtonian theory and shock layer structure. Constant density solutions. The blunt body problem; numerical techniques. Viscous and real gas effects: ideal dissociating gas; viscous interactions; other real gas phenomena. Mr. George.

7801. RESEARCH IN AREOSPACE ENGINEERING

(Credit to be arranged.) Prerequisite, admission to the Graduate School of Aerospace Engineering and approval of the Director.

Independent research in a field of aerospace science. Such research must be under the guidance of a member of the staff and must be of a scientific character.

7901. AEROSPACE ENGINEERING COLLOQUIUM

Credit one hour.

Lectures by Cornell staff members, graduate students, and visiting scientists on topics of interest in aerospace science, especially in connection with new research.

7902. ADVANCED SEMINAR IN AEROSPACE ENGINEERING

Credit two hours. Prerequisite, approval of the Director.

Special research topics under current investigation by the Bell Laboratories and Bellcomm in the Fall Term. Review of research in the General Electric Laboratories in the Spring Term.

Agricultural Engineering

Faculty: Richard D. Black, Edward W. Foss, Orval C. French, Ronald B. Furry, Richard W. Guest, Wesley W. Gunkel, Fred G. Lechner, Gilbert Levine, Robert T. Lorenzen, David C. Ludington, Everett D. Markwardt, William F. Millier, Gerald E. Rehkugler, Norman R. Scott, E. Stanley Shepardson, John C. Siemens, James W. Spencer, Clesson N. Turner.

Field Representative: Wesley W. Gunkel, Room 226 Riley-Robb Hall.

APPROPRIATE MAJOR AND MINOR SUBJECTS

Agricultural Engineering
Agricultural Structures
Electric Power and Processing
Power and Machinery
Soil and Water Engineering

Ph.D. candidates are required to have one major subject selected from the above list and two minor subjects. One minor subject may be selected from the above list and at least one minor subject must be selected in a Field outside Agricultural Engineering. M.S. candidates are required to take Agricultural Engineering as their major subject and to select one minor outside the Field. Candidates for either the Doctorate or the Masters degree with the major outside the Field may select any subject as a minor.

ADMISSION REQUIREMENTS. To be considered for admission an applicant must have a baccalaureate degree in Engineering, Physical Science, or Biological Science from a faculty or university of recognized standing. Training in the engineering and biological sciences is necessary. Any deficiencies in these areas in the undergraduate training will need to be satisfied early in the advanced degree program. The applicant must present evidence of promise in advanced study and research as indicated by past scholastic achievement and recommendations from his undergraduate or graduate institution.

Although it is not required by the Field, applicants applying for fellowships and scholarships are urged to take from the Educational Testing Service both the Graduate Record Examination Aptitude and Advanced Engineering tests. Scores should be sent to the Cornell Graduate School as part of their application.

LANGUAGE REQUIREMENTS FOR ADVANCED DEGREES. There is no general language requirement for either the M.S. or the Ph.D. in the Field. However, a candidate's Special Committee may require language to be included in the student's program.

EXAMINATIONS. The final examination for the M.S. may be oral, or oral and written. Students continuing for the Ph.D. in the Field may combine the M.S. final examination with the Examination for Admission to Ph.D. Candidacy with the permission of their Special Committee for their Ph.D. program. There are two examinations for the Ph.D. candidates. They are the Examination for Admission to Ph.D. Candidacy and the Final Examination.

RESEARCH AND STUDY OPPORTUNITIES. A broad spectrum of research and study activity is available in Agricultural Engineering. A thesis based on a research effort is required for both the M.S. and Ph.D. degrees. A partial list of the general areas of research interest and the faculty members associated with these interests are listed below. Specific topics of mutual interest may also be selected. If you desire information about current research projects write to the Field Representative and he will direct your inquiry to the faculty member best able to answer your request.

Agricultural Engineering: All faculty members. Bio-engineering, safety engineering, properties of agricultural materials, materials handling, agricultural waste handling and processing, agricultural mechanization, low cost roads.

Agricultural Structures: Ronald B. Furry, Robert T. Lorenzen, Norman R. Scott. Structural analysis and design, production systems synthesis, structural-biological relationships, environmental composition and control, biological response to environment, thermodynamic processes.

Electric Power and Processing: Ronald B. Furry, Richard W. Guest, David C. Ludington, E. Stanley Shepardson, Clesson N. Turner. Electrical control systems, processing of agricultural materials, application of electromagnetic radiation to agriculture.

Power and Machinery: Richard W. Guest, Wesley W. Gunkel, Everett D. Markwardt, William F. Millier, Gerald E. Rehkugler, E. Stanley Shepardson, John C. Siemens. Terramechanics, crop harvesting, handling and processing systems, metering and distribution of agricultural chemicals, soil mechanics as related to seedling establishment and crop production, agricultural machinery design and development.

Soils and Water Engineering: R. D. Black and G. Levine. Surface water hydrology, flow in porous media, irrigation efficiency, soil-plant-water relationships, waste water disposal, hydraulics.

GRADUATE COURSES

501. SIMILITUDE ENGINEERING

Spring term. Credit three hours. Lectures, T Th 11, Riley-Robb 105. Laboratory, F 2–4:30, Riley Robb 225. Associate Professor Furry.

Similitude methodology, including the use of dimensional analysis to develop general equations to define physical phenomena, model theory, distorted models, and analogies. Introduction to a variety of applications in engineering. It is preferred that students know how to program in Fortran, although knowledge of CORC is acceptable.

502. INSTRUMENTATION

Fall term. Credit three hours. Two lectures and one laboratory. Time and place to be arranged. Assistant Professor Scott and Staff.

Application of instrumentation to physical and biological measurements in agricultural engineering research, including measurement of force, displacement, velocity, acceleration, temperature, humidity, fluid flow, and electrical impedance and potential.

600. SPECIAL TOPICS

Fall or Spring term. Credit one or more hours. Staff.

Special work in any area of agricultural engineering on problems of special interest to the students and faculty.

601. GENERAL SEMINAR

Fall and Spring term. Required of all graduate students majoring in the Field. M 12:30, Riley-Robb 400. Staff.

Presentation and discussion of research and special developments in agricultural engineering.

602. POWER AND MACHINERY SEMINAR

603. SOILS AND WATER ENGINEERING SEMINAR

604. AGRICULTURAL STRUCTURES SEMINAR

Seminars 602, 603, 604 — Spring term. Credit one hour. Time and place to be arranged. Staff.

Thorough investigation and discussion of research or new developments in an area of special interest to those enrolled.

UNDERGRADUATE COURSES OPEN TO GRADUATE STUDENTS

461. AGRICULTURAL MACHINERY DESIGN

Spring term. Credit three hours. Offered in alternate years. Prerequisite, Engineering 3331 or the equivalent. Two lectures, one laboratory. Time and place to be arranged. Professor Gunkel.

The principles of design and development of agricultural machines to meet functional requirements. Emphasis is given to stress analysis, selection of materials of construction, and testing procedures involved in machine development.

462. AGRICULTURAL POWER

Fall term. Credit three hours. Offered in alternate years. Prerequisites, Engineering 3331, 3621, or the equivalent. Lectures, laboratory, and computing periods. Time and place to be arranged. Assistant Professor Siemens.

Basic theory, analysis, and testing of internal combustion engines specifically for use in farm tractors and other agricultural power applications. Tractor transmissions. Nebraska Tractor Tests, soil mechanics related to traction, stability, shop dynamometers, fuels, hydraulic equipment.

463. PROCESSING AND HANDLING SYSTEMS FOR AGRICULTURAL MATERIALS

Spring term. Credit four hours. Offered in alternate years. Three lectures and one laboratory. Time and place to be arranged. Associate Professor Furry.

Processes such as size reduction, separation, metering, drying, and refrigeration will be studied. Principles of and equipment for handling agricultural materials are included. Development of processing and handling systems and their electrical controls will be emphasized. Motors and electric power facilities are also included.

471. SOIL AND WATER ENGINEERING

Spring term. Credit three hours. Offered in alternate years. Prerequisites, Engineering 2301 and Agronomy 200, or their equivalents. Three lectures, one laboratory every other week. Time and place to be arranged. Associate Professor Black.

An advanced course in the application of engineering principles to the problems of soil and water control in agriculture. Includes design and construction of drainage systems and farm ponds; and design and operation of sprinkler systems for irrigation.

481. AGRICULTURAL STRUCTURES

Spring term. Credit three hours. Offered in alternate years. Prerequisites, Engineering 2701 and 3625. Lectures T Th 11. Laboratory, W 2–4:30. Riley-Robb 325. Assistant Professor Scott.

Synthesis of complete farmstead production units including structures, equipment, and management techniques. Integrated application of structural

theory, thermodynamics, machine design, and methods engineering to satisfy biological and economic requirements.

491. LOW-COST ROADS

Credit three hours. Primarily for applications to developing countries. Offered upon sufficient demand, usually in fall term. Prerequisite, consent of instructor. Principally directed study with one two and one-half hour class session per week to be arranged. Professor Spencer.

Study of economic considerations in road system improvement; road improvement planning and programming; road location and geometric design; engineering soil characteristics and classification; design of roadbed thickness; drainage; stabilization methods and materials; dust palliatives; wearing surfaces.

Applied Mathematics*

Faculty: Ralph P. Agnew, Michael S. Balch, Henry David Block, Nicholas DeClaris, Roger Farrell, Michael Fisher, Wolfgang H. J. Fuchs, Leonard Gross, Donald L. Iglehart, Frederick Jelinek, Harry Kesten, Jack Kiefer, James A. Krumhansl, Simon A. Levin, G. S. S. Ludford, Thomas P. Mitchell, Anil Nerode, Lawrence E. Payne, Narahari U. Praghu, Henry S. Sack, Edwin E. Salpeter, Duane Sather, William R. Sears, A. Richard Seebass, Shan-fu Shen, Frank L. Spitzer, Benjamin Widom, Jacob Wolfowitz.

Visiting Faculty: Roger Penrose, The University of London.

Field Representative: W. R. Sears, 275 Olin Hall.

APPROVED MAJOR SUBJECT, Applied Mathematics

APPROVED MINOR SUBJECTS. Chosen in consultation with the major advisor from those available in the biological, engineering, physical, and social sciences. One minor subject will usually be chosen in an area close to the thesis. The choice of an area within mathematics as a minor is not excluded, but the work done in this minor subject must be in addition to that done toward the fulfillment of the general mathematical requirements mentioned below.

ADMISSION REQUIREMENTS: Graduate students will be admitted to study in this Field from a variety of educational backgrounds, including the several branches of engineering and the physical and biological sciences as well as mathematics.

LANGUAGE REQUIREMENTS: A candidate for the degree of Ph.D. must demonstrate reading ability in two out of three languages (French, German and Russian) besides English by passing a written ETS examination. This requirement is being studied by the Field now and may be changed by September 1966.

PROGRAMS OF STUDY will include advanced courses in pure mathematics, thorough grounding in mathematical methods, and studies of subject areas in which significant applications of mathematics are made.

* Ordinarily the minor subject for candidates whose major subject is in engineering or science should be mathematics. Applied mathematics will be available as a minor subject only in unusual cases when a minor in mathematics does not meet the educational objectives.

At the time of the Qualifying Examination for the Ph.D. (or the final examination for the Master's Degree), candidates in this Field must demonstrate knowledge of advanced calculus (including both theoretical and applied aspects), vector calculus, and the fundamentals of modern algebra. All candidates must gain a sound command of "mathematican methods," i.e., applied mathematical analysis. Course work in mathematical analysis is also recommended.

Part of the Qualifying Examination will consist of a written examination to be taken the first September of graduate study and to be used diagnostically to determine course work necessary. If it is not passed at this time Math 411-412 and Math 431–432 should be taken and mastered with a high degree of competence; the written exam may be repeated the following September. The other part of the Qualifying Examination is an oral examination to be given by the student's Special Committee at the end of two terms of study.

Ph.D. candidates must reach the level of proficiency in one of the broad subject areas of the Field of Mathematics (analysis, algebra, geometry). Each candidate must also acquire familiarity with significant applications of advanced mathematics; such applications can be studied at Cornell in several areas, such as the various branches of engineering science, physics, and chemistry.

The thesis in Applied Mathematics must be a mathematical contribution toward the solution of a problem arising outside mathematics.

Course work may be chosen by the student in conjunction with his Special Committee from the course offerings in the various Fields of engineering, mathematics, computer science, physics, nuclear science, chemistry, or any of the biological, physical, and social sciences which will further his particular educational objectives.

All graduate students in Applied Mathematics receive financial assistance.

AREAS OF INTEREST

R. P. Agnew, Professor of Mathematics: mathematical analysis.
M. S. Balch, Assistant Professor of Mathematics: methods of applied mathematics, elliptic differential equations.
H. D. Block, Professor of Theoretical and Applied Mechanics: nonlinear mechanics, automata, functional analysis.
N. DeClaris, Professor of Electrical Engineering: system theory.
R. Farrell, Associate Professor of Mathematics: probability and statistics.
M. Fisher, Professor of Mathematics and Chemistry: foundation and applications of statistical mechanics.
W. H. J. Fuchs, Professor of Mathematics: mathematical methods of physics.
L. Gross, Associate Professor of Mathematics: analysis, mathematics of quantum theory.
D. L. Iglehart, Associate Professor of Industrial Engineering and Operations Research: stochastic processes, probabilistic models.
F. Jelinek, Assistant Professor of Electrical Engineering: information theory, coding, communication networks, automata.
H. Kesten, Professor of Mathematics: probability theory.
J. C. Kiefer, Professor of Mathematics: probability and statistics.
J. A. Krumhansl, Professor of Physics: mathematical physics, microscopic processes, and macroscopic descriptions.
S. Levin, Assistant Professor of Mathematics: mathematical analysis, partial differential equations, biomathematics.
G. S. S. Ludford, Professor of Applied Mathematics: fluid mechanics, magnetofluid dynamics.

A. Nerode, Professor of Mathematics: mathematical logic, recursive functions and computability, algebra, automata.
T. P. Mitchell, Professor of Theoretical and Applied Mechanics: mechanics of bodies and systems, elasticity, orbits and trajectories.
L. E. Payne, Professor of Mathematics: partial differential equations.
N. U. Prabhu, Associate Professor of Industrial Engineering and Operations Research: stochastic processes, queues and inventories, reliability.
H. S. Sack, Walter S. Carpenter, Jr., Professor of Engineering: engineering physics, physical properties of materials.
E. E. Salpeter, Professor of Physics and Astronomy: theoretical astrophysics, nuclear theory, statistical mechanics.
D. Sather, Assistant Professor of Mathematics: partial differential equations.
W. R. Sears, J. L. Given Professor of Engineering: aerodynamics, magneto-fluid dynamics.
A. R. Seebass, Associate Professor of Aerospace Engineering: aerodynamics, magneto-fluid dynamics.
S. F. Shen, Professor of Aerospace Engineering: aerodynamics, rarefied gas-dynamics.
F. L. Spitzer, Professor of Mathematics: probability theory and analysis.
B. Widom, Professor of Chemistry: physical chemistry, statistical mechanics.
J. Wolfowitz, Professor of Mathematics: mathematical statistics, probability, and information theory.
R. Penrose, Visiting Professor of Physics and Astronomy: general relativity.

Applied Physics

Faculty: Joseph Ballantyne, Robert W. Balluffi, Boris W. Batterman, John M. Blakely, K. Bingham Cady, David D. Clark, Marshall H. Cohen, Edmund T. Cranch, P. C. Tobias DeBoer, Lester F. Eastman, Thomas Gold, Paul L. Hartman, Martin O. Harwit, John P. Howe, Herbert H. Johnson, James A. Krumhansl, Che-yu Li, Richard L. Liboff, Paul R. McIsaac, Mark Nelkin, E. L. Resler, Thor N. Rhodin, Arthur L. Ruoff, Henri Sack, David Seidman, Benjamin M. Siegel, John Silcox, Ravindra Sudan, Chung-Liang Tang, Anthony Taylor, Donald L. Turcotte, Watt W. Webb, George J. Wolga.

Field Representative: W. W. Webb, 164 Rockefeller Hall.

APPROPRIATE MAJOR AND MINOR SUBJECT

Applied Physics

Graduate study in the Field of Applied Physics offers the opportunity to achieve proficiency in physics, mathematics and applied science. It is particularly suitable for students preparing for a scientific career in areas of applied science based on principles and techniques of physics and in certain associated areas of pure physics. It provides a means for students with undergraduate training in physics to branch out into applied science while continuing the study of physics, and for students with an engineering background to extend their knowledge of physical principles and techniques.

A student may choose for specialization and thesis research any subject that is compatible with an approach based on the application of principles of physics and mathematics. The areas in which the faculty of the Field are currently involved and in which thesis research or specialized study is being supervised includes the list below. Typical topics of research current interest are mentioned for each area. New areas are frequently added. Information about the availability of programs in other areas may be obtained from the Field Representative.

AREAS OF INTEREST

Applied theoretical physics: Quantum mechanics, electromagnetic theory, applications of irreversible thermodynamics, transport theory in plasmas and solids; calculation of band structure and thermodynamic properties of solids, quantum electronics, atomic basis of hydrodynamics in normal and superfluids, molecular theory of liquids.

Biophysics: Electron microscopy study of large protein molecules, high resolution autoradiography studies in cell biology.

Cryogenics: Superconductivity, superfluids, experimental low temperature physics.

Fluid physics: Transport theory, light scattering, critical and collective phenomena, cryogenic fluids, freezing.

Nuclear physics: Low energy nuclear physics, neutron physics, instrumentation, activation analysis and mass spectrometry, reactor physics.

Optics: Solid and gaseous lasers, coherence properties of lasers, electron optics, development of high resolution electron microscopy, contrast effects in electron microscopy, X-ray and electron diffraction, non-linear optics.

Plasma physics: Experimental and theoretical studies, magnetohydrodynamics, electron dynamics at microwave frequencies, instabilities.

Radiation and matter: Interaction of microwave and optical frequency radiation with gaseous and solid state matter (with applications to electronics), radiation damage, characteristic energy losses of electrons passing through thin solid films, excited state spectroscopy, X-ray diffraction, light scattering.

Solid state physics: Perfect and imperfect crystals, point and line imperfections, diffusion and conduction, dislocation mechanics, internal friction, electronic properties of metals, ionic crystals and semiconductors, superconductivity, ferromagnetism, electron spin resonance.

Space physics: Atmospheric and ionspheric investigations, physical phenomena in astronomy and astrophysics.

Surface physics: Atomistic properties of solid surfaces. Interfacial phenomena in liquid and solids. Electron physics of surfaces. Theory and application of low energy electron diffraction and field ionization. Physical properties and morphology of surface phases.

Additional general information is available in a booklet titled *Graduate Study in Engineering at Cornell.* Interested students should write to the Office of the Dean of the College of Engineering, Carpenter Hall.

A brochure with more details about research possibilities and graduate programs in the Field of Applied Physics is available by writing to the Field Representative, Applied Physics, Rockefeller Hall.

COURSES

Since course programs of graduate students in the Field of Applied Physics draw heavily on course offerings of the Fields of Physics and Mathematics and on various other Fields, the course lists of those Fields should be consulted. Course programs are arranged individually to suit the objectives of each student and the level of his first courses is determined by his preparation on entering Cornell. Generally the program is arranged so that the subject matter of Math 415–416. Physics 561–562, Physics 572–574, and Physics 510 are included during the first two years. In addition, of course, there would be specialized courses in applied science, engineering, or physics courses in the area of the student's special interests. Frequently included are Physics 653

and Physics 505-506. Some specialized course sequences may be started during the first graduate year; others follow a basic sequence in physics and mathematics.

Astronomy and Space Sciences

Faculty: W. Ian Axford, Ralph Bolgiano, Trevor R. Cuykendall, John P. Delvaille, Frank D. Drake, Thomas Gold, Kenneth I. Greisen, Martin Harwit, Frederick Jelinek, Richard L. Liboff, Duane O. Muhleman, Edwin L. Resler, Jr., Gian-Carlo Rumi, Henry S. Sack, Edwin E. Salpeter, William R. Sears, R. William Shaw, Ravindra N. Sudan, Leonard S. Wagner.

Field Representative: E. E. Salpeter, 308 Newman Laboratory.

APPROPRIATE MAJOR AND MINOR SUBJECTS

Astronomy
Astrophysics
Magnetohydrodynamics
Radiophysics
Space Sciences (General)

There is no language requirement for the master's degree. The language requirement for the Ph.D. degree consists of proficiency in one of the following: French, German, or Russian.

The major and both minor subjects for the doctorate should not all be chosen in this Field.

Students may come to this Field with a strong background in astronomy, electrical engineering, engineering physics, mathematics, or physics.

Members of the staff are particularly interested in directing graduate research in the following subjects:

Astronomy and astrophysics: Cosmic rays, cosmology, dynamics of the interstellar gas, geodetic astronomy, lunar photometry, solar system magnetohydrodynamics, stellar spectroscopy, theory of stellar structure, stellar evolution, nuclear processes in stars, stellar statistics.

Atmospheric and ionospheric radio investigations: Dynamics of the atmosphere and ionosphere; incoherent electron scattering; study of refraction, scattering, attenuation due to the inhomogeneous nature of the troposphere and ionosphere; theory and observation of propagation of radio waves in ionized media such as the ionosphere.

Radio astronomy: Distribution and classification of radio sources, radar investigations of the moon and planets, solar radio observations; studies of gaseous nebulae.

Space vehicle instrumentation: Instrumentation relating to lunar exploration, magnetic field measurements, tenuous gas and particle flux measurements; infrared observations from rockets.

Graduate students in this Field may be connected with the Cornell University Center for Radiophysics and Space Research. Many members of the faculty listed above are members of this Center, which possesses or is planning important facilities for geophysical and solar system investigations both by radio methods and by space vehicle instrumentation. Further details of this organization and facilities can be obtained by writing to the Secretary, Cornell University Center for Radiophysics and Space Research, Clark Hall of Science. See also pages 37–38.

The recently formed Cornell-Sydney University Astronomy Center, an international cooperative venture in the Field of Astronomy and Space Sciences, provides students and faculty members of the two universities with an oppor-

tunity to work together in the Field. The Sydney University facilities include the Criss-Cross and Mills Cross radio telescopes, the stellar intensity interferometer, detectors for very high energy cosmic rays, and plasma and nuclear physics laboratories. Further details can be obtained by writing to the Secretary, Astronomy Department, Clark Hall of Science. See also pages 38–39.

COURSES

510. COSMOLOGY AND EVOLUTION

Spring term. Credit three hours. Offered on sufficient demand. Open to graduate students with the consent of the instructor. Hours to be arranged. Messrs. Gold and Harwit.

Relativistic astrophysics. Cosmological models and tests of models. Evolution of stars and galaxies. Quasars.

520. RADIO ASTRONOMY I

Fall term. Credit three hours. Prerequisites, Astronomy 330, or graduate status, or consent of the instructor. Hours to be arranged. Mr. Drake.

Radio astronomy telescopes and electronics. Preferred observing procedures and data analysis. Concepts of aperture synthesis. Physical mechanisms of radio emission. Radio and radar studies of the solar system. Physical nature of the sun, moon, and planets as deduced from radio sources.

521. RADIO ASTRONOMY II

Spring term. Credit three hours. Prerequisite, Astronomy 520. Hours to be arranged. Mr. Drake.

Thermal and non-thermal radiation from the galaxy. Supernova remnants. Relation of galactic emission to cosmic rays. Galactic 21-cm. emission. Galactic structure and kinematics as inferred from radio observations. Radio emission from normal and abnormal galaxies. Quasi-stellar radio sources. Physical theories of the quasi-stellar sources and abnormal radio galaxies.

524. RADIO WAVES IN IONIZED GASES

Spring term. Credit three hours. Prerequisite, Astronomy 520 or consent of the instructor. Hours to be arranged. Staff.

Propagation of radio waves in inhomogeneous plasma. Scattering by irregularities. Generation and absorption of radio waves. Scintillations. Applications to the theory of radio emission by the sun and by Jupiter.

531. COSMIC RAYS

Fall term. Credit 3 hours. Prerequisite, consent of the instructor. Hours to be arranged. Messrs. Axford and Gold.

Motion of high energy particles through interstellar and interplanetary space. Solar particles and Sun-Earth relations. Intensity time variations. Cosmic rays in the geomagnetic field. Cosmic rays in the galaxy. The origin of cosmic rays.

532. PHYSICS OF THE MAGNETOSPHERE

Spring term. Credit 3 hours. Prerequisite, consent of the instructor. Hours to be arranged. Mr. Axford.

Interaction between charged and neutral components of the ionosphere. Tidal theory of regular magnetic variations. Equatorial anomaly. Sporadic E. Structure and composition of the ionosphere. VLF and ELF emissions. Radiation belts. Aurora. Magnetic storms.

540. ADVANCED STUDY AND RESEARCH

Either term. Credit one to four hours a term. Prerequisite, advanced standing in astronomy and consent of the instructor. Staff.

Upon sufficient demand, seminars will be arranged from time to time in topics not currently covered in regular courses. Typical seminar subjects are high energy particles in astronomy, planetary and lunar physics, geophysics.

560. THEORY OF STELLAR STRUCTURE AND EVOLUTION

Fall term. Credit three hours. Prerequisite, graduate status with good physics background. M W F 2. Given upon sufficient demand (usually in alternate years). Staff.

Summary of observational facts. Dimensional analysis. Nuclear reactions in stars. Models for static and evolving stars. Very massive objects and general relativity. White swarfs and neutron stars.

Chemical Engineering

Faculty: George G. Cocks, Victor H. Edwards, Robert K. Finn, Peter Harriott, Jay E. Hedrick, Jean P. Leinroth, Jr., Ferdinand Rodriguez, George F. Scheele, Julian C. Smith, Raymond G. Thorpe, Robert L. Von Berg, Herbert F. Wiegandt, Charles C. Winding, Robert York.

Field Representative: Charles C. Winding, 124 Olin Hall.

MASTER OF ENGINEERING (CHEMICAL)

The Master of Engineering degree is the only professional engineering degree offered by Cornell University to presently entering students.

Admission to the Master of Engineering (Chemical) degree program is open to persons who have been granted a Bachelor's degree or the equivalent, and whose background indicates that they can profitably study the advanced courses offered by the School of Chemical Engineering. The purpose of this program is to offer study in depth in both comprehensive and specialized chemical engineering subjects and to prepare students for professional careers in advanced engineering practice.

APPROPRIATE MAJOR AND MINOR SUBJECTS FOR GENERAL DEGREES

Biochemical Engineering
Chemical Engineering, General
Chemical Processes and Process Control
Materials Engineering
Nuclear Process Engineering

To qualify for admission, a student must have completed satisfactorily the equivalent of the fundamental work required by an accredited curriculum in chemical engineering. Outstanding students who have received a baccalaureate degree with a major in chemistry will also be considered for admission. Normally an extra year of residence is required of such students to make up work in engineering fundamentals.

A student in a Ph.D. program must demonstrate reading ability in one foreign language chosen from French, German, or Russian. There are no language requirements for the M.S. degree.

"Chemical Engineering, General" is required of all students. Ph.D. candidates are required to select one minor within the Field and one minor outside

the Field. M.S. candidates may choose a minor which can be within or outside the Field. Each M.S. candidate must pass an oral examination on his major and minor subjects and on his thesis. Two examinations are required before a student is designated as a Ph.D. candidate. On recommendation of the faculty, a student will be admitted to the written Field Examination. When this examination has been passed to the satisfaction of the faculty of the Field, the student takes an oral Comprehensive Examination administered by his Special Committee. After the thesis has been completed, an oral final examination, administered by the Special Committee, covering the thesis and related topics must be taken.

Candidates are expected to pursue a course of study and research that will give them a deeper comprehension of the basic and applied sciences and will develop initiative, originality, and creative ability. To achieve this goal the student participates in graduate courses and seminars and must complete an original, individual investigation for a thesis. Theses may involve either experimental research or special projects in such subjects as design, economics, and mathematical analysis. Specific programs are planned to fit the objectives of the student and to develop original thinking. An arbitrarily fixed series of courses is not required, but each student is expected to acquire a strong background in applied mathematics, chemical processes, rate and mass transfer processes, reaction kinetics, and thermodynamics. Outside minor subjects may be chosen from a wide variety of other Fields consistent with the student's objectives.

RESEARCH OPPORTUNITIES

Fluid dynamics, heat transfer, mass transfer, reaction kinetics, stage processes, and thermodynamics may be regarded as the fundamentals of chemical engineering. The Cornell staff is actively working or has interests in many such projects. Although particular projects actively in progress are continually changing, some recent, specific research interests of particular staff members are:

George G. Cocks: microscopy, properties of materials, solid state chemistry, crystallography.

Robert K. Finn: continuous fermentation, agitation and aeration, processing biochemicals, electrophoresis, microbial conversion of hydrocarbons.

Peter Harriott: chemical kinetics and reactor design, process control, diffusion in membranes and porous solids.

J. Eldred Hedrick: economic analyses and forecasts.

Jean P. Leinroth: adsorption, residence time distribution, chemical process development.

Ferdinand Rodriguez: non-Newtonian flow, Redox reactions, electrical and mechanical properties of polymer systems, rheological phenomena.

George F. Scheele: hydrodynamic stability, effect of heat transfer on flow fields.

Julian C. Smith: conductive transfer processes, flow of granual solids, heat transfer, mixing.

Raymond G. Thorpe: phase equilibria, fluid flow, kinetics of polymerization.

Robert L. Von Berg: liquid-liquid extraction, reaction kinetics, effect of radiation on chemical reactions.

Herbert F. Wiegandt: crystallization petroleum processing, saline water conversion, direct contact heat transfer.

Charles C. Winding: degradation of polymers, polymer compounding, filler-polymer systems, differential thermal analysis.

Robert York: mass transfer, diffusion, thermodynamic properties, production of shale oil, chemical market analyses.

COURSES

5105. ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS

Credit three hours. Spring. Three Lectures.

Application of the general thermodynamics method to advanced problems in chemical engineering. Evaluation, estimation, and correlation of properties. Chemical and phase equilibria. Mr. Von Berg.

5106. REACTION KINETICS AND REACTOR DESIGN

Credit three hours. Fall. Three Lectures.

A study of chemical reaction kinetics and principles of reactor design for chemical processes. Mr. Von Berg.

5107. ADVANCED REACTION KINETICS

Credit three hours. Fall. Three Lectures.

Effects of heat transfer, diffusion, and non-ideal flow on reactor performance. Optimum design for complex reactions. Analysis of current literature on topics such as partial oxidation, catalytic cracking, hydrogenation, and polymerization. Mr. Harriott.

5108. COLLOIDAL AND SURFACE PHENOMENA

Credit three hours. Fall.

Lectures, demonstrations, and problems in the physics and chemistry of small particles and surface films. Topics include surface energy, surface films, electrokinetics, and colloidal behavior. Mr. Finn.

5161. PHASE EQUILIBRIA

Credit three hours. Fall. Three Lectures.

A detailed study of the pressure-temperature-composition-relations in binary and multicomponent heterogeneous systems where several phases are of variable composition. Prediction of phase data. Mr. Thorpe.

5205. CHEMICAL PROCESS SEMINAR

Credit two hours. Fall.

A discussion of recent advances in chemical process development. Mr. Wiegandt.

5505. ADVANCED HEAT TRANSFER

Credit three hours. Spring. Three Lectures.

Heat transfer under unsteady-state conditions; numerical approximation methods; analogies among heat, mass, and momentum transfer; heat transfer to liquid metals; simultaneous heat and mass transfer, etc. Mr. Smith.

5506. DIFFUSIONAL OPERATIONS

Credit three hours. Spring. Three Lectures.

Molecular and turbulent diffusion in binary and multicomponent systems; film, boundary layers, and penetration-theory models of mass transfer; applications to distillation, gas absorption, liquid-liquid extraction, and other industrial operations. Mr. Scheele.

5507. ADVANCED FLUID DYNAMICS

Credit three hours. Fall. Three Lectures.

Viscous laminar flow of Newtonian and non-Newtonian fluids; flow stability; turbulent flow; perfect fluid theory; boundary layer theory; analogies among heat, mass, and momentum transfer.

5508. APPLIED MATHEMATICS IN CHEMICAL ENGINEERING

Credit four hours. Fall. Four Lectures.

Series and numerical solutions. Partial differential equations. Fourier Series; Bessel Functions; Laplace transforms. Calculus of finite differences. Applications to heat and mass transfer, reaction kinetics, and catalysis.

5605, 5606, 5607, 5608. DESIGN PROJECTS

Credit variable. Fall and spring.

Individual projects involving the design of chemical processes and plants. Estimation of costs of construction and operation, variation of costs and profits with rate of production, etc. Staff.

5609. ANALYSIS AND DESIGN OF PROCESS EQUIPMENT

Credit three hours. Fall. Three Lectures.

Discussion and analysis of operating principles, design, and selection of chemical process equipment. Mr. Smith.

5621. PROCESS DESIGN AND ECONOMICS

Credit six hours. Fall.

Methods for estimating capital and operating costs. Performances, selection, design, and cost of process equipment. Process development and design. Market research and surveys.

5622. PROCESS AND PLANT DESIGN

Credit six hours. Continuation of 5621.

Process design, including reactors, process equipment, and separating systems. Layout and model of process units. Plant location, design, and layout. Cost estimates and project evaluation; equivalent interest rate of return and discounted cash flow. Mr. York.

5631. SEPARATION PROCESSES

Credit three hours. Fall.

Problems involving the optimum design of equipment for the physical separation of chemical mixtures. Primarily for graduate students.

5632. PROCESS EVALUATION AND DESIGN

Credit four hours. Spring.

Techniques and case studies in evaluating chemical processes. Cost estimation for processes, equipment, and plant.

5635. MARKETING OF CHEMICAL PRODUCTS

Credit three hours. Fall. Three Lectures.

Examination of marketing activities, organizations, and costs in the distribution of chemicals. A market research project is required. Mr. Hedrick.

5636. ECONOMICS OF THE CHEMICAL ENTERPRISE

Credit three hours. Spring. Three Lectures.

Research economics; feasibility studies; information services; venture analysis; depreciation and amortization; planning. Mr. Hedrick.

5641. INVENTIONS, PATENTS, AND TRADE SECRETS

Credit three hours. Fall.

Protection of inventions and trade secrets. Statutory and other legal requirements for patentability of inventions. Evaluation of patents. Role and management of patents in planning growth and expansion. Mr. York.

5642. DEVELOPMENT ECONOMICS

Credit three hours. Spring.

Planning, evaluation, and management of development activities in the process industries as related to research, processing, new products, markets, and long-range growth. Mr. York.

5717. PROCESS CONTROL

Credit three hours. Spring. Two Lectures. One Laboratory.

Dynamic response of processes and control instruments. Use of frequency response analysis, Laplace transforms, and electronic analogs to predict the behavior of feedback control systems. Mr. Harriott.

5741. PETROLEUM REFINING

Credit three hours. Spring. Three Lectures.

A critical analysis of the processes employed in petroleum refining. Mr. Wiegandt.

5742. POLYMERIC MATERIALS

Credit three hours. Fall. Three Lectures.

Chemistry of polymerization reactions, manufacture and properties of synthetic resins, fibers, plastics, and rubbers. Mr. Rodriguez.

5743. PROPERTIES OF POLYMERIC MATERIALS

Credit three hours. Spring. Prerequisite, 5742.

Mechanical, electrical, and optical properties of polymers. Phenomenological aspects and molecular theories of non-Newtonian flow viscoelasticity and ultimate tensile properties. Mr. Rodriguez.

5745. ANALYSIS OF POLYMERIC PROCESSES

Credit three hours. Fall. Three Lectures. Prerequisite, 5742.

Technical and economic evaluations of the principal processes used in manufacture of resins, plastics, and elastomers, including analyses of raw materials, reactor systems, product preparation, and problems in distribution and marketing. Mr. Hedrick.

5746. CASE STUDIES IN THE COMMERCIAL DEVELOPMENT OF CHEMICAL PRODUCTS

Credit three hours. Spring. Three Lectures.

Detailed analysis of specific cases involving the development of new chemical products. Particular emphasis is given to planning activities, research justification, and market forecasting. Profitability calculations and projections are required. Mr. Hedrick.

5748. FERMENTATION ENGINEERING

Credit three hours. Spring. Two Lectures. One Recitation.

An advanced discussion of fermentation as a unit process. Topics include sterilization, aeration, agitation, and continuous fermentation. Mr. Finn.

5749. INDUSTRIAL MICROORGANISMS

Credit one hour. Fall. One Lecture.

A brief introductory course in microbiology for students with a good background in chemistry. Mr. Finn.

5752. POLYMERIC MATERIALS LABORATORY

Credit two hours. Fall. One Laboratory. Prerequisite, 5742.

Experiments in the formation, characterization, fabrication, and testing of polymers. Mr. Rodriguez.

5760. NUCLEAR AND REACTOR ENGINEERING

Credit two hours. Spring. Two Lectures.

Fuel processing and isotope separation, radioactive waste disposal, fuel cycles, radiation damage, biological effects and hazards, shielding, power reactors. Mr. Von Berg.

5859. ADVANCED CHEMICAL MICROSCOPY

Offered on demand either term. Credit variable.

Laboratory practice in special methods and special applications of chemical microscopy. Mr. Cocks.

5900. SEMINAR

Credit one hour. Fall-spring.

General chemical engineering seminar required of all graduate students majoring in the Field of Chemical Engineering.

5909. RESEARCH SEMINAR

Spring. One Lecture.

Required of all students enrolled in the predoctoral honors program. An introduction to the research methods and techniques of chemical engineering. Mr. Winding.

5952, 5953, 5954. RESEARCH PROJECT

Credit three hours; additional credit by special permission. Fall-spring.

Research on an original problem in chemical engineering. Staff.

5955, 5956. SPECIAL PROJECTS IN CHEMICAL ENGINEERING

Credit variable. Either term.

Research or studies on special problems in chemical engineering. Staff.

Chemistry

Faculty: Andreas C. Albrecht, Simon H. Bauer, Alfred T. Blomquist, James M. Burlitch, Richard A. Caldwell, W. Donald Cooke, Robert C. Fay, Michael E. Fisher, Jack H. Freed, David H. Geske, Melvin J. Goldstein, Gordon G. Hammes, J. L. Hoard, Roald Hoffmann, Robert E. Hughes, Edward Kostiner, John E. Lind, Jr., Franklin A. Long, Jerrold Meinwald, William T. Miller, George H. Morrison, Hans Muxfeldt, Robert A. Plane, Richard F. Porter, Harold A. Scheraga, Michell J. Sienko, David A. Usher, Benjamin Widom, Charles F. Wilcox, Jr., J. J. Zuckerman.

Field Representative: Jack H. Freed, 301 Baker Laboratory.

APPROVED MAJOR AND MINOR SUBJECTS

Analytical Chemistry
Bio-organic Chemistry
Biophysical Chemistry
Inorganic Chemistry
Organic Chemistry
Physical Chemistry
Theoretical Chemistry

Language requirement for the Master's degree: none. Language requirement for the Ph.D. Degree: proficiency in German or, with permission of student's Special Committee, Russian.

The program of graduate study in the Field of Chemistry is designed to give a broad training in the fundamental knowledge of chemistry and in methods of research. A graduate student will ordinarily pursue these objectives by taking advanced courses, by participation in organized and informal seminars and discussions with his associates and faculty members, and by carrying out and reporting on a research project in his major subject. Special opportunities are provided by (1) the Materials Science Center at Cornell, which supports several research assistantships for graduate students in chemistry, and (2) a National Institutes of Health Training Grant which similarly provides trainee stipends for work in bio-organic and biophysical chemistry. Upon completion of their study program, graduates normally go out to positions in research laboratories or to positions involving teaching and research.

Candidates for the degree of Master of Science or Doctor of Philosophy with a major in chemistry will be expected to offer for admission the equivalent of an A.B. degree with a major in chemistry. Such training should include courses in general chemistry, mathematics, organic chemistry, physical chemistry, physics, and qualitative and quantitative analysis. Some experience with foreign languages, preferably German and either French or Russian, is also regarded as essential. In admitting students, emphasis is placed on quality of performance and promise for research as judged by those best acquainted with applicants. Unusually promising students may be admitted with deficiencies in undergraduate training. In such cases work designed to make up the deficiencies will be required, and more than the usual period of residence may be necessary.

Proficiency tests will be required of all entering candidates for advanced degrees (M.S. or Ph.D.) with a major in chemistry. These tests are given a few days before registration for the fall term and cover the divisions of analytical, inorganic, organic, and physical chemistry. Each test will be about two and one-half hours in length and will cover material normally presented in elementary courses in the subjects listed above. The results of these tests will be used to aid the student's Special Committee in the planning of his program of study. While the results will not be considered in the usual sense of "passing" or "failing," low marks in one or more of the tests may require enrollment in elementary courses.

Graduate students are encouraged to carry on research during the summer, and a number of Summer Research fellowships are available for this purpose.

Graduate students are required to register with the Department of Chemistry on the registration days at the beginning of each term. Entering students will consult with the Chairman of the Department and with professors composing their temporary Special Committees.

In addition to the courses in chemistry, attention is directed to courses in biochemistry, chemical engineering, including chemical microscopy, and mathematics and physics.

A graduate student who desires to take a minor subject in Chemistry with a major subject from some Field other than Chemistry will be required to offer or acquire a satisfactory background for advanced work. This will ordinarily

consist of an introductory course in general chemistry and of intermediate courses prerequisite to advanced work in the minor subject in Chemistry. The work in his minor subject in Chemistry comprises advanced study planned with the approval of his Special Committee.

Specific inquiries from prospective graduate students are welcomed and should be addressed to the Field Representative or to any member of the faculty. Applications for teaching or research assistantships should be addressed to the Chairman of the Department of Chemistry, Baker Laboratory. A brochure entitled *Graduate Work in Chemistry at Cornell* is available from the Field Representative.

COURSES

411. INORGANIC CHEMISTRY LABORATORY

Fall term. Credit four hours. Prerequisite or parallel course, Chemistry 387, or consent of the instructor. Hours to be arranged. Mr. Fay.

Laboratory experiments illustrating the techniques and scope of modern inorganic chemistry.

421. INTRODUCTION TO INORGANIC RESEARCH

Either term. Credit two or four hours. Prerequisites, Chemistry 387–388 or 285–286 at an average of 80 or better and consent of the instructor. Hours to be arranged. Messrs. Burlitch, Fay, Kostiner, Plane, Porter, Sienko, and Zuckerman.

Informal advanced laboratory and library work, planned individually in consultation with a staff member, involving the preparation and characterization of inorganic substances. A written report is required.

426. INSTRUMENTAL ANALYSIS

Spring term. Credit four hours. Prerequisite, Chemistry 285 or 387 or consent of instructor. Enrollment is limited. Laboratory may be taken separately by graduate students. Lectures, T Th 10. Discussion period to be arranged. Laboratory, one afternoon a week, to be arranged. Mr. Morrison and Assistants.

A discussion of the broad aspects of modern analytical chemistry, including opticometric, electrometric, nuclear, and mass spectrometric methods.

433. INTRODUCTION TO ANALYTICAL RESEARCH

Either term. Credit two or four hours. Prerequisite, Chemistry 388 with an average of 80 or better or consent of instructor. Hours to be arranged. Messrs. Cooke, Geske, and Morrison.

Informal research in the Field of Analytical Chemistry involving both laboratory and library work.

456. IDENTIFICATION OF ORGANIC COMPOUNDS

Fall term. Credit four hours. Prerequisite, Chemistry 358. Lectures, T Th 8. Laboratory, T Th 2–4:30, or F 2–4:30 and S 10–12:30. Mr. Smith.

Laboratory experiments in the separation of mixtures of organic compounds and the application of the classification reactions of organic chemistry to the identification of pure organic substances.

[457. ADVANCED ORGANIC-ANALYTICAL LABORATORY]

Spring term. Credit four hours. Primarily for seniors and graduate students in chemistry. Prerequisites, Chemistry 358 and Chemistry 426, or Chemistry 525,

or consent of the instructor. Discussion. T Th 8. Laboratory, three of the following periods: T Th 9–11:30, M T W Th F 1:40–4:30, S 10–12:30. Not offered in 1966–67.

Laboratory problems illustrating the applications of instrumental analytical techniques to organic research.

461. INTRODUCTION TO ORGANIC RESEARCH

Either term. Credit two to four hours. Prerequisites, 456 or 457 and consent of instructor. Primarily for seniors and graduate students as preparation for advanced and independent work. Enrollment limited for undergraduates to those having a record of 80 or better in prerequisite courses. Laboratory and weekly discussion meeting, hours to be arranged. Messrs. Blomquist, Caldwell, Goldstein, Meinwald, Miller, Usher, and Wilcox.

465–466. ORGANIC CHEMISTRY

Throughout the year. Credit four hours a term. Prerequisite, Chemistry 358. Chemistry 465 is prerequisite to 466. Primarily for upperclass and graduate students. Enrollment limited for undergraduates to those having a record of 80 or better in previous courses in organic chemistry. Lectures, M W F 12. Discussion, to be arranged. Mr. Meinwald.

Fall term: structural theory; resonance; methods of structure determination; conformational analysis and other aspects of stereo-chemistry; introduction to reaction mechanisms; synthesis and characteristic reactions of hydrocarbons. Spring term: synthesis and reactions of the principal classes of organic compounds, with an emphasis on newer developments; the application of mechanistic reasoning to synthetic problems; multi-step syntheses.

[474. PHYSICAL CHEMISTRY OF HIGH POLYMERS]

Spring term. Credit four hours. Prerequisite, Chemistry 286 or 388 or consent of instructor. Primarily for graduate students. Lectures, T Th 8, S 9. Not offered in 1966–67.

477. INTRODUCTION TO RESEARCH IN PHYSICAL CHEMISTRY

Credit two to four hours. Prerequisite, Chemistry 388 at an average of 80 or better and consent of instructor. Hours to be arranged. Messrs. Albrecht, Bauer, Fisher, Freed, Hammes, Hoard, Hoffmann, Hughes, Lind, Long, Porter, Scheraga, and Widom.

Informal advanced laboratory and library work in physical chemistry, planned individually in consultation with a staff member.

481. ADVANCED PHYSICAL CHEMISTRY

Fall term. Credit four hours. Prerequisite, Chemistry 286 or 388. Lecture, M W F 9. Discussion section to be arranged. Mr. Hughes.

A discussion of advanced topics in physical chemistry, including an introduction to the principles of quantum theory and statistical mechanics, atomic and molecular spectra, and elementary valence theory.

505–506. ADVANCED INORGANIC CHEMISTRY

Throughout the year. Credit four hours a term. Prerequisite or parallel course, Chemistry 387–388 or 285–286, or consent of the instructor. Chemistry 505 is prerequisite to Chemistry 506. Open to upperclassmen and graduate students. Lectures, M W F 11. Fall term, Mr. Zuckerman. Spring term, Mr. Kostiner.

Theories of atomic structure and chemical bonding are applied systematically to the elements as they appear in the Periodic System, with emphasis on the stereochemistry of inorganic substances.

515–516. SELECTED TOPICS IN ADVANCED INORGANIC CHEMISTRY

Throughout the year. Credit two hours a term. Students may register for either term separately. Prerequisite, Chemistry 388. Lectures, T Th 12. Messrs. Plane and Weakliem.

Detailed consideration is given each term to one or two special topics selected from the field of theoretical and experimental inorganic chemistry. Topics are varied from year to year. For 1966–67, topics will be Boron Chemistry and Solid State Chemistry.

525. ADVANCED ANALYTICAL CHEMISTRY

Fall term. Credit four hours. Prerequisite, Chemistry 286 or 388. For graduate students except by consent of the instructor. Lectures, M W F 8. Examinations, T 8 p.m. Mr. Cooke.

The application of molecular spectroscopy to chemical problems. Topics discussed include ultraviolet, infrared, NMR, Raman, and mass spectroscopy.

[527. ADVANCED ANALYTICAL CHEMISTRY]

Spring term. Credit four hours. Prerequisite, Chemistry 286 or 388. Primarily for graduate students. Lectures, M W F 8. Mr. Geske. Offered in alternate years; not offered in 1966–67.

565. PHYSICAL ORGANIC CHEMISTRY

Fall term. Credit four hours. Prerequisite, Chemistry 465–466 or consent of instructor. Primarily for graduate students. Lectures, T Th S 12. Mr. Caldwell.

Mechanisms of organic reactions, with particular attention paid to the properties of reactive intermediates: carbonium ions, carbanions, free radicals, carbenes, and electronically excited molecules.

[566. PHYSICAL ORGANIC CHEMISTRY]

Spring term. Credit three hours. Prerequisite, Chemistry 565 or consent of instructor. Primarily for graduate students. Lectures, T Th 12. Mr. Wilcox. Not offered in 1966–67.

568. CHEMICAL PATHWAYS IN METABOLISM

Fall term. Credit four hours. Prerequisites, Chemistry 358 and 388, or their equivalents. Primarily for graduate students. Lectures, T Th S 8. Mr. Usher.

Organic and physical chemical aspects of the mechanisms of processes occurring in the metabolism of living systems. This course forms the chemical basis for the graduate program in molecular biology.

[570. SELECTED TOPICS IN ORGANIC CHEMISTRY]

Fall term. Credit three hours. Prerequisites, 465–466 or consent of instructor. Primarily for graduate students. Not offered in 1966–67.

572. ORGANIC MECHANISMS RELATED TO ENZYME CATALYSIS

Spring term. Credit four hours. Prerequisites, Chemistry 357–358 or equivalent, and a course in general biochemistry. Primarily for graduate students in chemistry and biochemistry. Lectures, M W F 11. Mr. Usher.

574. CHEMISTRY OF NATURAL PRODUCTS

Spring term. Credit three hours. Prerequisites, Chemistry 456 or 457, and 465–466. Primarily for graduate students. Lectures, T Th 9 and discussion period, M 4:30. Mr. Muxfeldt.

Particular attention will be devoted to methods of structure determination and synthesis as applied to selected terpenes, steroids, alkaloids, and antibiotics.

[577. ENZYME KINETICS]

Fall term. Credit four hours. Prerequisites, Chemistry 358 and 388, or their equivalents. Primarily for graduate students. Lectures, T Th S 8. Mr. Hammes. Not offered in 1966–67.

578. THERMODYNAMICS

Spring term. Credit four hours. Prerequisite, 286 or 388. Primarily for graduate students. Lectures, T Th S 9, and a discussion period to be arranged. Mr. Hoard.

Development of the general equations of thermodynamics from the first and second laws. Applications to the study of physicochemical equilibria in gases, liquids, solids, and liquid solutions. Problems.

580. KINETICS OF CHEMICAL REACTIONS

Fall term. Credit four hours. Prerequisites, Chemistry 481 and 578, or consent of instructor. Lectures, M W F 9. Mr. Hammes.

Principles and theories of chemical kinetics; special topics including fast reactions in liquids, enzymatic reactions, shock tubes and molecular beams.

582. SPECIAL TOPICS IN MOLECULAR BIOLOGY

Spring term. Credit four hours. Prerequisite, Chemistry 568 or consent of instructor. Primarily for graduate students. Topics to be announced. Lectures, T Th S 12. Mr. Mandelkern.

Detailed consideration is given to several special topics selected from recent research activity in the field of molecular biology. Topics are varied from year to year.

586. PHYSICAL CHEMISTRY OF PROTEINS

Spring term. Credit four hours. Prerequisite, Chemistry 286 or 388. Primarily for graduate students. Lectures, M W F 8 and S 10. Mr. Scheraga.

Chemical constitution, molecular weight, and structural basis of proteins; thermodynamic, hydrodynamic, optical, and electrical properties; protein and enzyme reactions.

[589. X-RAY CRYSTALLOGRAPHY]

Fall term. Credit four hours. Prerequisite, Physics 322 or consent of instructor. M W F 12. Mr. Hoard. Offered in alternate years. Not offered in 1966–67.

593. QUANTUM MECHANICS I

Fall term. Credit four hours. Prerequisites, Chemistry 279 and Physics 303 (or co-registration in Physics 319) or their equivalents, and co-registration in

Mathematics 421 (or equivalent), or consent of instructor. Lectures, M W F 11. Mr. Widom.

Bohr-Sommerfeld theory, Schrödinger equation, wave packets, uncertainty principle, WKB theory, matrices, orbital and spin angular momentum, exclusion principle, perturbation theory, variational principle, Born-Oppenheimer approximation. At the level of Bohm, *Quantum Theory.*

594. QUANTUM MECHANICS II

Spring term. Credit four hours. Prerequisite, Chemistry 593 or its equivalent. Lectures, M W F 11. Mr. Freed.

Time-dependent phenomena in quantum mechanics and interaction with radiation. Group theory and applications. Topics in molecular quantum mechanics.

596. STATISTICAL MECHANICS

Spring term. Credit four hours. Prerequisite, Chemistry 593 or equivalent is desirable but not required. Primarily for graduate students. Lectures, M W F 11. Mr. Fisher.

Ensembles and partition functions. Thermodynamic properties of ideal gases and crystals. Third law of thermodynamics, equilibrium constants, vapor pressures, imperfect gases, and virial coefficients. Radial distribution functions. Lattice statistics and phase transitions. Bose-Einstein and Fermi-Dirac ideal gases. Maxwell theory of viscosity and heat conduction.

[598. SELECTED TOPICS IN PHYSICAL CHEMISTRY]

Either term. Credit two or four hours.

Detailed consideration is given to special topics selected from the field of theoretical and experimental physical chemistry. Topics are varied from year to year. Not offered in 1966–67.

600. GENERAL CHEMISTRY SEMINAR

Throughout the year. No credit. Th 4:40. A series of talks representative of all fields of current research interest in chemistry, given by advanced graduate students, research associates, faculty members, and distinguished visitors.

601–602. INTRODUCTORY GRADUATE SEMINAR IN ANALYTICAL, INORGANIC, AND PHYSICAL CHEMISTRY

Throughout the year. No credit. Required of all first-year graduate students majoring in analytical, inorganic, physical, or theoretical chemistry, and molecular biology. Hours to be arranged. Messrs. Griffith and Zuckerman.

Weekly seminars on contemporary topics prepared and presented by first-year graduate students. Attention given to details of selecting, preparing, and presenting a given topic. Group preparation and participation emphasized.

650–651. GRADUATE SEMINAR IN ORGANIC CHEMISTRY

Throughout the year. No credit. Open to qualified upperclassmen and graduate students. Required of all graduate students majoring in organic chemistry. M 8 p.m. Mr. Usher.

700. BAKER LECTURES

T Th 11. Spring term: Dr. E. Katchalski, Weizman Institute, Israel.

Civil Engineering

Faculty: Vaughn C. Behn (Sanitary); Donald J. Belcher (Air-Photo); George H. Blessis (Construction Engineering and Administration); Wilfried Brutsaert (Hydrology); Nephi A. Christensen (Hydraulics); Leonard B. Dworsky (Water Resources, Pollution Control); Melvin I. Esrig (Soils); Gordon P. Fisher (Structures); Charles D. Gates (Sanitary); Peter Gergely (Structures); Walter H. Graf (Hydraulics); David J. Henkel (Soils); William L. Hewitt (Transportation); Taylor D. Lewis (Transportation); Ta Liang (Soils – Air-Photo); James A. Liggett (Hydraulics); Daniel P. Loucks (Sanitary); Walter R. Lynn (Systems – Sanitary); George B. Lyon (Surveying); William McGuire (Structures); Arthur J. McNair (Geodesy – Photogrammetry); Arthur H. Nilson (Structures); William L. Richards (Construction Engineering and Administration); Floyd O. Slate (Engineering Materials); Richard N. White (Structures); George Winter (Structures); David A. Woolhiser (Water Resources).

Field Representative: James A. Liggett, 117 Hollister Hall.

APPROVED MAJOR AND MINOR SUBJECTS FOR M.S. AND PH.D. DEGREES

APPROPRIATE MAJOR SUBJECTS	APPROPRIATE MINOR SUBJECTS
Aerial Photographic Studies (M.S. only)	Aerial Photographic Studies
Construction Engineering and Administration (M.S. only)	Construction Engineering and Administration
Geodetic and Photogrammetric Engineering	Geodetic and Photogrammetric Engineering
Hydraulic Engineering (M.S. only)	Hydraulic Engineering
Hydraulics	Hydraulics
Sanitary Engineering	Sanitary Engineering
Soil Mechanics and Foundation Engineering	Sanitary Sciences
Structural Engineering	Soil Mechanics and Foundation Engineering
Transportation Engineering	Structural Engineering
Water Resources Engineering (Ph.D. only)	Structural Mechanics
	Transportation Engineering
	Water Resources Engineering

PROFESSIONAL DEGREE

The School of Civil Engineering also offers the professional degree of Master of Engineering (Civil) which is intended primarily for those students who intend to enter engineering practice and who do not intend to obtain the doctorate. Work for this degree consists of courses which are designed to give the student a background in the elements of engineering design as well as a broad fundamental base. Those choosing the professional degree may concentrate their studies toward one or more of the sub-areas of civil engineering listed below or they may take a broad program without specific concentration.

ADMISSION REQUIREMENTS. To be admitted for graduate study in the Field of Civil Engineering, an applicant should hold a Bachelor's degree (or equivalent) in engineering, mathematics, or the sciences from a college of recognized standing.

LANGUAGE REQUIREMENTS. There are no language requirements for the M.S. degree in Civil Engineering or M.Engr. (Civil) degree. The Ph.D. requires a reading knowledge of two foreign languages, usually from French, German, or Russian.

EXAMINATIONS. Civil Engineering requires a final Comprehensive Examination for the M.S. degree. For the Ph.D. degree the student must take (a) a Qualifying Examination shortly after receiving his M.S. (which may be combined with the examination for the M.S.) or, if he comes to Cornell with an M.S., shortly after arrival; (b) a general examination on subject matter taken approximately at the time he completes his course work; and (c) a final examination in which the student is required to defend his dissertation.

FINANCIAL AID. Fellowships, traineeships, research assistantships, teaching assistantships, and laboratory assistantships are available to students seeking financial aid.

Additional information on specific programs is available by writing to the Field Representative, School of Civil Engineering. Study and research is usually carried on in one of the following areas:

COURSES AND RESEARCH

Civil Engineering Materials

2010. ADVANCED PLAIN CONCRETE

Credit 2 hrs. Spring. 2 Lect. Prerequisite, 2001 or the equivalent.

Topics in the field of concrete, such as history of cementing materials, air-entrainment, light weight aggregates, petrography, durability, chemical reactions, and properties of aggregates. Relationships between internal structure, physical properties, chemical properties, and the mechanical properties of interest to the design and construction engineer.

2011. STRUCTURE AND PROPERTIES OF MATTER

Credit 3 hrs. Fall. 2 Lect. plus conference. Open to graduate students in engineering or the physical sciences or by consent of instructor.

Internal structure of materials ranging from the amorphous to the crystalline state. Correlation of the internal structures of materials with their physical and mechanical properties, primarily on a qualitative basis. Applications to various engineering materials.

2041. CIVIL ENGINEERING MATERIALS PROJECT

On demand. Credit 1–6 hrs.

Individual projects involving civil engineering materials.

2042. CIVIL ENGINEERING MATERIALS RESEARCH

On demand. Hours and credit variable.

Individual assignments, investigations and/or experiments with civil engineering materials.

2044. SPECIAL TOPICS IN MATERIALS

On demand. Hours and credit variable. Fall-spring.

Geodetic and Photogrammetric Engineering and Aerial Photographic Studies

The laboratory facilities available to students in this area include a broad cross-section of modern optical tooling equipment, levels, theodolites, a double projection type stereoplotter, and a world-wide collection of aerial photography.

Recent research projects have included: satellite triangulation, developments in analytic aerotriangulation including triplets (three-eyed man) and sub-block adjustments, and panoramic photography, geodetic network adjustments and multisensor interpretation.

2107. ELEMENTS OF SURVEYING

Credit 2 hrs. Fall-spring. 1 Rec., 1 Lab.

Fundamentals of engineering measurements. Study of observations and errors. Principles of recording data. Use of steel tape, level, and transit. Optical tooling. Photogrammetry. Problems of particular interest to students in fields other than civil engineering.

2111. ELEMENTARY GEODESY

Credit 3 hrs. Fall. 3 Rec.

Principal problems of geodesy. Coordinate systems, reference datum. Geometric problems on earth ellipsoid. Geometric astronomy. Bjerhammar singular matrix calculus; singular matrices in geometry.

2112. GEOPHYSICAL GEODESY

Credit 3 hrs. Spring. 3 Rec.

Basic potential theory, Laplace and Poisson equations; gravity and potential field in, on, and outside the spheroid; figure of the earth, application of Stokes formula for determining undulations of the geoid and deflection of the vertical; applications of spherical harmonics.

2113. GEODETIC CONTROL SURVEYS

Credit 3 hrs. 2 Rec., 1 Lab. Prerequisite, 2102 or 2111.

Principles of establishing a geodetic sea-level datum; isostasy, the geoid and ellipsoid; altimetry, trigonometric, spirit, and electronic leveling; orthometric and dynamic heights; electronic distance measurement; triangulation and trilateration; design of control networks and systems; astronomic and gravimetric observations, and satellite triangulation.

2115. ADVANCED ENGINEERING MEASUREMENTS

Credit 3 hrs. Fall. Prerequisites, laboratory work involving physical measurements, Math 294, and permission of the instructor.

Measurement systems; analysis of errors and of error propagation; application of the principles of probability to the results of measurements for the purpose of determining the best estimates of measured and deduced quantities, and the best estimate of uncertainty in these quantities; adjustment of conditioned measurements by the methods of least squares and other methods; curve fitting; and related data processing methods.

2119. MAP PROJECTIONS

On demand. Credit 3 hrs.

Theory of map projections including conformal, equal-area, azimuthal equi-

distant, et al. projections; coordinate transformations; plane coordinate systems for surveying.

2121. ELEMENTS OF PHOTOGRAMMETRY

Credit 3 hrs. Fall. Lect., Rec., Lab.

Principles and practice of terrestrial and aerial photogrammetric mapping, including planning flights, control surveys, uncontrolled mosaics, radialline control, simple stereoplotting instruments, parallax distortions, graphical tilt determination, trimetrogen charting, and economics. A Balplex projection stereoplotter with three projectors is available for use.

2122. ADVANCED PHOTOGRAMMETRY

Credit 3 hrs. Spring. 2 Rec., 1 Lab. Prerequisite, 2121.

An advanced study of phogrammetric principles including: controlled mosaics; rectification; graphical anud instrumental aerotriangulation. Principles of photogrammetric plotters and systems and the economic relation of these to density of ground control, office methods, and personnel. Balplex projection plotter is used extensively.

2123. ANALYTIC AEROTRIANGULATION

Credit 3 hrs. 3 Rec. Prerequisite, 2121.

Analysis, theories, and computation of stereostrip triangulation by direction cosines, vector, and matrix methods. Coplanarity and colinearity equations for relative orientation and absolute orientation. Stereogram assemblage and coordinate transformation of strip and block coordinates. Cantilever extension and general bridging solutions. Propagation of errors.

2131. LAND SURVEYING

On demand. Credit 3 hrs. 3 Rec.

Functions and responsibilities of a land surveyor; deeds and land descriptions; land records and land courts. Study of U.S. public land system, metes and bounds, subdivisions, resurveys, cadastral surveys, riparian rights, mineral land surveys, and other land survey systems. Specifications and registration.

2132. CARTOGRAPHY

On demand. Credit 2 hrs.

Study of the needs of map users and methods of production of maps to meet these needs. Cartographic principles, systems, and economics.

2133. ENGINEERING SURVEYS

Credit 3 hrs. Spring. 1 Rec., 2 Labs. Prerequisite, 2101 or equivalent.

Circular curves, transition curves, earthwork measurement and calculation, construction surveys, and project planning from maps.

[2134. SUMMER SURVEY CAMP]

Not offered in 1966–67.

2141. PROJECT, GEODETIC OR PHOTOGRAMMETRIC ENGINEERING

On demand. Open to specially selected seniors or graduate students.

Projects in the various fields of geodesy and photogrammetry may be developed by conference between professors and students. Hours and credit variable.

2142. GEODETIC OR PHOTOGRAMMETRIC ENGINEERING RESEARCH

On demand. Prerequisites will depend upon the area of studies to be pursued.

Special problems in error analysis, geodesy, and photogrammetry as may be arranged.

2143. SEMINAR IN GEODESY OR PHOTOGRAMMETRY

On demand. Credit 1–6 hrs. Open to specially selected seniors or graduate students.

Abstraction and discussion of technical papers and publications in the geodetic or photogrammetric field.

See also course in photo-interpretation under "Transportation."

Construction Engineering and Administration

Programs may be arranged to suit the student's background and objectives. In general, emphasis is placed on preparing the student in modern quantitative methods that can aid the engineer-manager in determining the most advantageous course of action to take under a given set of conditions.

2901. CONSTRUCTION ENGINEERING

Credit 3 hrs. Fall. 3 Rec.

Introduction to methods, equipment, and engineering principles and procedures involved in construction activities; major emphasis is on heavy construction such as large earth-moving projects, tunnels, caisson foundations, etc.; problems and oral reports by students based on current literature.

2902. LAW FOR ENGINEERS

Credit 3 hrs. Fall-Spring. 3 Rec.

Basic features of laws and practices relating to contracts, torts, agency, property, water rights, business organizations, sales, insurance, labor, governmental regulation of business, negotiable instruments, workmen's compensation, patents, ethical responsibilities of the engineer; term paper dealing with the comparative analysis of the legal principles which affected the court decisions in some actual cases.

2904. PUBLIC ADMINISTRATION

On demand. Credit 3 hrs. 3 Rec.

Aspects of federal, state, and local government of interest to engineers, planners, constructors, and administrators: general principles of administration; patterns of government; the engineer's role in government; problems posed by our rapidly growing population and urbanization; regional public works projects; city and regional planning; codes; zoning; planning capital improvements; the city manager; managing and operating the engineering and other functions of municipalities.

2906. LEGAL PROBLEMS IN CONSTRUCTION

Credit 3 hrs. Spring. 3 Rec. Prerequisite, 2902.

An intensive investigation by the use of case material into the legal principles and practices affecting the work of the civil engineer in construction, particularly unknown site conditions, difficulties in construction, extensions of time, employer-employee relationships, liabilities of engineers and

contractors to third parties, acquisitions of rights-of-way; detailed study of contract documents used in construction.

2907. CONSTRUCTION MANAGEMENT

Credit 3 hrs.

Planning and operation of construction projects by the civil engineer: coordinated organizations and control of men, materials, and machines; scheduling; estimating; purchasing; selection and training of employees; operation and maintenance of equipment; cost control; accident prevention; and other topics. Special reports required.

2908. ENGINEERING PRACTICE

Credit 3 hrs. On demand. Prerequisite, fourth year or graduate standing.

Analysis of large engineering works; planning and organizing engineering and construction projects; professional practice; feasibility evaluations; financial justification of projects; social and political implications. The case method will be used extensively. Dean Emeritus Hollister.

2941. PROJECT, CONSTRUCTION ENGINEERING AND ADMINISTRATION

Credit 3 hrs. On demand. Prerequisites, 2901, 2902, 2903, or permission.

Development of a public or private engineering project selected by the student, involving economic analysis, planning, design, and construction procedures, with special emphasis on the legal, financial, and management aspects.

2942. CONSTRUCTION ENGINEERING AND ADMINISTRATION RESEARCH

On demand. Credit 3 hrs. Prerequisites, 2901, 2902, 2903, or permission.

Investigation of special problems relating to the economic, legal, financial, and management aspects of public and private engineering operation of interest to the engineer-administrator, consulting engineer, and constructor.

2943. CONSTRUCTION ENGINEERING AND ADMINISTRATION SEMINAR

On demand. Credit 1–6 hrs. Prerequisites, (or concurrently), 2901, 2902, 2903, or permission.

Guided study and discussions by small groups of selected students of topics which involve the legal, financial, and management aspects of civil engineering in public and private work, including discussions of current technical papers and publications.

Hydraulics and Hydraulic Engineering

Two modern laboratories are available for instruction and research. The Hollister Hall Laboratory is equipped for instruction in all phases of fluid mechanics and for many types of research. The department also operates the Cornell University Applied Hydraulics Laboratory on the Cornell campus. This laboratory draws water from nearby Beebe Lake and provides flows up to fifty cubic feet per second and heads up to eighty feet. Unusual facilities are available for research in all aspects of fluid mechanics.

At present the department is carrying on research in: mathematical models of hydrologic systems, secondary currents in non-circular conduits, settling velocities in turbulent regimes, frictional effects in rivers and waterways, vari-

ation of Karman's K-value in pipes carrying suspensions, recession hydrographs of idealized unconfined aquifers, and non-Newtonian flow in clayey porous media.

2303. HYDROLOGY

Credit 2 hrs. Fall. 2 Lect.-Rec. Prerequisite, 2301.

Introduction to hydrology including topics on precipitation, evapotranspiration, ground water, surface water, and sedimentation. Mr. Brutsaert.

2312. EXPERIMENTAL AND NUMERICAL METHODS IN FLUID MECHANICS

Credit 2 hrs. Fall-spring. Prerequisite, 2302 or permission of instructor.

Primarily a laboratory course for undergraduates and graduates; may be repeated for credit on permission of the instructor. Emphasis is on planning and conducting laboratory and field experiments and on numerical computation. Each section is limited to 4 students. Staff.

2315. ADVANCED FLUID MECHANICS I

Credit 3 hrs. Fall. 3 Rec. Prerequisite, 2301.

Introduction to vector and tensor notation. The equations of conservation of mass, momentum, and energy from a rigorous point of view. Similitude and modeling potential flow including circulation, vorticity, conformal mapping, and hodograph methods. Mr. Liggett.

2316. ADVANCED FLUID MECHANICS II

Credit 3 hrs. Spring. 3 Rec. Prerequisite, 2315.

Exact solutions to the Navier-Stokes equations, the laminar and turbulent boundary layers, turbulence, introduction to non-Newtonian flow, and other topics. Mr. Liggett.

2317. FREE SURFACE FLOW

Credit 3 hrs. Spring. 3 Rec. Prerequisite, 2315 or permission of instructor.

The formulation of the free surface equations and boundary conditions. Shallow water theory and the theory of characteristics. Unsteady and two-dimensional flow in open channels. Theory of small amplitude waves. Mr. Liggett.

2320. SURFACE-WATER HYDROLOGY

Credit 3 hrs. Fall. Prerequisite, 2301.

Physical analysis and design relative to hydrologic processes. Hydrometeorology, runoff, floods, unit-hydrograph procedures, channel and reservoir routing. Mr. Brutsaert.

2321. FLOW IN POROUS MEDIA

Credit 3 hrs. Spring. Prerequisite, 2301 (also recommended, 2315).

Fluid mechanics of flow through porous solids. The general equations of single phase and multiphase flow and the methods of solving the differential form of these equations. Hydraulics of wells, of infiltration and of ground water recharge, and of other steady state and transient seepage problems. Mr. Brutsaert.

2331. RIVER AND COASTAL HYDRAULICS

Credit 3 hrs. Fall. Prerequisite, 2302 or permission of instructor.

The first part of this course deals with the hydraulics of fixed bed channels including the specific energy concept, secondary currents, rapid flow problems, artificial obsructions in channels, and the general problem of frictional resistance. In the second part of the course attention is paid to coastal and oceanographical engineering problems including the theory of waves, breaking of waves, wave refraction, and wave diffraction. Mr. Graf.

2332. SEDIMENT TRANSPORT

Credit 3 hrs. Spring. Prerequisite, 2331 or permission of instructor.

Hydraulics of channels with a movable bed including particle mechanics, critical tractive force theory, the DuBoys Problem, the Swiss formulas, Einstein's Bedload theory, the suspension and saltation theory, calculation of total sediment loads. Interesting problems in fluvial hydraulics will be included. Mr. Graf.

2333. FLUVIAL PROCESSES (or 522 Geological Sciences)

Spring. Credit 2 hrs. Prereq., consent of instructors. Seminar, hours to be arranged, field trips. Course offered jointly with Department of Geological Sciences. On demand.

The common problems of fluvial processes, hydraulics, and sediment transport are studied along with the appropriate analytical methods and experimental techniques. Messrs. Graf and Kiersch.

2341. PROJECT

Offered on demand. Hours and credit variable. The student may elect a design problem or undertake the design and construction of a special piece of equipment in the areas of fluids mechanics, hydraulic engineering, or hydrology.

2342. RESEARCH IN HYDRAULICS

Offered on demand. Hours and credit variable. The student may select an area of investigation in fluid mechanics, hydraulic engineering, or hydrology. The work may be either of an experimental or theoretical nature. Results should be submitted to the instructor in charge in the form of a research report.

2343. HYDRAULICS SEMINAR

Credit 1 hr. Fall-spring. Open to undergraduates and graduates and required of graduate students majoring in hydraulics or hydraulic engineering. Topics of current interest in fluid mechanics, hydraulic engineering, and hydrology are presented and discussed.

2344. SPECIAL TOPICS IN HYDRAULICS

Offered on demand. Hours and credit variable. Special topics in fluid mechanics, hydraulic engineering, or hydrology are presented when a group of students expresses an interest or when an especially qualified person appears on campus.

Sanitary Engineering

Graduate study and research in sanitary engineering is directed toward the application of biological, physical, and mathematical principles to the analysis and design of water and waste-water treatment processes and of water and other environmental quality control systems.

Laboratories are designed and equipped for instruction and research in the chemical, microbiological and engineering aspects of water quality control.

Active research being carried on by members of the department includes: mathematical formulation of trickling filter performance, mass transfer in biological waste treatment, continuous sludge thickening operations, oxidation of organic wastes in eutropic environments, development of decision models for evaluation of environmental control policies, development of mathematical decision models for the operation of developed water resource systems, optimization of design of waste-water treatment systems, and simulation of water resource systems.

2502. WATER AND WASTE-WATER TREATMENT PROCESSES

Credit 3 hrs. 2 Lect., 1 Lab. Spring. Prerequisites, 2301, 2302.

Study of the microbiological, chemical, and physical phenomena underlying the treatment of water and of municipal and industrial waste-water. Application of these principles to the analysis and design of unit treatment processes. Laboratory studies of water quality and of unit treatment processes. Staff.

2509. ENVIRONMENTAL SANITATION

Open to non-civil engineering students. Credit 3 hrs. Fall. Lect.-Discuss., reports and field trips.

Environmental health concepts and methods, and their application to environmental planning and control at the subdivision, municipal, and metropolitan levels. Introduction to: water resource planning and development; water quality control; water supply; municipal, industrial, and private waste-water disposal; air quality control; solid waste disposal and radiological health. Mr. Gates.

2510. CHEMISTRY OF WATER AND WASTE-WATER

Credit 3 hrs. 2 Lect.-Rec., 1 Lab. Fall. Prerequisite, one year of college chemistry.

Principles of chemistry applicable to the understanding, design, and control of water and waste-water treatment processes and to reactions in receiving waters. Analytical methods applicable to the measurement and control of air and water quality. Staff.

2512. MICROBIOLOGY OF WATER AND WASTE-WATER

Credit 3 hrs. 2 Lect., 1 Lab. Spring.

Introduction to the characteristics of microorganisms, their interaction with the environment; and their effect on water quality. Their role in the oxidation of organic substances in waste-water treatment and in receiving waters. Bacteriological, biological, and limnological parameters of water quality and their measurement. Mr. Gates.

2513. TREATMENT PROCESSES

Credit 3 hrs. 3 Lect. Fall. Prerequisite, 2502 or equivalent.

Analysis and design of processes for the removal of impurities from water and from municipal and industrial waste-water. Theoretical and applied aspects of treatment process design, including reaction kinetics, transfer phenomena, and the mechanics of fine particles. Mr. Behn.

2514. ASSIMILATION OF WASTES IN WATER

Credit 3 hrs. 3 Lect. Spring. Prerequisite, appropriate undergraduate course.

Capacity of water resources to assimilate gaseous liquid and particulate

wastes. Phenomena pertinent to the dispersion and stabilization of wastes in water. Analog and digital computer methods. Emphasis on the advanced literature. Mr. Behn.

2515. WATER RESOURCES PROBLEMS AND POLICIES

Credit 3 hrs. Lect.-Discuss. Fall. Prerequisite, permission of the instructor.

Intended primarily for graduate engineering and non-engineering students but open to qualified undergraduates. A comprehensive approach to water resources planning and development. Historical and contemporary perspectives of water resources problems, organization and policies. Mr. Dworsky.

2516. PHYSICAL BASIS OF WATER RESOURCE PLANNING

Credit 2 hrs. Lect.-Discuss. Fall. Intended primarily for non-engineering graduate students taking water resources as a minor subject.

An introduction to hydrologic systems with topics in climate; surface and ground water flow; flood abatement and water quality control. Offers technical background material useful in subsequent courses in the water resources area. Mr. Woolhiser.

2517. ENVIRONMENTAL SYSTEMS ANALYSIS I

Credit 3 hrs. 3 Lect. Spring. Prerequisite, permission of the instructor. Intended for graduate students but open to qualified undergraduates.

Structuring and solution of mathematical programming models with emphasis on linear programming and its extensions. Introduction to Lagrangian multipliers, dynamic programming, queuing theory and game theory. Application of systems analysis techniques to the solution of complex environmental engineering-economic problems. Mr. Lynn or Mr. Loucks.

2518. ENVIRONMENTAL SYSTEMS ANALYSIS II

Credit 3 hrs. 3 Lect. Fall or Spring. Prerequisite, Engineering 9320, 9522, or 9530 or permission of the instructor.

Advanced topics in the application of mathematical programming and probability theory to the solution of environmental engineering problems. Special emphasis on water resource systems planning and management. Students will be expected to identify and solve practical problems using systems analysis techniques. Mr. Loucks.

2520. ENVIRONMENTAL HEALTH ENGINEERING

Credit 3 hrs. 3 Lect., Reports. Spring. Prerequisite, 2501, or equivalent, or permission of the instructor.

Concepts of environmental health, principles of epidemiology and of toxicology. Introduction to radiological health. Consideration of problems in environmental control with emphasis on water, quality control, air quality control, and solid waste disposal. Mr. Gates.

2521. SIMULATION OF WATER RESOURCE SYSTEMS

Credit 3 hrs. On demand. Prerequisite, courses in hydrology, statistics, and water resource economics.

Simulation of hydrologic inputs to water resource systems and the physical and economic response of such systems. Use of simulation as a complement to analytic techniques in the design and operation of water resource systems. Examination of the net-benefit response surfaces by random and uniform grid sampling, method of steepest ascent and other optimizing techniques. Mr. Woolhiser, Mr. Falkson.

2535. THE LEGAL BASIS OF WATER RESOURCES PLANNING

Credit 3 hrs. Spring or Fall. Prerequisite, permission of the instructor.

The course is designed specifically for non-law students interested in the legal aspects of water resources planning, development, and management. Mr. Farnham.

2541. DESIGN PROJECT IN WATER RESOURCES ENGINEERING OR IN SANITARY ENGINEERING

On demand. Credit variable. Prerequisites, 2501 or 2502 or equivalent.

The student will elect or be assigned problems in the design of water and waste-water treatment processes or plants; waste-water disposal systems; water quality control systems; water resource development or management systems; or of laboratory apparatus of special interest. Staff.

2542. SANITARY ENGINEERING RESEARCH

On demand. Credit variable. Prerequisites will depend upon the particular investigation to be undertaken.

For the student who wishes to study a special topic or problem in greater depth than is possible in formal courses.

2543. SANITARY ENGINEERING COLLOQUIUM

Credit 1–2 hrs. Fall-spring. Required of all graduate students taking a major or minor in sanitary engineering; open to undergraduates by permission of instructor.

Preparation, presentation, and discussion of topics and problems of current interest in sanitary engineering and water resources engineering.

2545. WATER RESOURCES PLANNING SEMINAR (Also Economics 638)

Credit 3 hrs. Spring. Prerequisite, 2515 or permission of the instructor.

The concepts, processes and techniques of regional, multi-purpose river basin planning and development. The case study method, including the preparation of an integrated, comprehensive report for the study area, is followed. Mr. Dworsky.

2547. SEMINAR IN WATER RESOURCES SYSTEMS ANALYSIS (Also Economics 640)

Credit 4 hrs. Spring or Fall. Prerequisite, permission of the instructor which will be based on the student's ability to contribute substantially to the seminar.

An interdisciplinary approach to the solution of a complex problem in water resources engineering involving the application of systems analysis, statistics, economic theory, hydrology, and hydraulic and sanitary engineering. Each student will study and discuss a particular aspect of the problem. The results of the individual studies should contribute to the solution of the over-all problem. Taught by engineering and economics faculty.

Soil Mechanics and Foundation Engineering

Graduate programs are designed to provide a sound practical and theoretical background in the varied aspects of the subject. Case studies and design projects are used to stress the importance of the geological environment in the solution of practical engineering problems.

The research interests of the faculty members cover a wide range of problems including: studies of the effects of weathering on the strength proper-

ties of soils, the changes in soil properties associated with the flow of electric currents through the soil, the strength and deformation properties of soils under complex stress systems with a view to the development of satisfactory general stress-strain relationships for soils, and problems associated with land — slides and the behavior of soils and soft rocks under high pressures.

2406. FOUNDATION ENGINEERING

Credit 3 hrs. Spring. 3 Lect. Prerequisite, 2401.

Principles of bearing capacity and deformation theory; stress distribution; shallow and deep foundations; prediction of settlement; design of footing, raft, caisson and pile foundations. Problems of construction, support of excavations; ground water lowering. Foundation investigations.

2410. ENGINEERING PROPERTIES OF SOILS

Credit 3 hrs. Fall. 3 Lect. Prerequisite, 2401.

The natural environments in which soils are formed; the chemical and physical nature of soils; soil classification; the principle of effective stress; shear strength and compressibility of saturated and partly saturated soils; sensitivity; effects of anisotropic consolidation; permeability; laboratory and field tests.

2412. GRADUATE SOIL MECHANICS LABORATORY

Credit 3 hrs. Spring. Prerequisite, 2410.

The laboratory measurement of soil properties; classification tests; direct shear tests; triaxial tests for the measurement of pore water pressure; strength parameters. Pore pressure dissipation tests. Relationship of laboratory tests to field behavior.

2414. EARTH PRESSURE AND SEEPAGE

Credit 3 hrs. Fall. 3 Lect. Prerequisite, 2401.

The mechanics of the development of earth pressure in relation to soil properties and the imposed deformation conditions. The effects of seepage on the development of earth pressure. Design and stability of bulkheads and cofferdams. Pressures on shafts, tunnels, and conduits.

The steady and transient flow of fluids through compressible and incompressible porous media. Consolidation processes. Sand drains. Field determination of permeability. Flow nets and the modification of flow patterns by drains and relief wells.

2416. SLOPE STABILITY, EARTH AND ROCK-FILL DAMS

Credit 3 hrs. Spring. 3 Lect. Prerequisite, 2410.

Principles of stability for earth and rock slopes; problems of draw-down; analysis of landslides and dam stability; principles of earth and rock-fill dam design; internal pore water pressures and drainage; filters; relief wells; foundation problems; grouting; cut-offs; control and instrumentation.

2430. CASE STUDIES IN SOIL MECHANICS AND FOUNDATION ENGINEERING

Credit 3 hrs. Spring.

The study of real engineering problems of various types; the importance of the geological environment in recognizing the nature of field problems; the application of mechanics and soil properties to obtain engineering solutions. The preparation of engineering reports.

2441. DESIGN PROJECT IN SOIL MECHANICS AND FOUNDATION ENGINEERING

Credit 1–6 hrs. On demand.

Design problems associated with the Master of Engineering Program.

2442. RESEARCH IN SOIL MECHANICS AND FOUNDATION ENGINEERING

Credit 1–6 hrs. On demand.

For students who wish to study one particular area of soil mechanics and foundation engineering in depth. The work may take the form of a laboratory investigation, field study, theoretical analyses, or the development of design procedures.

2443. SEMINAR IN SOIL MECHANICS AND FOUNDATION ENGINEERING

Credit 1–2 hrs. On demand.

Presentation and discussion of technical papers and current research in the general field of soil mechanics and foundation engineering.

2444. SPECIAL TOPICS IN SOIL MECHANICS AND FOUNDATION ENGINEERING

Credit 1–6 hrs. On demand.

Supervised study in small groups in one or more special topics not covered in the regular courses. Special topics may be of a theoretical or practical nature.

Structural Engineering

Structural engineering embraces not only the more conventional aspects of civil engineering design but also other structural work, such as aeronautical and space structures, nuclear engineering structures, tanks, bins, pressure vessels, antenna towers, and the like. Emphasis is placed on the common fundamental background, theoretical and experimental, of all structural engineering.

Complete facilities for experimental structural research of all kinds are available including a structural testing hall 50 feet in plan, and 45 feet high for full-scale three-dimensional static and fatigue testing of structures; static- and fatigue-testing machines of a variety of capacities; appropriate measuring equipment; and a laboratory for structural model analysis.

The department has a large number of externally and internally sponsored research projects upon which students can base theses and receive research assistantships. The externally sponsored projects include: shell structure of light-gage steel, microcracking of concrete and its influence on structural behavior and fracture, shear strength of light gage steel diaphragms, behavior of beams and columns continuously braced by diaphragms, performance of stainless steel structural members, torsional-flexural buckling of eccentrically loaded columns, fundamental concepts of cracking phenomena in reinforced concrete structures, effects of cold forming on performance of light gage steel members, reinforced concrete models, and thermal stresses in nuclear reactors.

A separate brochure on *Structural Engineering at Cornell University* is available on request from the School of Civil Engineering.

2710. STRENGTH OF STRUCTURES

Credit 3 hrs. Fall. 3 Rec. Prerequisite, 2704; can be taken concurrently.

Analysis of two- and three-dimensional stress and strain. Theories of failure of ductile and brittle materials. Microstructure of materials. Structural materials under load, strain hardening, Bauschinger effect residual stresses, hysteresis, stress concentration, brittle fracture, creep, alternating stress. Design for fatigue. Stresses beyond the elastic limit. Inelastic behavior of steel and reinforced concrete structures. Critical discussion of recent research and current design specifications. Mr. Winter.

2711. BUCKLING: ELASTIC AND INELASTIC

Credit 3 hrs. Spring. Prerequisite, 2710.

Analysis of elastic and plastic stability. Determination of buckling loads and postbuckling behavior of columns. Solid and open web columns with variable cross-section. Beam columns. Frame buckling. Torsional-flexural buckling. Lateral strength of unbraced beams. Buckling loads and post-buckling strength of plates, shear webs, and cylindrical shells. Critical discussion of current design specification. Mr. Winter.

2712. ADVANCED STRUCTURAL ANALYSIS

Credit 2 or 3 hrs. Fall. 3 Lect. per week. Prerequisite, 2703 or equivalent.

Brief review of fundamental methods of analyzing hyperstatic structures and extension to complex structural systems. Real, virtual, and complementary work theorems. Elastic arch theory and design considerations. Curved beams, out-of-plane loading, grids, suspension systems, and other special structures. Plastic analysis. Mr. Fisher.

2713. MATRIX STRUCTURAL ANALYSIS

Credit 3 hrs. Spring. 3 Lect. per week. Prerequisites, 2712 or equivalent, short course in computer programming, and consent of instructor.

The use of matrix algebraic methods of analysis of complex frameworks. Matrix formulation of generalized hyperstatic analysis, including generalized flexibilities of finite structural elements. Idealization techniques. Finite beam theory with applications to members on spring foundations, to secondary arch analysis, and to the analysis of suspension bridges. Use of digital computer (currently CDC 1604) for solution of problems. Mr. Fisher or Mr. Nilson.

2714. STRUCTURAL MODEL ANALYSIS AND EXPERIMENTAL METHODS

Credit 3 hrs. Spring. 2 Lect., 1 2-hr. period. Prerequisite, indeterminate analysis.

Dimensional analysis and principles of similitude. Indirect model analysis of beams, frames, and trusses. Direct model analysis including loading and instrumentation techniques. Strain measurement and interpretation. Confidence levels for model results. Laboratory projects in elastic behavior and ultimate strength of model structures. Mr. White.

2715. NUMERICAL METHODS IN STRUCTURAL ENGINEERING

Credit 3 hrs. Fall. Prerequisites, differential equations and consent of instructor; concurrent registration in FORTRAN instruction.

Newmark's method and other numerical integration techniques. Solution of linear systems. Finite difference techniques for stress, stability, and other boundary value problems. Eigenvalue determination. Applications of digital computers in structural engineering analysis and design, including introduction to optimization techniques. Independent projects involving extensive use of digital computer. Mr. White.

2716, 2717. BEHAVIOR AND DESIGN OF CONCRETE STRUCTURES

Credit 3 hrs. a term. Fall-Spring. Prerequisite 2703 or equivalent.

Analysis, design, and behavior of prestressed concrete and continuous reinforced concrete frameworks. Design of folded plate structures. Mr. Nilson.

2718, 2719. BEHAVIOR AND DESIGN OF METAL STRUCTURES

Credit 3 hrs. a term. Fall-Spring. Prerequisite, 2703 or equivalent.

Contemporary methods for analyzing and designing metal structures. Behavior of structural elements and frames. Selected design applications from the fields of steel plate structures, bridges, suspension systems, light weight structures. Mr. McGuire.

2720. SHELL THEORY AND DESIGN

Credit 3 hrs. Fall. Prerequisites, Math. 294 or equivalent and consent of instructor.

Differential geometry of surfaces. Bending and membrane theory of shells. Analysis and design of cylindrical shells, domes, paraboloids. Application to reinforced concrete roofs and pressure vessels. Stability of certain types of shells. Mr. Gergely.

2721. SPECIAL TOPICS IN MATRIX ANALYSIS

Credit 2 hrs. Spring. 2 Lect. per week. Prerequisite, a prior exposure to matrix methods of structural analysis; 2713 may be taken concurrently.

Analysis of tall buildings. Methods of tridiagonalization, transfer matrices. Iterative and direct solutions. Finite element analysis. Non-linear problems. Eigenvalue problems; buckling and dynamic analysis. Mr. Fisher or Mr. Nilson.

2722. DYNAMICS OF STRUCTURES

Credit 3 hrs. Spring. Prerequisites, Math. 294 or equivalent and consent of instructor.

Equations of motion and vibration of simple systems. Numerical, energy and matrix methods of analysis of multiple degree systems. Analysis and design of structures for ground disturbances, including inelastic effects. Mr. Gergely.

[2733. STRUCTURAL SYNTHESIS AND PLANNING]

Not offered in 1966–67.

2741. DESIGN PROJECT IN STRUCTURAL ENGINEERING (Meets project requirement for M.E. degree).

Credit 1 hr. Fall and 3 hrs. Spring; both terms required.

Comprehensive design projects by design teams. Formulation of alternate design proposals, including economics and planning, for a given situation, and complete design of the best alternate. Determination of construction costs and preparation of sketches and drawings. Presentation of designs by oral and written reports. Staff.

2742. RESEARCH IN STRUCTURAL ENGINEERING

On demand. Hours and credit variable.

Students wishing to pursue one particular branch of structural engineering further than can be done in any of the regular courses may elect work in this subject. The prerequisite courses depend upon the nature of the work desired. The work may be in the nature of an investigation of existing types of con-

struction, theoretical work with a view of simplifying present methods of design or proposing new methods, or experimental investigation of suitable problems. Staff.

2743. STRUCTURAL ENGINEERING SEMINAR

Credit 1–3 hrs. Spring. Open to qualified seniors and graduate students.

Preparation and presentation of topics of current interest in the subject of structures for informal discussion.

2744. SPECIAL TOPICS IN STRUCTURAL ENGINEERING

On demand. Hours and credit variable.

Individually supervised study in one or more of the specialized topics of civil engineering such as tanks and bins, suspension bridges, towers or movable bridges, which are not covered in the regular courses. Independent design or research projects may also be selected.

See also courses under "Civil Engineering Materials."

Transportation Engineering

Three modern laboratories are maintained in which graduate training and research are conducted. The Cornell Center for Aerial Photographic Studies maintains files of over 80,000 photographs showing worldwide coverage of soil, rock, and drainage patterns of arid, humid, arctic, and tropic areas. The Concrete and Aggregate Laboratory contains specialized research tools such as a precision petrographic microscope and a complete industrial X-ray installation. The Transportation Laboratory is fully equipped for bituminous material and mixture research.

Currently research is being carried on in tropical soils, bituminous pavement design, air-photo applications, and concrete.

2612. HIGHWAY LABORATORY — BITUMINOUS

Credit 3 hrs. Fall. 2 Lab., 1 Rec. Prerequisite, 2601, or may be taken concurrently with 2601.

Physical, rheological, and durability properties of bituminous materials. Principles of the design of bituminous mixtures, including methods of test and the influence of aggregate, binder, test temperature, and rate of load application on the strength and flexibility of paving mixtures. Production of bituminous mixtures and construction practice. Laboratory fully equipped for all phases of applied and research studies. Mr. Hewitt.

2613. HIGHWAY LABORATORY — SUBGRADE SOILS

On demand. Credit 3 hrs. 2 Lab., 1 Seminar. Prerequisite, permission of instructor.

Soil surveying, sampling, and classification. Correlation of field and laboratory procedures. Tests on soil samples stabilized with bituminous materials, Portland cement and chemicals. Condition surveys on stabilized roads. Evaluation of current practice and development. Laboratory fully equipped for all phases of applied and research studies. Mr. Liang.

2616. HIGHWAYS AND AIRPORTS

Credit 3 hrs. Spring. 3 Rec. Prerequisite, 2601 or permission of the instructor.

Part I: Soil index properties and classification systems; subgrade strength evaluation; compaction; drainage and frost action; stabilization; aggregates. Part II: Design and construction of base and surface courses for flexible pave-

ments. Part III: Design and construction of rigid pavements. Part IV: Airport site selection; master plan; terminal facilities; heliports. Staff.

2618. LOW-COST ROADS

Credit 3 hrs. Primarily for foreign students. Offered upon sufficient demand, usually in fall term. Prerequisite, consent of instructor.

Principally directed study with one 2½ hour class session per week to be arranged. Rural road systems as instruments of economic development. Study of economic considerations in road system improvement; road improvement planning and programming; road location and geometric design; engineering soil characteristics; design of roadbed thickness; drainage; stabilization methods and materials; dust palliatives; wearing surfaces. Staff.

2621. ANALYSES AND INTERPRETATION OF AERIAL PHOTOGRAPHS

Preregistration required. Credit 3 hrs. Fall-spring. 2 Lect., 1 Lab. (The student is expected to pay the cost of field trips and aerial photographs for use in a term project, amounting to approximately $15.)

A study of the soil and rock areas of the United States and the patterns present in aerial photographs. Fundamental elements of soil patterns are analyzed to permit determination of soil texture, type of bedrock, and drainage properties. Field training in selected test areas. Mr. Belcher.

2622. ADVANCED INTERPRETATION OF AERIAL PHOTOGRAPHS

Preregistration required. Credit 3 hrs. Fall-Spring.

Course includes lectures and team projects in laboratory and field. Facilities include material for city-regional planning, soil mapping, conservation, ground and surface water, and civil engineering projects. Mr. Belcher.

2626. TRAFFIC ENGINEERING

Credit 3 hrs. Fall-Spring. 2 Rec., 1 Lab. Prerequisite, permission of the instructor.

City and highway traffic surveys and designs. Accidents, congestion, delay, speed, volume, density, parking, channelization, lighting, traffic control, and routing. Signs, signals, and markings. Urban traffic consideration in city planning. Driver reactions and habit pattern. Traffic engineering organization. Knowledge of simple programming procedures (CORC) desirable but not mandatory. Mr. Lewis.

2627. TRAFFIC ENGINEERING — OPERATIONS

On demand. Credit 3 hrs. 2 Lab., 1 Seminar. Prerequisite, preceded by or taken concurrently with 2626.

Definition of traffic problems, collection of field data, analysis of field data, findings, conclusions, and recommendations. Traffic surveys. Design of traffic control systems. Mr. Lewis.

2628. HIGHWAY GEOMETRIC DESIGN

Credit 3 hrs. Spring. 1 Lect., 2 Lab. Prerequisite, 2601 or permission of the instructor.

Route selection; design controls and criteria, including vehicle characteristics and highway capacity; sight distance, and horizontal and vertical control; cross section elements; right-of-way problems and access control; at-grade intersection design, including rotary and channelized intersection; grade separations and interchanges; regional systems of highways, freeways, and parkways. Mr. Lewis.

2631. PHYSICAL ENVIRONMENT EVALUATION

Credit 3 hrs. Fall. 2 Lect., 1 Lab. Intended for graduate students or upperclassmen in engineering and planning. Permission of the instructor.

A study of physical environment factors affecting engineering and planning decisions and the evaluation methods of these factors. Physical factors include the climate, soil and rock conditions, and water sources in different parts of the world. Evaluation methods include air and ground reconnaissance, interpretation of meteorological, topographic, geological, and soil maps, aerial photography, engineering data, and sub-surface exploration records. Mr. Liang.

2632. ADVANCED PHYSICAL ENVIRONMENT

On demand. Credit 3 hrs. Mr. Liang.

2641. TRANSPORTATION ENGINEERING PROJECT

On demand. Credit 1–6 hrs.

Projects in the various fields of transportation, advanced aerial photographic studies, traffic engineering, and earth engineering may be developed by conference between professors and students. Projects may involve integrated planning or design, drawing upon several fields of interest, or they may concentrate upon special subjects. Adequate facilities, material, and sources of data are necessary for a satisfactory project.

2642. TRANSPORTATION ENGINEERING RESEARCH

On demand. Hours and credit variable.

Students who wish to pursue one particular branch of transportation engineering further than can be done in any of the regular courses may elect work in this field. The work may be in the nature of an investigation of existing methods or systems, theoretical work with a view to simplifying present methods of design or proposing new methods, or experimental investigation of suitable problems.

2643. TRANSPORTATION ENGINEERING SEMINAR

On demand. Credit 1–2 hrs. Number of meetings a week to be arranged.

Abstraction and discussion of selected technical papers and publications in the transportation engineering field.

2644. TRANSPORTATION SPECIAL TOPICS

On demand. Credit varies.

Also see courses under "Civil Engineering Materials."

Water Resources Engineering

This area offers an opportunity to develop and combine competence in water quality control, hydraulics and hydrology, economics and systems analysis, and to apply this integrated knowledge to the solution of engineering problems encountered in water resources planning and management.

Sponsored research projects make possible student participation in a wide range of research problems and provide assistantships.

Completely equipped laboratory facilities are available. Active research topics and relevant courses are listed under Hydraulics and Hydraulic Engineering, Sanitary Engineering, Economics, and Industrial Engineering and Operations Research.

Computer Science

Faculty: H. D. Block, Kenneth M. Brown, Richard W. Conway, Patrick C. Fischer, Juris Hartmanis, William L. Maxwell, Charles W. Merriam, Anil Nerode, Lawrence E. Payne, Christopher Pottle, Gerard Salton, Sidney Salzman, Shayle R. Searle, Robert J. Walker.

Field Representative: Patrick C. Fischer, Upson Hall.

APPROPRIATE MAJOR AND MINOR SUBJECTS

Computer Science	Numerical Analysis
Information Processing	Theory of Computation

ADMISSION REQUIREMENTS: As prerequisite for candidacy in this Field, a student is expected to have had significant experience in programming a digital computer, and depending upon the particular subject major chosen, appropriate background in mathematics, engineering, linguistics, etc., to permit the immediate enrollment in graduate level courses. A student is also expected to have had at least an introductory course in computer science although this deficiency can be remedied after admission.

FOREIGN LANGUAGE REQUIREMENTS. A candidate for the degree of Ph.D. must demonstrate reading ability in two approved languages besides English. Approved languages are French, German, Russian and any language in which there exists a substantial body of literature in the area of the student's doctoral thesis. There is no Field requirement of a foreign language for the M.S. degree.

Any Special Committee may, at its discretion, require knowledge of foreign language beyond the above requirements.

OTHER FIELD REQUIREMENTS. All candidates for the Ph.D. are required to have at least one minor in a Field other than Computer Science. The most frequent choices would be in the Fields of Mathematics, Applied Mathematics, Statistics, Industrial Engineering and Operations Research, Electrical Engineering, Biology, Psychology, or Linguistics, but others would be possible. For a candidate whose major subject is numerical analysis, a minor in Mathematics or Applied Mathematics is required.

A comprehensive oral examination is required before the granting of the M.S. degree or admission to Ph.D. candidacy. This examination is normally taken after the completion of formal course work and the satisfaction of any foreign language requirements.

GENERAL COMMENTS

The Field of Computer Science at Cornell includes not only the fundamental theoretical material in automata, computability, and language structure but also such subjects as numerical analysis and information processing, which underlie broad areas of computer application. A graduate student should consider a major in computer science if he is primarily interested in the general aspects of computational processes, both theoretical and practical, e.g., theory of algorithms, methods by which algorithms are implemented on a computer, and information structures. If he is primarily interested in the result of a computer process and its relation to a particular area of application, then he should major in another Field and consider a minor in Computer Science.

RESEARCH AND STUDY OPPORTUNITIES

Opportunities exist for research and study in the following areas of Computer Science: numerical analysis (Brown, Payne, Walker), programming languages and systems (Conway, Maxwell, Salzman), automata and computability theory (Fischer, Hartmanis, Nerode), information organization and retrieval (Salton), systems and control theory (Merriam, Pottle), adaptive systems (Block).

FACILITIES

Student and staff offices in computer science are located in Upson Hall on the recently completed Engineering Campus. The principal laboratory facility is the Cornell Computing Center in Rand Hall. The Center was established in 1953, and now operates a Control Data 1604 with a satellite 160A. No outside commitments exist for this machine, and its full capacity is available for student and faculty use. While the great majority of instructional and research work is done at the Computing Center there is also an IBM 1410 (tape), two IBM 140's (tape), and an IBM 1440 (disc) on campus that may be used as the need arises. There is also a well-developed analog computing facility. An IBM 360/40 has recently been added, and in 1967 a large-scale, remote-access, time-shared computing system will be installed.

A booklet describing in more detail the graduate work at Cornell in Computer Science and closely related subjects can be obtained by writing to the Field Representative, Upson Hall.

COURSES

401. INTRODUCTION TO COMPUTER SCIENCE (In 1966–67, offered as Engineering 9481.)

Fall term. Credit four hours. Prerequisite, Mathematics 293 or equivalent. T Th S 9, Laboratory M, W or Th 2–4:30.

Introduction to programming and programming systems. Computer organization and characteristics. Survey of computer applications. This course is intended principally for students who are majoring in computer science.

411. PROGRAMMING SYSTEMS AND THEORY I

Fall term. Credit four hours. Prerequisite, 301 or 401 or equivalent. M W F 10. Mr. Wegner.

Concerned with assembly-level and machine-level programming of large-scale digital computing systems. Will consider principles and techniques involving indirect addressing, index registers, input-output control, program interrupts, storage allocation, magnetic tape and disc auxiliary storage, diagnostic methods and routines. Also, advanced programming systems for executive control. Students will program problems for the Control Data 1604–160A at the Cornell Computing Center.

412. PROGRAMMING SYSTEMS AND THEORY II

Spring term. Credit four hours. Prerequisite, 411 or equivalent. M W F 10. Mr. Wegner.

Concerned with theory and techniques of programming languages and programming systems for large scale digital computer systems. Will consider programming aspects of time-sharing, multiprogramming, real-time, and satellite systems. Also, the structure and form of different types of programming languages including assemblers, interpreters, compilers, and list processors.

Basic techniques for scanning, ordering, and translating will be covered. Students will design and implement several simple programming languages during the term.

417. ADVANCED INFORMATION PROCESSING

Fall term. Credit four hours. Prerequisite, 401 or equivalent experience. M W F 9. Mr. Salton.

This course provides a theoretical foundation in information processing, with emphasis on the use of computers for the solution of primarily non-numeric problems. Covered are recent developments in processor organization and processing methods, compiling and translating systems, search and sorting techniques. Students will run individual term projects on the available computing equipment.

421. NUMERICAL ANALYSIS

Fall term. Credit four hours. Prerequisite, Math 222 or 294 or the equivalent and Computer Science 301 or 401, or consent of instructor. M W F 9. Mr. Walker.

The computational aspects of calculus and related mathematics are discussed in the light of modern computing machines. Topics include numerical differentiation and integration, solution of algebraic and differential equations, interpolation, and error analysis of these processes. The student is expected to know CORC, the Cornell computing language.

422. NUMERICAL ANALYSIS

Spring term. Credit four hours. Prerequisite, 421 or consent of instructor. M W F 9. Mr. Walker.

Numerical methods in matrix analysis and the solution of partial differential equations.

435. INFORMATION ORGANIZATION AND RETRIEVAL

Spring term. Credit four hours. Prerequisite, 401 or equivalent. T Th 9, occasionally W 2–4. Mr. Salton.

This course covers all aspects of automatic language processing on digital computers, with emphasis on applications to information retrieval. Analysis of information content by statistical, syntactic, and logical methods. Dictionary techniques. Search and Matching Techniques. Automatic retrieval systems, question-answering systems. Evaluation of retrieval effectiveness.

[481. FORMAL LANGUAGES]

Fall term. Credit four hours. Prerequisite, 401, 485–486, 488, or consent of instructor. M W F 10. Mr. Fischer. (To be offered in 1967–68.)

A study of formal languages, their processing and processors. Topics include: regular, context-free, and context-sensitive languages; their recognition, parcing, algebraic properties, decision problems, recognition devices, and applications to computer and natural languages.

485–486. THEORY OF AUTOMATA I and II

Throughout the year. Credit four hours each. Prerequisite, C.S. 401, Mathematics 481, or consent of instructor. M W F 11. Mr. Hartmanis.

Automata theory is the study of abstract computing devices; their classification, structure and computational power. Topics include: finite state machines, regular expressions, pushdown-automata, linear bounded automata, context free and context sensitive languages, Turing machines and the study of computational complexity.

488. THEORY OF EFFECTIVE COMPUTABILITY

Spring Term. Credit four hours. Prerequisite, Computer Science 401 or 485 or Mathematics 481, or consent of instructor. M W F 10. Mr. Fischer.

Turing machines and Church's Thesis, universal Turing machines, unsolvability of the halting problem. Recursively enumerable sets, productive and creative sets, relative computability, the recursion theorem, Post's problem. Computational complexity hierarchies.

490. SPECIAL INVESTIGATIONS IN COMPUTER SCIENCE

Throughout the year. Credit and sessions to be arranged.

Offered to qualified students individually or in small groups. Directed study of special problems in the field of Computer Science. (Register only with the registration officer of the department.)

491. COMPUTER SCIENCE GRADUATE SEMINAR

Throughout the year. Credit one hour. For graduate students interested in computer science W 4:30–6:00. Staff, visitors, and students.

A weekly meeting for the discussion and study of important topics in the field.

522. ADVANCED TOPICS IN NUMERICAL ANALYSIS

Spring Term. Credit four hours. Prerequisite, 422 and Mathematics 312, 413, and 331.

Current literature dealing with specific areas of numerical analysis will be carefully analyzed.

[585. SEMINAR IN THEORY OF COMPUTATION]

Fall term. (To be offered in 1967–68).

ADVANCED DATA PROCESSING SYSTEMS (Offered as Engineering 9582)

Fall term. Credit four hours. Prerequisite, Computer Science 301 or BPA 901 or consent of instructor.

Concerned with design of integrated data processing systems for operational and financial control: questions of system organization, languages, and equipment appropriate to this type of application, file structures, addressing and search problems, sorting techniques; problems of multiple-remote-input, on-line data processing systems; techniques of system requirement analysis.

DIGITAL SYSTEMS SIMULATION (Offered as Engineering 9580)

Fall term. Credit four hours. Prerequisites, Computer Science 301 and a course in probability.

The use of a program for a digital computer to simulate the operating characteristics of a complex system in time. Discussion of problems encountered in construction of a simulation program; synchronization and file maintenance, random number generation, random deviate sampling. Programming in the CLP and SIMSCRIPT languages. Problems in the design of effective investigations using simulation; statistical considerations when sampling from a simulated process. Applications of simulation to queuing, storage, traffic, and feedback systems. Applications will include use in the design of facilities, design of operating disciplines, and use in real-time control of an operating system.

SWITCHING SYSTEMS I (Offered as EE 4587)

Fall term. Credit three hours. Prerequisite, EE 4322 or consent of instructor.

Switching algebra; switching devices; logical formulation and realization of combinational switching circuits; minimization aids; number representation and codes; simple memory devices; synchronous sequential circuits; counters; shift registers, and arithmetic units in a digital computer.

SWITCHING SYSTEMS II (Given as EE 4588)

Synchronous and asynchronous sequential circuits, formulation and optimization; large-scale memory units, selection and control; further discussion of arithmetic units; integrated study of switching systems including general-purpose digital computer, control switching, and communication switching; introduction to the general theory of learning machines.

Electrical Engineering

Faculty: Paul D. Ankrum, Joseph M. Ballantyne, Henry D. Block (on leave 1966–67), Ralph Bolgiano, Nelson H. Bryant, G. Conrad Dalman, Nicholas DeClaris, Rolf B. Dyce, Lester F. Eastman, William H. Erickson, Terrence L. Fine, Newell T. Gaarder, Thomas Gold, Juris Hartmanis, Clyde E. Ingalls, Frederick Jelinek, Myunghwan Kim, Keith R. Kleckner, Richard L. Liboff, Simpson Linke, Lee A. MacKenzie, Henry S. McGaughan, Paul R. McIsaac, Charles W. Merriam, Wilbur E. Meserve, Sanjit K. Mitra (on leave 1966–67), John A. Nation, Benjamin Nichols, Robert E. Osborn, Christopher Pottle (on leave 1966–67), Edwin L. Resler, Joseph L. Rosson, Gian-Carlo Rumi, Howard G. Smith, Everett M. Strong, Ravindra N. Sudan, Chung L. Tang, James S. Thorp, Hwa Chung Torng (on leave 1966–67), Norman M. Vrana, Leonard S. Wagner (on leave 1966–67), Howard R. Witt (on leave 1966–67), George J. Wolga, Stanley W. Zimmerman (on leave 1966–67).

Field Representative: Wilbur E. Meserve, 230 Phillips Hall.

APPROPRIATE MAJOR AND MINOR SUBJECTS

Electrical Engineering, Electrophysics, Electrical Systems

ADMISSION REQUIREMENTS. Though the Graduate Record Examination is not required of applicants in the Field of Electrical Engineering, applicants are urged to take this examination, submitting its results along with their application for graduate work.

As prerequisite for graduate work leading to the degree of M.S. or Ph.D. with a major in the Field of Electrical Engineering, the candidate should have had the equivalent of the fundamental work required by an accredited undergraduate curriculum in the area of his major subject. The candidate must also supply definite evidence of scholarly interest and aptitude for advanced study.

LANGUAGE REQUIREMENTS. There is no foreign language requirement for the M.S. degree.

The Graduate Field of Electrical Engineering requires for admission to Ph.D. candidacy that a student demonstrate proficiency in one modern foreign language.

Examinations as required by the Graduate School are conducted by the student's Special Committee.

Considerable latitude is allowed in the selection of the minor subjects, provided that the entire program shows a unified purpose.

Adequate work in advanced physics and mathematics is required of candidates for the degree of Ph.D. At least one of the two minor subjects must be chosen outside the Field of Electrical Engineering.

The appropriate major and minor subjects listed above define broad areas in the Field of Electrical Engineering within which a student may plan a graduate program which best suits his needs. In addition to the formal courses listed below, members of the faculty are prepared to guide individual students in special topics and to arrange seminars for students interested in closely related lines of study and research. Proficiency is expected in all phases of the graduate program.

Members of the faculty in the Field of Electrical Engineering are especially interested in directing graduate research in the following areas:

ELECTRICAL ENGINEERING. Applied mathematics; biomedical electronics; electrical measurements; ionospheric studies; magnetohydrodynamics; materials science; physics of maser and laser systems; radio astronomy; satellite instruments.

ELECTRICAL SYSTEMS. Analysis and synthesis of time-variable and nonlinear systems; switching systems; control systems analysis, optimization and adaptation; conversion, transmission and control of electric energy; information theory; random processes; signal processing, system theory.

ELECTROPHYSICS. Lasers; microwave electronics; plasma physics; quantum electronics; radiophysics.

It is not desirable, nor is it intended, that the boundaries between these areas within the Field of Electrical Engineering be too rigidly defined. Rather, every effort is made to allow each student to pursue a program designed to give him a period of broad advanced study. To this end work in such subjects as applied physics, astronomy, biological science, engineering materials, fluid mechanics, or thermodynamics may be considered as partially fulfilling the requirements for a major or minor in Electrical Engineering, even though these subjects are not under the direct jurisdiction of the faculty of the School of Electrical Engineering.

ELECTRICAL ENGINEERING FELLOWSHIPS. In addition to the Fellowships offered by the Graduate School and the special Engineering Fellowships, such as the Ford Fellowship and N.S.F. Traineeships, the Field of Electrical Engineering has the following to award: Michael Faraday Fellowship of Cornell Aeronautical Laboratory, James Clerk Maxwell Fellowship of Cornell Aeronautical Laboratory, Charles Bull Earle Memorial Graduate Fellowship, and United States Steel Foundation Fellowship.

MASTER OF ENGINEERING (ELECTRICAL)

The Master of Engineering degree is the only professional engineering degree offered by Cornell University to a presently entering student. Admission to the Master of Engineering (Electrical) degree program is open to persons who have been granted bachelor's degrees, or the equivalent, and who have sufficient training to indicate that they can profitably study the advanced courses offered for these students in the School of Electrical Engineering. The purpose of this degree program is to offer depth of study in both comprehensive and specialized electrical engineering subjects, and to offer study extending the abilities of the electrical engineer to other areas.

The requirements for the M. Eng. (E.) degree are:

1. A minimum of 30 credit hours of advanced technical course work in the field of electrical engineering or in related subjects.
2. A minimum of two two-course sequences in advanced electrical engineering (chosen from a designated list).

3. A minimum of three credit hours of engineering design experience involving individual effort and a formal report.

4. A minimum grade point average of 2.5 and a minimum final grade of C for any courses counting toward this degree.

There are no residence requirements, although all course work must, in general, be completed under Cornell University staff instruction. The degree requirements must normally be completed within a period of four calendar years.

Graduates of Cornell University with a Bachelor of Electrical Engineering degree may be granted up to 15 hours of credit for advanced courses taken during the fifth undergraduate year, provided they enter the M.Eng.(E). program not later than the fall term following the sixth anniversary of their receiving the B.E.E. degree. For those students who are granted 15 credit hours of advanced standing, the requirement is six credit hours in the School of Electrical Engineering rather than two two-course sequences, and the design requirement may be waived.

ELECTIVE AND GRADUATE COURSES

Of the following elective and graduate courses, certain ones may not be offered every year if the demand is considered to be insufficient.

Semiconductor and Quantum Electronics

EE 4531. QUANTUM ELECTRONICS I

Credit 4 hrs. Fall. 3 Lect., 1 Rec.-Comp. Prerequisites, EE 4311, EE 4412, and Physics 443 or EE 4411.

A detailed treatment of the physical principles underlying microwave and optical masers and related areas. Topics will include a brief review of quantum mechanics and the theory of angular momentum; spectroscopy of free atoms and ions with particular emphasis on the application of the results to neutral and ionized noble gas masers; theory of interaction of radiation and matter; quantum theory of coherence; a thorough study of the steady-state and dynamic characteristics of microwave and optical masers.

EE 4532. QUANTUM ELECTRONICS II

Credit 4 hrs. Spring. 3 Lect., 1 Rec.-Comp. Prerequisite, Quantum Electronics I or consent of instructor.

A continuation of the treatment of the physical principles underlying masers and related areas. Topics will include a consideration of microwave and optical spectroscopy of impurity ions in solids with particular emphasis on the application of the results to microwave and optical solid state masers; density matrix and its applications in the study of masers and related problems; nonlinear optical phenomena and multiple-photon processes; interaction of intense light waves with molecular vibrations and elastic waves; theory and properties of molecular and semiconductor masers; characteristics of optical resonators.

4533. SEMICONDUCTOR ELECTRONICS I

Credit 3 hrs. Fall. 2 Lect., 1 Lab. Prerequisite, 4412.

The physical theory of p-n junction devices; device fabrication; properties of semiconductor devices such as diodes and rectifiers, tunnel diodes, solar batteries, transistors, four-layer devices (diodes, controlled rectifiers, and switches), etc.; device equivalent-circuit representations; bias-stabilized transistor amplifiers.

4534. SEMICONDUCTOR ELECTRONICS II

Credit 3 hrs. Spring. 2 Lect., 1 Lab. Prerequisite, 4533.

A continuation of Semiconductor Electronics I with emphasis on the application of semiconductor devices as active or passive elements in circuits for use as power supplies, power controls, amplifiers, oscillators and multivibrators, pulse circuits, gates and switches, etc.; integrated circuits; parametric amplification.

4535. INFRARED AND OPTICAL PROPERTIES OF SOLIDS

Credit 4 hrs. Fall. 3 Lect. 1 Rec. Prerequisite, 4412 or Physics 454 or consent of instructor.

Macroscopic dielectric properties of solids: complex permittivity and permeability, Fresnel equations, reflection and refraction by lossless and lossy media, anisotropic dielectric constant tensor, rotation and deflection of radiation by electro-optic crystals; microscopic formulation of dielectric properties; electronic, atomic, and orientation polarization, dielectric dispersion via resonance or relaxation, local internal field and spontaneous ordering, introductory lattice dynamics, lattice frequency spectrum, application of group theory to derivation of selection rules for infrared and Raman active normal modes. Extended-frequency analysis of vibrational spectra with applications to ferroelectrics.

Microwave and Physical Electronics

4511. ELECTRODYNAMICS

Credit 4 hrs. Fall. 3 Lect. 1 Rec. Prerequisites, 4312, 4402.

Foundations of electromagnetic theory; vector analysis, introductory potential theory, static electric and magnetic fields; boundary value problems; fields in dielectric and magnetic media; electromagnetic stresses, forces, and torques; quasi-stationary fields, eddy currents; transformation to moving reference frames; interaction of fields with rigid and fluid conductors in motion, electromechanical energy conversion; traveling waves in various media, including plasmas; reflection, refraction, and guiding of waves; wave-guides and cavities; radiation and antennas.

4512. FIELDS, WAVES, AND ELECTRONS

Credit 4 hrs. Spring. 3 Lect., 1 Rec. Prerequisites, 4412-4511.

Electromagnetic fields and waves in metal and dielectric wave guides and cavities; plasmas and electron-beam generation; fields and waves in stationary and moving plasmas, coupling of modes of wave propagation; sources of electronic noise.

4452. INTRODUCTION TO PHYSICAL ELECTRONICS

Credit 3 hrs. Spring. 3 Lect. Prerequisite, 4312.

Fundamental theory of electron devices; particle dynamics; generation and formation of electron beams; electrostatic and magnetic lenses; space charge phenomena; limitations at high frequencies; noise; interaction of electron streams and electromagnetic waves in localized and distributed regions; the electron ballistic and space charge wave approaches; application to planar vacuum tubes and microwave tubes.

4553. MICROWAVE ELECTRONICS LABORATORY

Credit 1–3 hrs. 2 Labs. for 3 hrs. credit. Fall. Prerequisites, 4461, 4452.

Selected experiments in the area of measurement of active and passive

microwave devices including klystrons, traveling-wave tubes, magnetrons, cavities, and periodic structures; term experiment; stress laid upon independent work by the student.

4554. VACUUM AND PHYSICAL ELECTRONICS LABORATORY

Credit 1–3 hrs. 2 Labs. per week for 3 hours credit. Spring.

Prerequisites, 4312, 4422. Experiments in the fields of vacuum, gaseous, and solid state electronics; selected experiments involving high-vacuum measurements, r-f mass spectroscopy, gas plasma measurements, evaporation measurements; also selected experiments involving such techniques as film evaporation, ceramic-metal sealing; production of ultra-high vacuum; term experiment.

4551. ADVANCED PHYSICAL ELECTRONICS

Credit 4 hrs. Fall. 3 Lect., 1 Rec. Prerequisite, 4512.

A study of the physical theories underlying devices based on the controlled flow of electric charges in vacuum, gases, and solids. Review of the fundamental principles: energy exchange, effects of magnetic fields, space charge, collisions, velocity spread, etc. Charge flow across metal-vacuum boundaries: thermionic, secondary, photoelectric, and high field emission. Charge flow across semiconductor contacts: diodes, transistors, field effect transistors. Tunneling phenomena: thin films, tunnel diode, analysis. Thermionic devices: high power electron optics, classical electron devices, gaseous electron devices.

4552. MICROWAVE ELECTRONICS

Credit 4 hrs. Spring. 3 Lect., 1 Rec. Prerequisite, 4512.

Fundamental theories of high vacuum, gaseous, and solid state microwave devices. Review of fundamental relations: wave equation, equations of motion, power flow, Liouville equation, etc. Field theory for electron and gaseous electron devices: study of kylstrons, traveling wave tubes, wave propagation in stationary plasmas, Faraday effect, etc. Coupled mode theories and ballistic theories. Generalized study of electron stream networks with application to microwave tubes and to solid state microwave dielectric diodes and triodes. Properties of solid state devices at microwave frequency: microwave transistors, parametric diodes, tunnel diodes, injection lasers, gas lasers. Contemporary topics include Gunn oscillator, radio diode oscillators, approaches to high power solid state microwave generation, etc.

4653. ADVANCED MICROWAVE THEORY I

Credit 4 hrs. Fall. 3 Lect. 1 Rec. Prerequisite, 4512.

Intended primarily for graduate students. Microwave circuit theory with emphasis on mathematical techniques. Use of perturbational and variational techniques. Green's functions and scattering matrices for solution of microwave circuit problems. Normal modes in uniform waveguides and cavities; excitation of waveguides; obstacles in waveguides and microwave junctions; quasi-stationary approximations; equivalent circuits.

4654. ADVANCED MICROWAVE THEORY II

Credit 4 hrs. Spring. 3 Lect. 1 Rec. Prerequisite, 4653.

Intended primarily for graduate students. Microwave circuit theory with emphasis on mathematical techniques. Inhomogeneous media; ferrites and nonreciprocal networks; microwave filters; periodic circuits; surface waveguide; radiation systems.

Wave Propagation and Plasma Physics

4461. ELECTROMAGNETIC THEORY

Credit 3 hrs. Fall. 3 Lect. Prerequisite, 4311.

Foundation of electromagnetic theory; vector analysis and introductory potential theory; electrostatic fields in vacuum and dielectrics; magnetic fields and magnetic materials; Maxwell's equations; electromagnetic waves in space, waveguides and cavities; excitation of waveguides; boundary value problems; radiation and scattering of waves. Emphasis will be on mathematical technique.

4462. WAVE PROPAGATION IN THE ATMOSPHERE I

Credit 3 hrs. Spring. 3 Lect. Prerequisites, 4311, 4312.

An elementary treatment of wave phenomena in the lower and upper atmosphere of the earth, including radio waves, plasma waves, acoustic waves, and gravity waves.

4467. RADIO ENGINEERING

Credit 3 hrs. Fall. 2 Lect., 1 Comp. Prerequisites, 4311, 4302.

A study of communication circuits with distributed constants and the production and propagation of electromagnetic radiation; transmission line theory and applications; impedance matching; ultra-high-frequency generation and transmission; electromagnetic theory; propagation phenomena; antenna characteristics and radiation.

4560. RADIO AND COMMUNICATION LABORATORY

Credit 3 to 5 hrs. Spring normally, but either term if demand is sufficient. 1 Rec. 1 or more Labs. Prerequisites, 4467, 4422, or consent of the instructor.

Three or more different experiments chosen from the areas of electronic circuits, networks, modulation, transmission lines, waveguides, and antennas. Experiments selected to meet individual needs.

4561. PLASMA PHYSICS I

Credit 3 hrs. Fall. 3 Lect. Prerequisites, 4311, 4312. Available to fourth year students with permission of instructor.

Motion of charged particles in fields; adiabatic invariants; collisions; coulomb scattering and bremsstrahlung; Langevin equation; transport coefficients; ambipolar diffusion; elementary discharge theory; plasma oscillations and waves; hydromagnetic equations; diffusion of magnetic lines; plasma confinement and mascroscopic instabilities; test particle in a plasma: elements of solid state plasmas.

4562. PLASMA PHYSICS II

Credit 3 hrs. Spring. 3 Lect. Prerequisite, 4561 or permission of instructor.

MHD equations; low-conductivity channel flow; Alfven waves; Friedrich's diagrams; shock waves; magneto-active cold plasma theory: CMA diagrams; quasi-longitudinal and quasi-transverse approximation; whistlers and radio waves; bounded plasma; cyclotron radiation; applications to laboratory and natural phenomena.

4565, 4566. RADIOPHYSICS OF THE ATMOSPHERE I AND II

Credit 3 hrs. each term. Fall and Spring. Prerequisites, 4461 or equivalent, 4462 or equivalent.

The structure of the radio refractive index in the lower atmosphere and in the ionosphere; advanced treatment of special topics in radio wave propagation in the atmosphere: line-of-sight, ground-wave, waveguide mode, smooth-earth diffraction, ionospheric reflection, whistler mode, weak scattering by fine-scale structure, backscattering by thermal fluctuations in electron density, and others as interest warrants; interpretation of radio data in regard to atmospheric physics.

4567. ANTENNAS AND RADIATION I

Credit 3 hrs. Fall. 3 Lect. Prerequisite, 4311.

Linear radiators: formulation of the electromagnetic field in terms of vector and scalar potentials; radiation from an infinitesimal current element; radiation from short dipoles; small loops; resonant wire antennas; long wire antennas; theory of linear arrays; impedance properties of wire antennas; antennas with parasitic elements. Aperture radiators: uniqueness theorem for vector fields; equivalence and induction principle; radiation from open-ended waveguides; horn antennas; reflector antennas; Babinets principle; slot antennas.

4568 ANTENNAS AND RADIATION II

Credit 3 hrs. Spring. 3 Lect. Prerequisite, 4567 or equivalent.

Huygens' Principle for electromagnetic fields; application to problems of diffraction and aperture radiators; surface wave antennas; radiation in media other than free space; antenna thermodynamics.

4661. KINETIC EQUATIONS

Credit 3 hrs. Fall. 3 Lect. Prerequisites, 4561, 4562, or permission of instructor.

Critical development of the Liouville equation; concept of the ensemble and N-particle distribution function; formulation of the Boltzmann, Vlasov, Fokker-Planck and B-G-K equation from the BBKGY scheme; the correlation function; approach to equilibrium; coarse graining; ergodic and H-theorems; equilibrium ensembles; the transition from microscopic to macroscopic descriptions; two particle and radial distributions; Percus-Yevic theory; Density Matrix.

4662. KINETIC THEORY OF PLASMA

Credit 3 hrs. Spring. 3 Lect. Prerequisites, 4561, 4562, or permission of instructor.

Boltzmann equation; Lorentz model, transport coefficients for weakly ionized gases; moments of Boltzmann's equation; MHD equations, Chew-Goldberger-Low theory; relativistic and quantum mechanical modifications of Vlatsov equation; waves in hot plasmas; Landau damping, velocity-space instabilities, quasi-linear theory, fluctuations, cyclotron and Cerenkov radiation from plasma; coulomb scattering and Fokker-Planck equation.

Systems

4501. SYSTEMS WITH RANDOM SIGNALS

Credit 4 hrs. Fall. 3 Lect. 1 Rec. Prerequisite, 4402.

Modulation theory; basic principles of AM and FM; introduction to random signals; heuristic development of random variables and processes; statistical and time averages; analysis of linear systems with random excitations; noise in physical systems; optimization techniques; filtering; prediction; compensation; matched systems.

4502. STATISTICAL ASPECTS OF SYSTEM ANALYSIS

Credit 4 hrs. Spring. 3 Lect. 1 Rec. Prerequisite, 4501.

Development of statistical concepts and their application to system problems. Sampling; estimation of parameters; regression; hypothesis testing. Basic elements of information theory with application to various transmission systems.

4503. THEORY OF LINEAR PHYSICAL SYSTEMS

Credit 4 hrs. Fall. 3 Lect. Prerequisite, 4402 or 4404, or consent of instructor.

The state space approach to linear system theory. The concept of state; basic properties of the state and the state equation; state vectors and equations of linear differential systems; modes in linear systems; time varying linear systems; the adjoint system; stability; generalized functions and the Fourier Transform; properties of system functions; discrete-time linear systems; controllability, and observability.

4504. THEORY OF NONLINEAR SYSTEMS I

Credit 4 hrs. Spring. 3 Lect. Prerequisite, 4503.

Analysis of first and second order nonlinear systems with applications. Phase plane analysis of autonomous systems; singular points, limit cycles, and the theory of equilibrium; theories of Bendixson, Lienard, and Poincare; relaxation behavior in the phase plane; perturbation theory, existence, convergence, and periodicity of perturbation series; method of Krylov and Bogoliubov. Forced nonlinear systems, harmonics, subharmonics, jump phenomena, and frequency entrainment; periodic systems, Floquet theory, Mathieu-Hill theory, applications to the stability of nonlinear systems and to parametrically-excited systems.

4505–06. OPTIMIZATION AND APPROXIMATION TECHNIQUES

Credit 4 hrs. Fall and Spring. 3 Lect. Prerequisites 4402 and 4503 or current registration in 4503. M W F 10.

Optimization and approximation techniques used in the synthesis of systems and signals, with applications in control and communication.

The approximation problem; linear vector space interpretation, L_p and weighted norms, convex functions, existence and uniqueness of solutions. Least-squares approximations and orthogonal functions; completeness, orthogonalization procedures, measurement of expansion coefficients, complementary filters. Chebyshev and L_1 approximations; Chebyshev sets, uniqueness. Nonlinear approximations; choice of basis function parameters, exponential approximation, optimum pole positions. Computational methods for parameter optimization and approximation problems; gradient algorithms, first and second variations, Lagrange multipliers for equality and inequality constrants, geometric interpretation, vector space projections, convergence.

Formulation of deterministic optimization problems in function spaces; equality and inequality constraints, penalty functions. Introduction to the calculus of variations, dynamic programming, and Pontriagin's maximum principle; necessary and sufficient conditions for optimality, boundary conditions. Solution of two-point boundary-value problems by successive approximations; convergence, convexity constraints. Duality and statistical optimization problems. Synthesis of optimal filters and feedback controllers; complexity and stability constraints. Selected topics; sequential optimization, discrete optimization, and min-max problems.

[4543. UNIFIED THEORY OF ELECTROMECHANICAL SYSTEMS]

Credit 3 hrs. Fall. 2 Lect., 1 Comp. Prerequisites, 4441, 4442, or consent of instructor. Not offered in 1966–67.

Electric machines studied as networks of coupled circuits with periodically varying parameters; forces and torques in electromechanical systems; electromagnetic and electrostatic transducers; Kron's basic machine with its practical derivatives; the synchronous, induction and commutator machines in the transient and steady state; frequency response methods applied to machines.

EE 4545. ELECTRIC ENERGY SYSTEMS I

Credit 4 hrs. Fall. 3 Lect.-Rec., 1 Lab.-Comp. Prerequisite 4422 or 4302 and consent of instructor.

The physical and engineering principles that underlie the steady-state operation, control and development of modern electric power systems, with emphasis on the characteristics and operational analysis of major power-system parameters and components. Topics include electromechanical energy converters, direct thermal energy converters, magnetohydrodynamics, fuel cells, conventional and extra-high-voltage transmission lines and cables, high-voltage-direct-current transmission, half-wave lines, cryogenic lines; power-system network theory; power-angle equations and the circle diagram; the two-machine system; load-flow analysis of complex systems. Several computing periods will involve power laboratory experiments. Load-flow studies will be performed on the digital computer.

EE 4546. ELECTRIC ENERGY SYSTEMS II

Credit 4 hrs., Spring 3-Lect. Rec., 1 Lab.-Comp., Prerequisite 4545.

A continuation of modern power-system analysis with emphasis on abnormal and transient conditions of operation. Topics include unbalanced three-phase systems; theory of symmetrical components; fault analysis of complex systems; introduction of the principles of protective relaying; constant-flux-linkage theorem; synchronizing and damping torque for salient pole and solid rotor machines; basic assumptions for transient stability studies; the Swing Equation; transient stability of complex networks; control of system frequency; switching and lightning surges; theory of the electric arc; a-c circuit interruption; harmonic conditions in three-phase networks; the phenomena of ferroresonance. Several computing periods will be used for demonstrations and laboratory experiments. Fault studies and transient stability studies will be performed on the digital computer.

EE 4571. NETWORK THEORY

Credit 4 hrs., Fall, 3 lect., Prerequisites, EE 4402 or consent of instructor.

Fundamental notions of networks and systems through an axiomatic approach to n-ports. The concepts of linearity, causality, stability, activity, duality, and time-invariance: definitions and basic theorems. Rigorous development of linear graph theory and elements of matrix theory. Detailed treatment of how linear n-ports are characterized mathematically: immittance description and properties, state-variable description and properties, scattering description and properties. An introduction to the problem of finding network functions or structures to approximately meet desired behavior in the time and frequency-domains.

EE 4572. NETWORK SYNTHESIS

Credit 4 hrs., Spring, 3 lect., Prerequisite, EE 4571 or EE 4503, or equivalent.

Logical and systematic approaches for obtaining suitable functions and/or

networks from given overall performance specifications. The approximation problem is introduced and then developed from a mathematically abstract point of view: hierarchy of functions, function spaces, fundamental theorems for the existence and uniqueness of solutions. Weighted-least-square approximation: Hilbert Spaces, orthonormalization and completeness of basis. Minimax approximation: theorems of Chebyshev and de la Vallée Poussin, Chebyshev sets. Formal network realizability considerations: classical lossless, immittance and scattering structures. Parametric representation and sensitivity functions. Variational techniques for finding optimal network element values directly from signal-processing requirements in either the frequency or time domain.

4573. RANDOM PROCESSES IN ELECTRICAL SYSTEMS I

Credit 4 hrs., Fall, 3 Lect. Prerequisite, 4402 or 4404 or equivalent.

Inadequacy of a deterministic formulation of communication and control problems. Combinatorics and discrete probability. Elements of set theory, and non-denumerable sample spaces. Random variables and their transformations. Moments and correlations. The properties of the normal distribution. The weak and strong laws of large numbers. Engineering importance of exponential convergence. The characteristic functions and the central limit theorem. Problems illustrating use of the developed theory in systems analysis and design.

4574. RANDOM PROCESSES IN ELECTRICAL SYSTEMS II

Credit 4 hrs., Spring, 3 Lect. Prerequisite, 4573 or Math 571.

Dependence of random variables: Markov chains and their ergodic properties. Generalization of random sequences to processes. The linear theory of stationary random processes. Relation of time to statistical averages. Spectral Analysis in Hilbert space and its application to random process representation and linear filtering. Normal, Poisson, and related processes. Characterization of Markov processes. Nonlinear transformations. The course material is treated from the point of view of its applicability to communication and control.

4581–82. FEEDBACK CONTROL SYSTEMS

Credit 4 hrs. Fall and Spring. Prerequisite, 4402 or consent of instructor.

Principles of feedback control systems with emphasis on methods of analysis and synthesis to meet prescribed performance criteria; electronic, electromechanical and electrohydraulic components; root locus, and Bode techniques; cascade and feedback compensation of control systems; complex control systems; sampled data feedback control systems.

Laboratory exercises in the form of projects in components, transient and frequency response measurements on complete systems, analog simulation of control systems, and compensating techniques are integrated with the lecture material.

Analytical and numerical methods for the investigation and solution of Nonlinear Control System; applications of Z-transforms to Sampled Data Control Systems; the phase plane; common physical nonlinearities encountered in Control Systems; optimization of relay and Sampled Data Control Systems; dual mode systems; nonlinear compensation techniques; self adaptive control systems.

Laboratory work consists of projects of the student's choice. Topics include on-off control systems, nonlinear compensation techniques, control system design using analog simulation and control system optimization techniques.

4583. ANALOG COMPUTATION

Credit 3 hrs. Fall. 2 Lect., 1 Lab. Prerequisites, 4302 and concurrent registration in 4401, or consent of instructor.

Concepts and principles of analog computation; scaling and programming linear, non-linear, and time-varying differential equations: direct simulation of electrical and mechanical systems; analog programming using digital logic. Laboratory work involves solution of problems on a general-purpose analog computer and by arrangement can be devoted in part to special projects to suit the interests and needs of the student.

4587. SWITCHING SYSTEMS I

Credit 3 hrs. Fall. 2 Lect. 1 Lab. Prerequisite, 4322.

Switching algebra; switching devices; logical formulation and realization of combinational switching circuits; minimization aids; number representation and codes; simple memory devices; synchronous sequential circuits; counters; shift registers and arithmetic units in a digital computer.

4588. SWITCHING SYSTEMS II

Credit 3 hrs. Spring. 3 Lect. Prerequisite, 4587 or equivalent.

Synchronous and asynchronous sequential circuits, formulation and optimization; large-scale memory units, selection and control; further discussion of arithmetic units; integrated study of switching systems including general-purpose digital computer, control switching, and communication switching; introduction to the general theory of learning machines.

4589. AUTOMATA (COMPUTER SCIENCE 900)

Credit 3 hrs. Spring. 3 Rec. Prerequisite, Math. 293–294 or Math. 221–222, or equivalent.

Both the engineering and mathematical aspects of automata will be introduced. Examples of mathematical topics: finite-state machines, neural nets, input-output machines, Turing machines, computability. Examples of engineering topics: machines that learn, adaptive systems, pattern recognition, self-reproducing and self-repairing machines, system reliability, threshold logic systems, biological models, heuristic programming, industrial and technological applications, progress in devices, automatic language translation, cybernetics and robots.

4670. ADVANCED TOPICS IN SYSTEM THEORY

Credit 3 hrs. Term dependent upon demand.

A course centered about some broad but particular problems of current interest. Topics vary from semester to semester. One of the major aims of the course is to develop the ability of the student to select needed information from available sources.

4671. THEORY OF NONLINEAR SYSTEMS II

Credit 3 hrs. Fall. 3 Lect. Prerequisite, 4504.

Non-autonomous and higher order nonlinear systems with applications; representation of systems with several degrees of freedom; approximations; use of Liapunov functions in system stability determination and design; describing functions and Aizerman's hypothesis, theory of Lur'e-Letov for nonlinear control; asymptotic expansions for the period behavior of systems under the influence of periodic external forces; method of averaging: systems with slowly varying parameters, Manley-Rowe relations; orthogonal representation of nonlinear systems; nonlinear filters and compensating systems, system optimization.

4673. PROCESSING OF SIGNALS IN NOISE

Credit 4 hrs. Fall. 3 Lect. Prerequisite, 4574.

The generation and processing of signals in communication systems. Characterization of time-varying deterministic systems, generalized modulation. Characterization of time-varying non-deterministic systems; random channels, multipath distortion, Doppler shift, signal detection and processing; linear and nonlinear smoothing and prediction, signal-to-noise ratios in simple detectors, matched filters, radar detection and ambiguity functions. Comparison of communication systems in the presence of noise.

4674. TRANSMISSION OF INFORMATION

Credit 4 hrs., Spring. 3 Lect. Prerequisite, 4402, and 4573 or Math 571.

Selection of fidelity criteria for accurate and efficient transmission of information. Efficient representation of outputs of message sources. The entropy measure and its properties. Encoding for reliable communication through discrete memoryless noisy channels. Rate of information transmission and the probability of decoding error, channel capacity. Systematic codes and the instrumentation problem. Time-discrete continuous channels. Coding and decoding for the band-limited Gaussian channel. Application of information theory to the analysis and design of communications systems.

4680. ADVANCED EXPERIMENTAL CONTROL SYSTEMS

Credit 4 hrs. Either term. 2 Lab. Prerequisite, 4582 or consent of instructor.

Limited to graduate students except by special permission. Programs on selected topics in experimental concepts, techniques, and design. Many different experiments are available including: components and systems in the Control System Laboratory; linear and nonlinear system simulation (including compensation) with the analog computer in Phillips Hall and/or the digital computer in the Cornell Computing Center; system optimization (experiment design); discrete control systems; and investigation of methods of adaptation in control systems. During a term the student is expected to perform three to six experiments, selected to meet his individual needs. Emphasis is placed on independent work.

4681. RANDOM PROCESSES IN CONTROL SYSTEMS

Credit 4 hrs. Fall. 3 Lect. Prerequisites, 4574 and 4581 or 4503.

Prediction and filtering in linear control systems; Gaussian-Markov sequence, Gaussian-Markov process, prediction problem, Hamiltonian formulation of filtering problem, generalized Wiener filtering, stochastic optimal and adaptive control problems. Selected topics: Bayes decision rule, min-max policy, maximum likelihood estimate, control of systems with uncertain statistical parameters; stochastic differential equations, optimal nonlinear filtering; Gaussian input describing function, stability of control systems with random parameters.

4682. SEMINAR IN CONTROL SYSTEMS

Credit 2 hrs. Fall or Spring. Prerequisites, 4582, 4681. Open to graduate students who are doing research in the area of control system engineering.

Presentation and discussion of current research and publications in control systems and switching systems.

4492. ILLUMINATING ENGINEERING

Credit 3 hrs. Spring. 2 Rec., 1 Lab.-Comp. Prerequisite, 4491.

Computation of light-flux distribution and study of difficult lighting problems; emphasis on specialized rather than general lighting problems.

4590. SPECIAL TOPICS IN ELECTRICAL ENGINEERING

Credit 1 to 3 hrs. Seminar, reading course, or other special arrangement agreed upon between the students and faculty members concerned.

4591 AND 4592. PROJECT

Credit 3 hrs. Fall and Spring.

Individual study, analysis, and usually experimental tests in connection with a special engineering problem chosen by the student after consultation with the faculty member directing his project; an engineering report on the project is required.

4593. FUNDAMENTALS OF ACOUSTICS

Credit 4 hrs. Fall. 3 Lect., 1 Lab. Laboratory assignments to meet individual needs. Prerequisite, 4401, or permission of the instructor.

Vibrations in strings, bars, membranes, and plates; plane and spherical acoustic waves; transmission, reflection, absorption, resonators, and filters; loudspeakers and microphones; speech, hearing, and noise; architectural and musical acoustics; ultrasonic and sonar transducers; underwater acoustics.

4595. ELECTRICAL ENGINEERING DESIGN

Credit 3 hrs. Offered either term for students enrolled in the M.Eng.(E.) Program.

A course utilizing real engineering situations in which to present fundamentals of engineering design.

Geography

Students interested in graduate work in geography will find study programs in many aspects of this subject in several Fields described in this Announcement. Graduate degrees are not offered in the subject of geography as such, but advanced study in geography is made possible by informally combining study in the constituent elements of the subject by arrangement with faculty members listed below.

Agricultural Geography: Prof. John W. Mellor
Anthropology: Prof. Lauriston Sharp
Climatology: Prof. Bernard E. Dethier
Geological Sciences: Prof. Arthur L. Bloom
Land Economics: Prof. Howard E. Conklin
Rural Sociology: Prof. Olaf F. Larson
Sociology: Prof. J. Mayone Stycos
Soil Science: Prof. Marlin G. Cline

Correspondence with members of the faculty in the student's special subject of interest is encouraged.

Geological Sciences

(Geology, Geochemistry, Geophysics, Geobiology, Physical Geography, Applied Fields)

Faculty: Messrs. Arthur L. Bloom, Kenneth F. Clark, W. Storrs Cole, George A. Kiersch, Wesley E. LeMasurier, Earle S. Lenker, Shailer S. Philbrick, John W. Wells.

Visiting Professor: Edwin D. McKee, United States Geological Survey, Denver, Colorado. (Fall term 1966).

Field Representative: George A. Kiersch, 140 McGraw Hall.

APPROPRIATE MAJOR SUBJECTS

Areal Geology
Engineering Geology
Geohydrology and Hydrogeology
Geomorphology
Geochemistry, Mineralogy-Petrology
Geobiology, Paleontology, and Stratigraphy
Mineral Deposits, Mining Geology
Physical Geography
Structural Geology and Geomechanics

APPROPRIATE MINOR SUBJECTS

All of the major subjects in the Field of Geological Sciences can also be taken as minor subjects, along with others in the department such as sedimentation, Pleistocene geology, water resources, and physical oceanography. Minor subjects outside of the Field of Geological Sciences may be chosen from many Fields, such as Agronomy, Botany, Engineering, Chemistry, Mathematics, Physics, Water Resources, Zoology, and Biological Sciences, or non-scientific Fields.

The program of graduate study in the Field of Geological Sciences is designed to give broad training in the field and laboratory. Candidates for advanced degrees normally will take one or both minor subjects outside of the Field of Geological Sciences.

Graduate work in Geological Sciences may include investigation under approved direction in localities away from Ithaca and the northeastern states. A brochure about graduate work in Geological Sciences may be obtained by writing to the Field Representative.

ADMISSION REQUIREMENTS. Candidates with a major in this Field will be expected to offer for admission an A.B. degree or its equivalent. Students with undergraduate majors other than geology such as physical sciences or engineering may be admitted, with the expectation that deficiencies equivalent with the undergraduate major in Geological Sciences similar to those at Cornell University will be rectified soon after admission.

Applicants for graduate study in Geological Sciences should take the Graduate Record Examination Aptitude Test and Advanced Test in Geology in sufficient time to permit inclusion of the results in the application for admission to the Graduate School.

LANGUAGE REQUIREMENTS. *Master's:* One of the following: proficiency in French, German, or Russian, to be established before the completion of the second residence unit. *Doctorate:* Two of the following: proficiency in French, German, Russian. Both must be established before the candidate will be allowed to schedule the Final Thesis Examination.

Language examinations will be administered by the Graduate Language Board.

EXAMINATIONS. The Special Committee conducts all examinations required for the degree.

For the Master's Degree: A Final Examination which consists of a comprehensive on the major and minor fields and the thesis. *For the Doctoral Degree:* A Qualifying Examination is required in addition to the examinations required by the Grdauate School. The Qualifying Examination will determine the applicant's fitness for undertaking advanced studies and will enable the Special Committee to plan a program which will make the student familiar

with the requisite knowledge in his chosen area. Required before the end of the second semester in residence.

DEGREE REQUIREMENTS. *Master's:* One year's residence; one language; submission of thesis.

A Master of Arts in Teaching (Earth Science) program is offered in conjunction with the Department of Science Education; a non-thesis degree. *Doctorate:* Three years residence; two languages; comprehensive examination on major and minor Fields; submission of dissertation and defense.

RESEARCH AND STUDY OPPORTUNITIES

The Ithaca region is particularly suited for research in stratigraphy, paleontology, geomorphology, and glacial geology. The nearby Adirondack area is a classic one for studies in metamorphic and igneous petrology. Research projects in structural geology, geomechanics, engineering geology, and hydrogeology are available at field sites in western as well as northeastern states, as are projects in mineral deposits, physical geography, and areal geology. The laboratories of the department contain standard as well as specialized equipment. Through the cooperating faculty of other departments on campus, every type of special and advanced equipment is available. The well-equipped laboratories and the exceptional libraries provide excellent opportunities for graduate research.

The department owns outstanding reference collections for teaching and research, such as: The Benjamin Silliman, Jr. Collection of minerals acquired in 1868; suites of ores and host rocks from worldwide mining districts; and extensive invertebrate fossils of Paleozoic, Mesozoic, and Cenezoic from throughout the world; as well as the major collection of Recent mollusks (10,000 species) assembled by Wesley Newcomb and purchased in 1868 by Ezra Cornell.

The Paleontological Research Institution, a private research organization, is nearby the campus and its facilities are available to the specialized investigator.

The department has a cooperating agreement with the Museum of Northern Arizona, Flagstaff, for accommodating research projects and investigators. Every conceivable geologic condition and feature is available for study in the region, and constitutes an unusual field setting. The Committee for Labrador Studies has been pursuing research in the country for 40 years and projects are in progress on field mapping, glacial geology, and petrography.

For summer research grants in geological science at the Museum of Northern Arizona and elsewhere, (after one year at Cornell) consult with the Field Representative.

INTERDISCIPLINARY STUDIES

Graduate studies may be pursued in many of the specialized interdisciplinary Fields of Geological Sciences as either a major or a minor at the Master's and Doctorate levels, such as:

OCEANOGRAPHY. Oceanography and marine ecology are available through the Department of Conservation and the Division of Biological Sciences. Research projects are in progress in the Long Island coastal areas, and cooperative research with the Woods Hole Oceanographic Institution and Adelphi University is provided.

WATER RESOURCES. Water Resources is available through the University-wide Water Resources Center with programs of study to meet individual requirements in the physical, biological, and social sciences, in engineering, and in the humanities.

A professional scientific hydrology program is available for majors in geohydrology in the Geological Sciences.

APPLIED BRANCHES. Programs of study are available in the following branches of applied geological science: mining geology-mineral deposits, petroleum geology, hydrogeology and geohydrology, and engineering geology. The major in a branch of applied geological science has two minors outside the department, in such subjects as soil science, hydraulics, water resources, soil mechanics, materials engineering, mathematics, chemistry, physics, economics, and regional planning.

COOPERATING FACULTY. Many additional interdisciplinary courses are offered by faculty in other departments or divisions such as: paleobotany, ecology-systematics, biogeochemistry, limnology, soil genesis, soil mineralogy, aerial photo analysis, regional planning, hydraulics and hydrology, and materials science and engineering.

FINANCIAL AID

There are nine Graduate Teaching Assistantships available in the Field of Geological Sciences. Appointments are for the academic year to supervise laboratory sections and other duties for approximately 15 hours per week. The stipend ranges from $2200 to $2500, plus scholarships covering tuition and fees ($1950) for a total value of $4150 to $4450. Full residence credit is normally given toward advanced degrees.

In addition, Teaching Assistants are eligible for special summer awards of up to $500 to pursue their research projects.

The Eleanor Tatum Long Fellowship, restricted to research in the subject of structural geology and geomechanics, for either master's or doctoral candidates, carries a stipend of $2100 and a scholarship covering tuition and fees ($1950) for a total value of $4050.

The department has several special endowments which, at the discretion of the staff, may be used to assist graduate students in their research and field work.

Research assistantships are available in certain cases from individual faculty research grants or contracts, either during the summer or the academic year.

The Graduate School administers a number of scholarships and fellowships. Awards are based on scholastic ability and promise of achievement as a graduate student. Besides the Cornell-supported awards, financial aid is offered by foundations and national agencies, e.g., NASA, NSF, NIH, NDEA, and by the State of New York.

COURSES

(Students should check this tentative listing with department for any changes).

Geography, Physical

[312. GEOGRAPHY OF ANGLO-AMERICA]

Spring term. Credit four hours. Prerequisite, Geography 111, or Geology 102. Lectures M W F 9, and additional assigned problems. Mr. Bloom. Alternate-year course; not offered in 1966–67.

The geographic provinces of Anglo-America, their geomorphic expression, climates, resources, development, and interrelationships.

314. CONTINENTAL GEOGRAPHY

Spring term. Credit four hours. Prerequisite, Geography 111, or Geology 102. Lectures M W F 9, and additional assigned problems. Mr. Bloom. Alternate-year course; offered in 1966–67.

Physical geography, regional climatology, land use, and natural resources of a selected continent or region.

610. SPECIAL WORK

Throughout the year. Credit two hours. Prerequisite, consent of the instructor. Staff.

Special or original investigations in physical geography on the graduate level.

General Geology

PHYSICAL PROCESSES

322. STRUCTURAL GEOLOGY

Spring term. Credit four hours. Prerequisite, Geology 352 recommended. Lectures, M W 11. Laboratory, M 2–4:30, and additional assigned problems. Field trips. Mr. Kiersch.

Nature, origin and recognition of geologic structures. Environmental geology and the behavior of materials and geomechanics due to stresses. Tectonic principles are applied to the solution of geologic problems; analysis of structural features by three-dimensional methods.

421. SEDIMENTATION

Fall term. Credit four hours. Prerequisite, Geology 352; Geology 441 recommended. Lectures, M W 11. Laboratory, M 2–4:30, and additional laboratory work. Field trips. Mr. Kiersch. Alternate-year course; offered in 1966–67.

Source materials, mechanics of transport and dispersal, depositional environments, lithification and diagenesis of sediments. Analysis of common problems in applied fields due to these phenomena.

522. FLUVIAL PROCESSES (or 2333 Civil Engr.)

Spring term. Credit two hours. Prerequisite, consent of instructors. Seminar, hours to be arranged; field trips. Course offered jointly with Department of Civil Engineering on demand. Messrs. Graf and Kiersch.

The common problems of fluvial processes, hydraulics, and sediment transport are studied along with the appropriate analytical methods and experimental techniques.

441. GEOMORPHOLOGY

Fall term. Credit four hours. Prerequisite, Geology 102. Lectures, T Th 9. Laboratory, T 2–4:30, and additional assigned problems. Mr. Bloom.

Description and interpretation of land forms in terms of structure, processes, and stage.

542. GLACIAL AND PLEISTOCENE GEOLOGY

Spring term. Credit three hours. Prerequisite, Geology 441. Lectures, T Th 9. Laboratory, T 2–4:30. Several Saturday field trips. Mr. Bloom.

Glacial processes and deposits and the stratigraphy of the Pleistocene.

Geochemistry

MINERAL MATERIALS AND PROCESSES

351. MINERALOGY

Fall term. Credit four hours. Prerequisite, Geology 102, Chemistry 108. Lecture, M 10. Laboratories W F 2–4:30, and additional assigned problems. Mr. LeMasurier.

Crystallography, crystal chemistry, and systematic mineralogy of the ore and rock-forming minerals.

352. PETROLOGY

Spring term. Credit four hours. Prerequisite, Geology 351. Lectures, M F 10. Laboratory, Th 2–4:30, and additional assigned problems. Mr. LeMasurier.

Composition, classification, and origin of igneous, sedimentary, and metamorphic rocks.

451. OPTICAL MINERALOGY

Fall term. Credit four hours. Prerequisite, Geology 351. Lecture, W 12. Laboratories, M T 2–4:30, and additional assigned problems. Mr. LeMasurier.

Optical properties of crystals and their application to the determination and study of common rock-forming minerals with the petrographic microscope.

452. OPTICAL PETROGRAPHY

Spring term. Credit four hours. Prerequisites, Geology 352 and 451. Lecture, W 12. Laboratories, M T 2–4:30, and additional assigned problems. Mr. LeMasurier.

Description, classification, and determination of the origin of igneous, metamorphic, and sedimentary rocks by the use of the petrographic microscope.

551. GEOCHEMISTRY

Fall term. Credit three hours. Prerequisite, Geology 352. Lectures, M W F 8. Instructor to be appointed. Alternate year course; offered in 1966–67.

Distribution of major and minor elements in the earth, geochemical cycles of the elements, and chemistry of weathering and petrogenesis.

554. X-RAY ANALYSIS

Spring term. Credit two hours. Prerequisite, Geology 352 or consent of instructor. Lecture, W 12. Laboratory, F 2–4:30. Instructor to be appointed. Alternate-year course; offered in 1966–67.

Theory and use of X-ray diffraction and spectroscopy in identification and analysis of minerals, rocks, and soils.

MINERAL DEPOSITS

461. MINERAL DEPOSITS – METALS

Fall term. Credit four hours. Prerequisites, Geology 102 or 203, 351. Lectures, M W F 10. Laboratory, F 2–4:30. Mr. Clark.

Principles and processes involved in the formation of mineral deposits. Modes of occurrence, origin, distribution, and utilization of the major, rare, and minor metals.

462. MINERAL DEPOSITS – NON-METALS

Spring term. Credit four hours. Prerequisite, Geology 461. Lectures, M W F 10. Laboratory, F 2–4:30. Mr. Clark.

Properties, occurrence, associations, distribution, and economic utilization of the industrial minerals and rocks.

563. ORE MICROSCOPY

Fall term. Credit two hours. Prerequisite, Geology 461. Laboratory, F S 8–10:30. Alternate-year course; offered in 1966–67. Mr. Clark.

Identification of ore minerals in polished sections which reflect light by etching and microchemical reactions; study and interpretation of mineral relationships.

Applied Geological Science

532. HYDROGEOLOGY

Spring term. Credit three hours. Prerequisites, Geology 322, 352; recommended, Geology 441. Lectures T Th 11. Laboratory T 2–4:30, and field trips. Mr. Kiersch. Alternate-year course. Offered in 1966–67.

Hydrologic cycle and water provinces; occurrence, movement, quantity, and chemical quality of ground water in porous media. Water resources development.

[533. ENGINEERING GEOLOGY – THEORY AND ENVIRONMENTS]

Fall term. Credit three hours. Prerequisites, Geology 322, 352; recommended, Geology 441. Lectures, M W 11, Laboratory, M 2–4:30, and field trips. Mr. Kiersch. Alternate-year course. Not offered in 1966–67.

Advanced study of the physical phenomena and rock properties of special importance to the planning-design, construction, and operation of major engineering works; includes underground fluids, sediment, subsidence, gravity movement, rock-soil weathering, and geologic materials of construction. Analysis of geologic problems encountered in practice; predicting the influence of natural and man-made environmental factors on engineering works.

535. ENGINEERING GEOLOGY – PRACTICE

Fall term. Credit three hours. Prerequisites, Geology 533 or Geology 322–352, and 441. Lectures, M W 12; Laboratory, T 2–4:30, and field trips. Messrs. Philbrick and Kiersch. Alternate-year course. Offered in 1966–67.

Application of geological principles in the planning-design, construction, and operation of engineering works. Case histories, analysis, and evaluation of physical environmental factors, remedial treatment, and reports.

[561–562. ADVANCED MINERAL DEPOSITS – MINING GEOLOGY]

Throughout the year. Credit three hours a term. Prerequisite, Geology 461. Lectures, M W F 8. Alternate-year course. Not offered in 1966–67. Mr. Clark.

Studies of selected districts and ore-forming phenomena. Evaluation of mineral resources and mining geology reports.

581. EXPLORATION GEOPHYSICS

Fall term. Credit two hours. Prerequisites, graduate standing and consent of instructor. Lectures, T Th 9. Mr. Clark. Alternate-year course. Offered in 1966–67.

Elementary theory and interpretation of data from exploration geophysical methods. Environmental geology and selection of techniques for important applied areas.

582. EXPLORATION GEOLOGY

Spring term. Credit three hours. Recommended for all graduate students in Geological Sciences. Prerequisites, graduate standing and field geology. Lectures M W 9. Laboratory, W 2–4:30. Messrs. Philbrick and Kiersch. Alternate-year course. Offered in 1966–67.

Methods of exploration and appraisal of geologic data from both field and laboratory investigations. Assessment of environmental geology and the presentation of direct and indirect information for professional purposes and applied fields.

Geobiology

PALEONTOLOGY AND STRATIGRAPHY

471. INVERTEBRATE PALEONTOLOGY

Fall term. Credit four hours. Prerequisites, Geology 102, and, if possible invertebrate zoology. For those interested in fossil evidence of the development of organisms. Lectures, T Th 10. Laboratory, W Th 2–4:30. Mr. Cole.

Paleobiology and classification of important fossil invertebrates.

472. BIOSTRATIGRAPHY

Spring term. Credit four hours. Prerequisite, Geology 471. Lectures, T Th 10. Laboratory, W 2–4:30, and additional assigned problems. Mr. Wells.

Zone fossils, faunas, and faunal provinces of the geologic periods.

571. STRATIGRAPHY — Paleozoic

Fall term. Credit three hours. Prerequisite, Geology 472. Lectures, T Th 9, and W 7:30 p.m. Mr. Wells.

Principles of stratigraphy developed by detailed study of selected American and European systemic examples.

572. STRATIGRAPHY — Mesozoic and Cenozoic

Spring term. Credit three hours. Prerequisite, Geology 472. Lectures. T W Th 9. Mr. Cole.

Principles of stratigraphy developed by detailed study of selected American and European systemic examples.

671. MICROPALEONTOLOGY

Spring term. Credit two hours. Prerequisite, Geology 472, 572. Lecture W 9. Laboratory, W 2–4:30, and additional assigned problems. Mr. Cole.

Microfossils, chiefly Foraminifera.

[672. STRATIGRAPHY OF NEW YORK STATE]

Spring term. Credit three hours. Prerequisite, Geology 571. Lectures, T Th 12, early in the term, followed by all-day and weekend field trips. Mr. Wells. Alternate-year course. Not offered in 1966–67.

The classic Paleozoic sections of New York studied through lectures, readings, and field observation.

Seminars and Special Work

GEOLOGY 673. SEMINAR IN THE HISTORY OF GEOLOGY

Fall term. Credit two hours. Hours to be arranged. Mr. Wells.

Part of the graduate program in the history of science.

SEMINAR IN GEOLOGICAL SCIENCES

Each term. No credit. For majors and required of graduate students, but open to all who are interested. T 4:45. Staff and visiting lecturers.

Reports and discussion of current research in the geological sciences.

690. SPECIAL WORK

Throughout the year. Credit two hours a term. Prerequisite, consent of the instructor. Staff.

Advanced work or original investigations in geological sciences on the graduate level.

690-a. Analytical geochemistry and petrology: Mr. Lenker

690-b. Volcanic petrology and geochemistry: Mr. LeMasurier

690-c. Coastal geomorphology and Pleistocene Geology: Mr. Bloom

690-d. Engineering geology, geomechanics, and hydrogeology: Mr. Kiersch

690-e. Invertebrate paleontology and geomorphology: Mr. Cole

690-f. Invertebrate paleontology and paleoecology: Mr. Wells

690-g. Sedimentology and primary structures

A special lecture seminar by Mr. E. D. McKee, fall term. Credit one hour. Hours to be arranged.

690-h. Physical and engineering geology, water resources: Mr. Philbrick

690-i. Mineral deposits and resources, geophysics: Mr. Clark

Industrial Engineering and Operations Research

Faculty: Robert E. Bechhofer, Richard H. Bernhard, Richard W. Conway, Henry P. Goode, Donald L. Iglehart, Kenneth O. Kortanek, William L. Maxwell, Narahari U. Prabhu, Sidney Saltzman, Martin W. Sampson, Byron W. Saunders, Andrew Schultz, Jr., Howard M. Taylor 3d, Lionel Weiss.

Field Representative: D. L. Iglehart, Room 370 Upson Hall.

Listed below are appropriate major subjects in the Field of Industrial Engineering and Operations Research, and appropriate minor subjects in outside Fields. Certain of these major subjects may also be chosen as a minor subject by students majoring in the Field. For example, in recent years the most popular major-minor combination has been Operations Research — Applied Probability and Statistics; Mathematics is the minor subject which is most commonly chosen from outside the Field.

APPROPRIATE MAJOR SUBJECTS	APPROPRIATE MINOR SUBJECTS
Applied Probability and Statistics	Applied Mathematics (Applied Mathematics)
Industrial Engineering	Computer Science (Computer Science)
Information Processing	Control Systems Engineering (Electrical Engineering)
Operations Research	Econometrics (Economics)
Systems Analysis and Design	Managerial Economics (Business and Public Administration)
	Mathematics (Mathematics)
	Regional Planning (City and Regional Planning)
	Water Resources (Water Resources)

A general description of the five major subjects is given below.

APPLIED PROBABILITY AND STATISTICS. This subject is intended for those students whose primary interests lie in the development of new methodology in probability and statistics, particularly insofar as these techniques are applied to problems arising in engineering and sciences. Thus, for example, applied probability is concerned with problems in queuing theory, inventory theory, reliability theory, and time series analysis; applied statistics deals with problems in the design, analysis, and interpretation of experiments, statistical control theory and sampling inspection, and statistical decision theory. Students who elect work in this subject are expected to acquire a deep knowledge of the theory underlying the various techniques; the doctoral dissertation shall represent a fundamental contribution to theory and application. All students who major in this subject are required to minor in mathematics.

INDUSTRIAL ENGINEERING. This subject is concerned with studies in the analysis and design of the complex operational systems that occur in industry, particularly in manufacturing. Plant design, cost analysis and control, and production planning are some of the major topics which are considered. A high degree of facility is expected with some of the modern analytical techniques which provide tools for rational decision-making, and which aid in the establishment of valid design criteria. Such techniques are drawn from the areas of queuing theory, inventory theory, mathematical programming, statistical control, and computer simulation.

INFORMATION PROCESSING. Information processing is concerned with the design of computing-communication-decision systems for the control of complex operations such as are encountered in manufacturing, transportation, logistics, and institutional management. Such systems are studied in several graduate Fields; the emphasis in this Field is on the analysis of requirements, the development of decision procedures and the overall systems design. A graduate program in information processing will normally include substantial work in the Fields of Computer Science and/or Electrical Engineering.

The Cornell Computing Center provides the principal laboratory facility for this area with a Control Data 1604 computer. In 1967 an IBM 360/67 remote-access, time-shared computing system will be installed.

OPERATIONS RESEARCH. The program in operations research is strongly analytical in approach and content. Emphasis is placed on understanding the phenomena underlying practical problems in order that suitable mathematical models can be developed or selected to represent the operational situation.

Such models may be drawn from inventory theory, queuing theory, reliability, replacement and maintenance theory, control theory, decision theory, and mathematical programming theory. The operations research student, motivated by a program which emphasizes the mathematical, probabilistic, statistical, and computational sciences, has interests that are much broader than those associated with industrial problems alone.

SYSTEMS ANALYSIS AND DESIGN. This subject shares with operations research an interest in the development of analytical models to represent the basic structure of operational systems. However, in this case the model is simply a predictive stage of a design task. The objective is not so much the understanding of the mechanism of the model as it is the using of predictions based on the model to compare design alternatives. There is also a distinction in the scale of systems that are considered; the analytical models of operations research often correspond to the components of these larger structures. Typical systems which might be considered would be found in manufacturing, integrated transportation, marketing, highway, and other related systems complete with their control elements.

ADMISSION REQUIREMENTS. As a prerequisite for graduate study leading to the degree of M.S. or Ph.D. with a major in the Field of Industrial Engineering and Operations Research, the candidate must have been graduated from an institution of recognized standing with a Bachelors degree in engineering, mathematics, economics, or the physical sciences. In addition, he must have a commendable undergraduate scholastic record and must supply other evidence of his interest in, and ability to pursue, advanced study and research in his major and minor subjects. It is strongly recommended that all applicants to the Field take the Graduate Record Examination and submit the results along with their application for graduate study.

LANGUAGE REQUIREMENTS. For the M.S. degree: no language requirements. For the Ph.D. degree: a candidate must demonstrate either (a) exceptional reading ability in one language additional to his native language, or (b) reading ability in two languages additional to his native language.

Required languages shall be chosen from French, German, Russian, or others to be approved by petition to the Field.

PH.D. EXAMINATIONS. In addition to the Admission to Candidacy examination which will ordinarily be administered by the student's Special Committee during the third year of graduate study, and the final examination on the thesis, the student will be given a Qualifying Examination administered by the Field. This latter examination will normally be taken during the third term of graduate study. It shall serve to determine the ability of the candidate to pursue doctoral studies, and to assist the Special Committee in developing a program of study for the candidate.

RESEARCH INTERESTS OF THE FACULTY

R. E. Bechhofer (design of experiments, ranking and selection procedures), R. H. Bernhard (capital investment planning, cost analysis and control), R. W. Conway (computer science, scheduling theory), H. P. Goode (manufacturing engineering, sampling inspection), D. L. Iglehart (inventory theory, stochastic processes), K. O. Kortanek (mathematical programming, systems analysis), W. L. Maxwell (data processing and production control systems, computer simulation of manufacturing systems), N. U. Prabhu (queuing and inventory theory, stochastic processes), S. Saltzman (information processing

systems, econometrics), M. W. Sampson (industrial organization, methods engineering), B. W. Saunders (manufacturing engineering, materials handling), A. W. Schultz, Jr. (operations research, engineering administration), H. M. Taylor 3d (statistical control theory, time series analysis), L. I. Weiss (statistical decision theory, non-parametric statistics).

RESEARCH OPPORTUNITIES. During the academic year 1966–67 several members of the faculty will be engaged in sponsored research on contracts or grants which provide financial support and which offer opportunities for thesis research for advanced graduate students. The research areas include statistical multiple-decision ranking and selection procedures, information processing and operations control systems, multi-echelon logistics, statistical control theory, and sequential procedures and applied stochastic processes.

COURSES

IE 9460. INTRODUCTION TO PROBABILITY THEORY WITH ENGINEERING APPLICATIONS

Credit 4 hrs. Fall. 3 Lec.-Rec., 1 Comp. Prerequisite, Mathematics 294 or equivalent.

Definition of probability and basic rules of probability theory. Random variables, probability distributions, and expected values. Special distributions important in engineering work and relations among them; elementary limit theorems. Introduction to stochastic processes and Markov chains, and their applications in the construction of mathematical models of operation, with emphasis on queuing and inventory models.

IE 9470. INTRODUCTION TO STATISTICAL THEORY WITH ENGINEERING APPLICATIONS

Credit 4 hrs. Spring. 3 Lec.-Rec., 1 Comp. Prerequisite, 9460.

The application of statistical theory to problems associated with the analysis of data and inference drawn therefrom. Principles of statistical inference: estimating the value of the unknown parameters of probability distributions, testing hypotheses concerning these parameters; elements of statistical decision theory. Introduction to correlation theory and curve fitting by least squares. Applications in regression, statistical control, and experimentation.

IE 9481. INTRODUCTION TO COMPUTER SCIENCE

Credit 3 hrs. Spring. 2 Lect., 1 Rec.-Comp.

Introduction to the Field of Computer Sciences including principles and characteristics of information processing equipment, programming languages, and applications. Topics are selected to illustrate a wide range of current and potential areas of application with emphasis being placed on the modern digital computer as a symbol manipulating device rather than as an arithmetic calculator. Number systems, computer logic, and organization, and characteristics of current equipment are covered along with various aspects of programming. Introductory concepts and problems associated with using computers in information processing systems, real-time control systems, simulated experimentation, and the design process are also considered.

[IE 9501. ENGINEERING ADMINISTRATION]

Credit 3 hrs. Spring. 3 Lec.-Rec.

Organization of the engineering function, planning and analysis of engineering activities. Project management and control. Problems of innovation

and introducing technological change. Measurement and evaluation of engineering activities. Selected topics from current literature. Not offered in 1966–67.

IE 9510. WORK DESIGN AND MEASUREMENT

Credit 3 hrs. Fall. 2 Rec., 1 Lab. Prerequisite, 9310 or permission of the instructor.

An advanced course in the analysis and design of man-micro systems and man-machine micro systems. Advanced statistical treatment of work measurement design, variables measurement, and work sampling; mathematical and statistical treatment of model design, standard data, control, and standards maintenance; study of the micro-systems design problem, including emphasis on the behavioral aspects and wage incentives.

IE 9511. MANUFACTURING ENGINEERING

Credit 3 hrs. Fall. 1 Lect., 1 Rec.-Comp. Prerequisite, 9311.

The analysis and design of production facilities based on output requirements of the system. Attention will be directed towards the interaction of processing methods and requirements with handling methods and storage facilities. The effects of various levels of mechanization on operating costs and initial investment will be studied.

IE 9512. STATISTICAL METHODS IN QUALITY AND RELIABILITY CONTROL

Credit 3 hrs. Spring. 3 Lect. Prerequisite, 9470 or equivalent.

Control concepts; control chart methods for attributes and for variables; process capability analysis; attributes acceptance sampling plans and procedures; double and multiple sampling inspection; elementary plans and procedures for variables; acceptance-rectification procedures; basic reliability concepts; exponential and normal distributions as models for reliability application; life and reliability analysis of components; analysis of series and parallel systems; stand-by and redundancy; elementary sampling-inspection procedures used for life and reliability.

[IE 9513. SYSTEMS ENGINEERING]

Credit 3 hrs. Spring. 2 Rec., 1 Lab. Prerequisites, 9320 or 9470 or permission.

Methods of describing, analyzing, and manipulating complex, interrelated open systems. Graphical and mathematical analysis. Techniques of design and transportation, service, and information systems and appropriate evaluation methods. Not offered in 1966–67.

IE 9521. PRODUCTION PLANNING AND CONTROL

Credit 4 hrs. Spring. 3 Rec., 1 Comp. Prerequisites, 9460, and 9320 or equivalent.

Methods for the planning and control of large-scale operations with emphasis on manufacturing systems. Among the areas covered will be sales and production forecasting; manufacturing planning; routing, scheduling and loading; sequencing; dispatching; planning and control of inventories. Emphasis will be on mathematical and statistical methods for performing these functions; however, the empirical systems and procedures in common use will also be discussed and evaluated.

IE 9522. OPERATIONS RESEARCH I

Credit 3 hrs. Fall. 3 Lec.-Rec. Prerequisite, permission of the instructor.

Model design, methodology of operations research, linear programming, transportation problem, assignment problem, dual theorem, parametric linear programming, integer programming, non-linear programming, dynamic programming, introduction to inventory theory; comprehensive problems and case studies.

IE 9523. OPERATIONS RESEARCH II

Credit 3 hrs. Spring. 3 Lec.–Rec. Prerequisite, 9460 or permission of the instructor.

Models for inventory and production control; replacement theory; queuing, including standard birth and death process model and non-standard models, application of queuing theory; simulation; game theory; illustrative examples and problems.

IE 9524. PROBLEMS IN OPERATIONS RESEARCH

Credit 3 hrs. One 2-hr. meeting a week. Prerequisite, 9523 or equivalent.

An advanced seminar concentrating on problem definition, measures of effectiveness, applicability of various analytical methods to the solution of real problems.

IE 9525. FLOW AND SCHEDULING IN NETWORKS

Credit 3 hrs. Spring. 3 Lec.-Rec.

Network analysis for continuous static flow; feasibility theorems, capacity determination, minimal cost operation. Sequencing models for deterministic discrete flow networks. Determination of capacity, routing and discipline for networks of queues.

IE 9526. MATHEMATICAL MODELS – DEVELOPMENT AND APPLICATION

Credit 4 hrs. Fall. 3 Lec.-Rec., 1 Comp. Prerequisites, 9311 and 9320 or permission of the instructor.

A detailed examination of probabilistic and deterministic models used in industrial engineering work. Study of some of the standard models found in the literature.

IE 9530. MATHEMATICAL PROGRAMMING

Credit 3 hrs. Fall. 3 Lec.-Rec. Prerequisite, permission of the instructor.

Theory, methods, computational techniques, and applications of mathematical programming. Classical constrained maximization and Lagrange multipliers. Linear programming; simplex methods and variations; the dual and the dual simplex methods; transportation programming. Integer programming. Quadratic and convex programming. Linear and quadratic assignment programming.

IE 9531. DYNAMIC PROGRAMMING

Credit 3 hrs. Spring. 3 Lec.-Rec. Prerequisite, permission of the instructor.

Topics discussed will be drawn from the recent technical literature. Emphasis will be placed on the analytical aspects of dynamic programming, although some computational questions will also be discussed.

IE 9539. SELECTED TOPICS IN MATHEMATICAL PROGRAMMING

Credit 3 hrs. Spring. 3 Lec.-Rec. Prerequisite, 9530.

Topics will be selected from such areas as non-linear, stochastic, and semi-infinite programming.

IE 9550. ENGINEERING ECONOMIC ANALYSIS

Credit 3 hrs. Fall. 3 Lec.

An intensive accelerated survey of financial and managerial accounting and engineering economics. Use of cost information for financial reporting, cost control, and decision making. Specific topics include: theory of double-entry accrual accounting as background for subsequent material; bookkeeping is deemphasized. Use of costs in manufacturing: job order vs. process costing; predetermined overhead rates; standard costs and variances. Modification of cost information for decision making: cost dichotomies; profit-volume charts; direct costing; costing of joint products and by-products; economic lot sizes; use of costs in other models of operations research. Capital investment planning: the time value of money; use of interest rates; ranking procedures for proposed projects including the MAPI formulas; handling of risk and uncertainty.

IE 9551. ADVANCED ENGINEERING ECONOMIC ANALYSIS

Credit 3 hrs. Spring. 3 Lec. Prerequisite 9311 or equivalent.

Topics include: Brief review of use of cost information for financial reporting, cost control and decision making. Intensive discussion of capital investment planning procedures. Problems in project ranking including use of payoff period, present worth, internal rate of return and MAPI urgency rating. Interdependence of productive investment and financing decisions. The cost of capital controversy. Handling of risk and uncertainty. Applications of linear programming to capital budgeting problems. Theory of the firm including objectives, market structure, and pricing policies. Measures of performance. Problems of profit measurement in the decentralized firm including intensive discussion of transfer pricing.

IE 9560. APPLIED STOCHASTIC PROCESSES

Credit 3 hrs. Spring. 2 Rec., 1 Comp. Prerequisites, 9460 and 9470, or permission of the instructor.

An introduction to stochastic processes, emphasizing basic theory and its engineering application. The following topics are covered: second order processes, covariance function and spectral distribution, Markov chains and processes, diffusion processes, renewal theory and recurrent events, fluctuation theory, random walks, branching processes, queues, Brownian motion, and birth and death processes.

IE 9561. QUEUING THEORY

Credit 3 hrs. Fall. 2 Rec., 1 Comp. Prerequisites, 9460 and permission of the instructor.

Definition of a queuing process. Poisson and Erlang queues. Imbedded chains. Transient behavior of the systems M/G/1 and GI/M/1. The general queue GI/G/1. Bulk queues. Applications to specific engineering problems such as shop scheduling, equipment maintenance, and inventory control.

IE 9562. INVENTORY THEORY

Credit 3 hrs. Fall. 3 Lec.-Rec. Prerequisites, 9460 and permission of the instructor.

An introduction to the mathematical theory of inventory and production control with emphasis on the construction and solution of mathematical models; topics will be drawn from the recent technical literature and will include deterministic and stochastic demands; dynamic programming and stationary analyses of inventory problems; renewal theory applied to inventory

problems; multi-echelon problems; statistical problems; and production smoothing.

IE 9563. SELECTED TOPICS IN THE THEORY OF QUALITY AND RELIABILITY CONTROL

Credit 3 hrs. Spring. 3 Lec. Prerequisite, 9470 or the equivalent.

This course will concentrate on the statistical properties and derivation of some quality and reliability control procedures. Topics will include the economic design of Shewhart control charts, cumulative sum control charts, Girshick and Rubin control procedures, moving average control charts, sampling inspection by variables for percent defective, reliability estimation, and reliability growth models.

IE 9564. SEQUENTIAL DECISION AND CONTROL PROCEDURES

Credit 3 hrs. Spring. 3 Lec. Prerequisites, 9560 and permission.

Markovian sequential control processes will be discussed with attention concentrated on the problem of existence of optimal control strategies. The recent work of C. Derman and D. Blackwell will be intensively studied.

[IE 9571. DESIGN OF EXPERIMENTS]

Credit 4 hrs. Fall. 2 Rec., 1 Comp. Prerequisite, 9470 or permission.

Use and analysis of experimental designs such as randomized blocks, Latin squares, and incomplete blocks; analysis of variance and covariance; factorial experiments, confounding, fractional replication; statistical problems associated with finding best operating conditions; response-surface analysis. Not offered in 1966–67.

IE 9572. STATISTICAL DECISION THEORY

Credit 3 hrs. Fall. 3 Rec. Prerequisites, 9470 or equivalent.

The general problem of statistical decision theory and its applications. The comparison of decision rules; Bayes, admissible, and minimax decision rules. Problems involving a sequence of decisions over time, including sequential analysis. Use of the sample cumulative distribution function, and other nonparametric methods. Applications to problems in the areas of inventory control, sampling inspection, capital investment, and procurement.

[IE 9573. STATISTICAL MULTIPLE DECISION PROCEDURES]

Credit 3 hrs. Spring. 2 Rec. 1 Comp. Prerequisite, 9571 or permission.

The study of multiple-decision problems in which a choice must be made among two or more courses of action. Statistical formulations of the problems. Fixed-sample size, two-stage, and sequential procedures. Special emphasis on applications to ranking problems involving choosing the "best" category where goodness is measured in terms of a particular parameter of interest. Recent developments. Not offered in 1966–67.

[IE 9574. EMPIRICAL TIME SERIES ANALYSIS]

Credit 3 hrs. Fall. 3 Lec.

Model fitting and prediction theory; correlation analysis; spectral analysis of univariate and multivariate time series. Not offered in 1966–67.

IE 9579. SELECTED TOPICS IN APPLIED STATISTICS

Credit 3 hrs. Either term. 2 Rec., 1 Comp. Prerequisite, 9470 or permission of the instructor.

Selected topics chosen from such areas as nonparametric statistical methods, sequential analysis, multivariate analysis.

IE 9580. DIGITAL SYSTEMS SIMULATION

Credit 4 hrs. Fall 2 Lect., 1 Rec. Prerequisites, 9481 and 9470, or permission of the instructor.

The use of a program for a digital computer to simulate the operating characteristics of a complex system in time. Discussion of problems encountered in construction of a simulation program; synchronization and file maintenance, random number generation, random deviate sampling. Programming in the CLP and SIMSCRIPT languages. Problems in the design of effective investigations using simulation; statistical considerations when sampling from a simulated process.

IE 9582. DATA PROCESSING SYSTEMS

Credit 3 hrs. Fall. 1 Lect. 1 Comp. Prerequisite, 9481 or permission of the instructor.

The design of integrated data processing systems for operational and financial control; questions of system organization, languages and equipment appropriate to this type of application, file structures, addressing and search problems, sorting techniques; problems of multiple-remote-input, on-line data processing systems; techniques of system requirement analysis.

IE 9591. INDUSTRIAL ENGINEERING AND OPERATIONS RESEARCH GRADUATE SEMINAR

Credit 1 hr. Both terms. A weekly 1½ hr. meeting.

Presentation of latest research results by visitors, staff, and advanced graduate students. Discussion and study of assigned topics of importance in the Field.

DEPARTMENTAL FELLOWSHIPS

In addition to several University-wide and College of Engineering fellowships, the following fellowships are specifically designated for incoming candidates in the Field of Industrial Engineering and Operations Research:

JOHN MCMULLEN GRADUATE FELLOWSHIP. $2000 plus tuition and fees.

PROCTER AND GAMBLE FELLOWSHIP. $2000 plus tuition and fees. A $700 allowance is available if the recipient is married.

SUN OIL FELLOWSHIP. $2250 plus tuition and fees if the recipient is single or married without children. A $450 allowance is available if the recipient is married and has children.

DEXTER S. KIMBALL FELLOWSHIP OF CORNELL AERONAUTICAL LABORATORY. $2500 or more plus tuition and fees.

Materials Science and Engineering

Faculty: Robert W. Balluffi, Boris W. Batterman, John M. Blakely, Malcolm S. Burton, James L. Gregg, John P. Howe, Joseph O. Jeffrey, Herbert H. Johnson, Chi-yu Li, Walter S. Owen, Thor N. Rhodin, Arthur L. Ruoff, Henri S. Sack, Eraldus Scala, David Seidman, Benjamin M. Siegel, John Silcox, Floyd O. Slate, George V. Smith, Anthony Taylor, Watt W. Webb.

Visiting Professor: P. G. Winchell, Purdue University.

Field Representative: H. H. Johnson, Thurston Hall.

APPROPRIATE MAJOR SUBJECTS	APPROPRIATE MINOR SUBJECTS
Materials Science	Materials Science
Materials and Metallurgical Engineering	Materials and Metallurgical Engineering

ADMISSIONS REQUIREMENTS. Graduates from any undergraduate engineering or physical science program will be accepted if they have demonstrated marked competence in the basic parts of their studies and show competence, in general, as graduate students. Applicants who lack some prerequisites for graduate courses recommended by the Field, but are otherwise qualified, will be allowed to remedy the deficiency by taking undergraduate courses while enrolled as graduate students.

It is recommended, but not required, that applicants present the results of the Graduate Record Examination with their applications.

LANGUAGE REQUIREMENTS. For the Ph.D. degree the student must pass an examination in either German or Russian. There are no language requirements for the M.S. degree.

EXAMINATIONS. All examinations required for a degree are administered and reported by the candidate's Special Committee. The examinations may be oral, or written and oral. In accord with Graduate School legislation, a comprehensive examination is required for admission to Ph.D. candidacy. A thesis examination is given upon submission of the Ph.D. thesis.

For the M.S. degree, an examination is required at the time of submission of the M.S. thesis. At the discretion of the Special Committee, this examination may consider the thesis, or the thesis and course work. Under suitable circumstances, the Master's examination and the examination for admission to Ph.D. candidacy may be combined.

RESEARCH AND STUDY OPPORTUNITIES

Graduate programs in Materials Science and Engineering lead to careers either in research and development, or in engineering application of materials. This is accomplished through comprehensive and integrated course programs, participation in formal and informal research seminars, thesis research, and not infrequently in hallway discussions.

The spectrum of current research programs in the Field is very broad, ranging from problems of immediate technological interest such as crack propagation in high strength steels to considerably more basic investigations in such areas as point defects and superconductivity.

Current research in the Field includes the following:

1. Mechanical behavior: interstitial and substitutional solid solutions, crack formation and propagation, embrittlement phenomena, fatigue, composite materials, anelasticity.
2. Imperfections in solids: point defects, dislocation mechanics, defect interactions, radiation damage, substructure.
3. Phase transformations: crystal growth, precipitation, martensite, alloy steels, superconductivity, solidification, phase decomposition during sintering.
4. Surface structure and reactions: solid-liquid and solid-gas interfaces, field ion microscopy, surface diffusion, low energy electron diffraction, crystal nucleation.
5. High temperature materials: structure and properties of pyrolytic graphite, composite materials, refractory metals and alloys, complex compounds, sintering of ceramics.

6. High pressure studies: creep, diffusion, elastic constants, electrical properties.

7. Electrical and magnetic behavior: superconductivity, semiconductors, NMR, conduction in oxides, magnetic domain wall motion, photoconductivity.

8. Development of advanced experimental techniques: electron microscopy, x-ray, high pressure, crystal growing, purification methods.

More detailed information about course programs and research areas is available upon request.

A strong catalyst for the materials research activities at Cornell has been provided by the Materials Science Center, which is supported by the Advanced Research Projects Agency of the U.S. Government, and with which most of the Field Faculty are affiliated. The MSC provides substantial financial assistance for graduate students through research assistantships, new equipment for approved thesis research projects, and in some cases technician assistance in performing routine measurements.

A most important contribution of MSC has been the creation and maintenance of central research facilities which are used by both faculty and graduate students. Each central facility is directed by a senior staff member and staffed by trained technicians. Faculty and students receive expert guidance and assistance from these facilities, which include laboratories for high temperature studies, x-ray and optical metallography, electron microscopy, crystal growth, analytical chemistry, and materials processing.

COURSES

Graduate Core Program: Materials Science and Engineering

6601. TOPICS IN THERMODYNAMICS AND KINETICS

Credit 3 hrs. Fall.

Generalization of thermodynamics to include non-chemical forms of energy. Statistical nature of entropy. Phase stability. Defect equilibria. Thermodynamics of solutions, surfaces, and interfaces. Reaction kinetics. At the level of Slater, *Introduction to Chemical Physics;* Guggenheim, *Thermodynamics.* Mr. Johnson.

6602. PHASE TRANSFORMATIONS

Credit 3 hrs. Spring.

Diffusion. Spinodal decomposition. Nucleation theory. Diffusional growth. Formal theory of nucleation and growth transformations. Diffusionless transformations. Applications of the theory to specific changes in real materials. At the level of Christian, *Phase Transformation.* Mr. Balluffi.

6603. CRYSTAL MECHANICS

Credit 3 hrs. Fall.

Crystal symmetry. Vector field and tensor fields, lattice deformation and fault crystallography. Reversible tensor properties of crystals. Relationships between different tensor properties. Crystal elasticity, elastic waves and polymer elasticity. Lattice dynamics. Thermophysical properties. Irreversible tensor properties. Coupling of transport phenomena. High order effects. At the level of Nye, *Physical Properties of Crystals,* Born and Huang, *Dynamical Theory of Crystal Lattices,* and Smith, *Wave Mechanics of Crystalline Solids.* Mr. Ruoff.

6604. DISLOCATIONS

Credit 3 hrs. Fall.

Review of elementary geometrical and strain energy aspects of dislocation theory. Experimental evidence for dislocations. Dislocation elasticity. Energy considerations. Applied stresses. Point defects. Crystallographic aspects of dislocation theory, stacking faults, partials, Thompson tetrahedron and layer structures. Jogs. Strain hardening in single crystals. Mechanical twinning. At the level of Friedel, *Dislocations*. Mr. Silcox.

6605. ELECTRICAL AND MAGNETIC PROPERTIES OF ENGINEERING MATERIALS

Credit 3 hrs. Fall. Prerequisite, Physics 454 or consent of instructor.

Electrical properties of semiconductors. Metallic alloys. Ferromagnetic materials. Superconductivity. Optical and dielectric properties of insulators and semiconductors. At the level of Kittel, *Introduction to Solid State Physics;* Chikazumi, *Physics of Magnetism;* Lynton, *Superconductivity;* Livingston and Schadler, *The Effect of Metallurgical Variables on Superconductivity Properties*. Messrs. Silcox and Webb.

6606. MECHANICAL BEHAVIOR OF MATERIALS

Credit 3 hrs. Spring.

Geometry of slip in single crystals. Strain hardening and recovery. Dislocation dynamical treatment of yield and flow. Interaction of interstitial solute atoms with dislocations. Solution hardening. Two-phase hardening. Time dependent deformation. Ductile and cleavage, fatigue, creep-rupture, and stress-corrosion fracture. At the level of review articles in *Progress in Materials Science* and various conference reports. Messrs. Owen and Smith.

6611. PRINCIPLES OF DIFFRACTION

Credit 3 hrs. Fall.

Production of neutrons, x-rays, absorption, scattering, Compton effect. Diffraction from periodic lattices, crystal symmetry, single crystal and powder techniques. Fourier methods, thermal vibrations and scattering, diffraction from liquids and gases, introduction to dynamical diffraction of x-rays and electrons, extinction phenomena and perfect crystals. Selected experiments in diffraction. Mr. Batterman.

For the Professional Master's Degree

6503. MATERIALS SELECTION AND USE

Credit 3 hrs. Fall. 3 Lect. Prerequisite, 6432.

Metallurgical and mechanical factors governing the selection of metals for various services. Analysis of service requirements and the selection and fabrication of metals to fulfill such requirements; analysis of service failures of metals and remedies for such failures; and study of the merits and limitations of materials applications in existing products and equipment. Mr. Smith.

6551. PRODUCTION OF METALS AND CERAMICS

Credit 3 hrs. Fall. 3 Lect. Prerequisite, 6442 or consent of instructor.

Discussions and calculations concerning fuels, fluid flow, heat flow, roasting and sintering, gas cleaning, and application of thermochemical data to metallurgical processes. Production and utilization of refractories. Mr. Gregg.

6552. MATERIALS ENGINEERING (CASE STUDIES)

Credit 3 hrs. Spring.

Engineering problems which involve mechanical, chemical, electrical, thermal, and aerodynamic design specifications are reviewed as examples of materials selection, processing, and use. The case study method is used to evaluate designs, investigate service failures, and select suitable materials and processing techniques. Students make engineering analylses and propose materials for specific applications. Mr. Scala.

6553–6554. PROJECT

Credit 3 hrs. Fall-Spring.

Research on a specific problem in materials or metallurgical engineering.

6555. MATERIALS PROCESSING

Credit 3 hrs. Spring. 3 Lect.

An extension of Engineering 6045 emphasizing recent engineering developments in materials processing. Mr. Burton.

Other Graduate Courses

6612. SELECTED TOPICS IN DIFFRACTION

Credit 3 hrs. Spring. 3 Lect. Prerequisite, 6611.

Dynamical Diffraction: Ewald-von Laue theory of dynamical diffraction applied to x-rays and electrons. Currently developing theory and application to defects in solids. Phenomena investigated via diffuse scattering: phonons, measurement of dispersion curves, frequency spectrum, Debye temperatures, vibrational amplitudes. Order-disorder phenomena: short and long-range order, Guinier-Preston zones. Selected topics of current interest related to x-ray, neutron, and electron diffraction, with contributions from other members of the faculty. Mr. Batterman.

6669. INTRODUCTORY PHYSICAL CERAMICS

Credit 2 hrs. Spring, alternate years. 2 Lect.

The properties and behavior of ceramics as single and poly-crystalline nonmetallic inorganic materials, and as composites will be reviewed based on crystal structure, atom mobility, and structural imperfections. The surface effects, interfaces, composition, and microstructure of ceramics will be studied as a background for their behaviors during sintering and forming and as thermal, electrical, and mechanical properties, with discussions on nucleation, crystal and grain growth, and vitrification. Mr. Scala.

6662. REFRACTORY MATERIALS

Credit 3 hrs. Spring, alternate years. 2 Lect., 1 Lab.

The lectures review of crystallography, rheology, and engineering characteristics of refractory metals (tungsten, molybdenum, columbium, and tantalum); graphites; refractory oxides (magnesia, alumnia, zirconia, beryllia, and thoria); and the refractory compounds (carbides, nitrides, borides, and beryllides). Laboratory demonstrations supplement the lectures, illustrating plasma and high temperature techniques, and electron beam applications. Research laboratories actively involved in studying these materials are visited. Mr. Scala.

6762. PHYSICS OF SOLID SURFACES

Credit 3 hrs. Coordinated with EP 8262 in spring term. 3 Lect. Graduate level.

Physical principles describing the behavior of atoms, ions, and electrons at surfaces or in two dimensional structures. Emphasis on applications to phenomena or matter in which the role of surfaces and interfaces is important. Equilibrium thermodynamics and statistical mechanics of interfaces. Atomistic theory of surface forces, surface energy and surface structure. Kinetics of heterogeneous processes including evaporation, condensation, adsorption, and chemical reaction. Capillary effects and mechanisms of interfacial phenomena in materials. Presented at the level of review articles such as *Progress in Materials Science* and *Solid State Physics* series. Mr. Rhodin.

6872. NUCLEAR MATERIALS

Credit 3 hrs. Spring. 3 Lect. Prerequisites, Materials Science, Physical Chemistry, or equivalent and consent of instructor.

Application of materials science to choice and design of systems used in nuclear reactors. Emphasizes effects of radiation, temperature, temperature differences, composition, and structure. Brings in preparation, fabrication, and use of reactor materials and components. Mr. Howe.

Mathematics

Faculty: Ralph P. Agnew, James B. Ax, Michael Balch, Israel Bernstein, Jan M. Chaiken, Stephen U. Chase, Clifford J. Earle, James Eells, Jr., William G. Faris, Roger H. Farrell, Wolfgang H. J. Fuchs, Hillel H. Gershenson, Robert Greenblatt, Leonard Gross, Siegfried Grosser, David W. Henderson, Carl S. Herz, Peter J. Hilton, Peter J. Kahn, Harry Kesten, Jack Kiefer, Simon B. Kochen, Richard B. Lavine, Simon A. Levin, George R. Livesay, Anil Nerode, Paul Olum, Lawrence E. Payne, George S. Rinehart, Alex Rosenberg, Harold Rosenberg, Oscar S. Rothaus, Gerald S. Sacks, Duane P. Sather, Stephen H. Schanuel, Alfred H. Schatz, Leonard Silver, Frank L. Spitzer, Robert J. Walker, Hsien-Chung Wang, Harold Widom, John A. Williamson, Jacob Wolfowitz.

Field Representative: Alex Rosenberg, 124 White Hall.

APPROPRIATE MAJOR AND MINOR SUBJECTS

Algebra	Geometry
Analysis	Mathematics

Prerequisites for candidacy are a knowledge of advanced calculus (including both theoretical and applied points of view) and modern algebra.

The Field of Mathematics has set the following language requirements: none for the Master's degree, a reading knowledge of German *or* Russian for the Ph.D. degree. There is no formal French requirement, but books and papers in that language will be freely used in all graduate courses and students can expect to be called upon to read French mathematical texts.

Candidates for the Master's degree are expected to obtain some understanding of mathematical thought, ordinarily by taking about 24 hours of courses at the graduate level. Qualifications for the Doctor's degree include a broad acquaintance with the basic subjects of present-day mathematics plus a demonstration of ability to do research in one or more branches of mathematics.

A booklet entitled *Graduate Work in Mathematics at Cornell* may be obtained by writing to the Chairman, Department of Mathematics, White Hall. The booklet contains additional information about graduate work, thesis and examination requirements, and research in mathematics for the entering graduate student.

All the three major subdivisions of mathematics, algebra, analysis, and geometry are well represented at Cornell. Moreover, the department is also very strong in logic, probability, and statistics. A detailed listing of the research interests of the members of the faculty will be sent to all who request the booklet *Graduate Work in Mathematics* referred to above.

COURSES

In all 600-level courses, as well as in Courses 502 and 552, the final grades will be only S or U.

All listings are tentative; students should check with the departmental office for definite listings, times, places, etc.

The advanced courses, 500 and 600 level, shown below are the ones being offered during 1966–67. In 1967–68 about the same number of advanced courses will be given; they will be selected from those offered in 1966–67 and the bracketed courses which are not being offered in 1966–67.

General

502. GRADUATE PROSEMINAR

Spring term. Credit four hours. Prerequisite, candidacy for an advanced degree with a major in mathematics. M W F 4.

Presentation by students of material in mathematical literature. Required of all graduate students majoring in mathematics.

Applied Mathematics and Differential Equations

315–316. HIGHER CALCULUS

Throughout the year. Credit three hours a term. Prerequisite, 213. First term prerequisite to second. T Th S 10. Mr. Gross.

This is intended as a course for students who have had only three semesters of calculus. It does not prepare for 415–416, and will not meet the needs of those graduate students whose work requires really serious application of mathematical methods.

Partial differentiation, multiple and line integrals, vector algebra (including matrices) and vector analysis, Fourier series, partial differential equations, complex variables, Laplace transforms. Emphasis is placed on a wide range of formal applications of the calculus rather than on the logical development.

421. APPLIED MATHEMATICS

Fall term. Credit four hours. Prerequisite, 222 or honors section of 294 or consent of the instructor. (Students from regular sections of 294 will be admitted upon the 294 instructor's recommendation, provided their grade is very high and they make up the extra work.) M W F 12, Th 2. Mr. Widom.

Graduate students who need mathematics extensively in their work and who have had a solid advanced calculus course as undergraduates should take 415–416. If they have not had such an advanced calculus course they should take 421–422–423. If their preparation is still too weak for this, they should take all or part of 221–222, followed by 421–422–423.

Sequences and infinite series. Norms, inner products, orthogonality, Fourier series and orthogonal functions. Self adjoint differential operators. Theorems of Stokes, Green, Gauss, etc. Introduction to complex variables.

422. APPLIED MATHEMATICS

Spring term. Credit four hours. Prerequisite, 421 or consent of the instructor. M W F 12, Th 2. Mr. Widom.

Continuation of complex variables. Conformal mappings. Harmonic functions. Some special functions. Laplace and Fourier transforms. Asymptotic expansions of functions.

423. APPLIED ANALYSIS

Fall term. Credit four hours. Prerequisite, 422. M W F 12, Th 2. Mr. Schatz.

Linear operators and integral equations. Calculus of variations. Application to eigenvalue problems. Green's function, and treatment of special problems of mathematical physics.

415–416. MATHEMATICAL METHODS IN PHYSICS

Throughout the year. Credit four hours a term.

Intended for graduate students in Physics or related Fields who have had a strong advanced calculus course and at least two years of general physics. The course goes very quickly, covering in two semesters slightly more than 421–422–423. Undergraduates will be admitted only with consent of the instructor. First term prerequisite to second. T W Th F 12. Mr. Fuchs.

Lectures and problem work designed to give a working knowledge of the principal mathematical methods used in advanced physics. Topics include infinite series, Fourier series and integrals, Laplace transforms, complex variables, calculus of variations, matrices, integral equations, and eigenvalue problems.

427–428. ADVANCED DIFFERENTIAL EQUATIONS

Throughout the year. Credit four hours a term. Prerequisite, 315 or consent of instructor. First term prerequisite to second. M W F 12. Mr. Payne.

Basic theory of ordinary differential equations, treatment of Laplace, heat, and wave equations with introduction of eigenfunction methods and generalized functions. Topics include transform methods, approximation methods, and special functions. Applications to a variety of physical problems.

517–518. ORDINARY DIFFERENTIAL EQUATIONS

Throughout the year. Credit four hours a term. Prerequisites, 411–412 and concurrent registration in 413. First term prerequisite to second. T Th S 10. Mr. Balch.

Existence and uniqueness. Autonomous systems, with specialization to geometric theory in two dimensions. Linear equations. Stability. Bifurcation theory. Some special functions of mathematical physics, from the viewpoint of equations in the complex domain and the two point boundary value problem.

519–520. PARTIAL DIFFERENTIAL EQUATIONS

Throughout the year. Credit four hours a term. Prerequisite, concurrent registration in 413 or, with consent of instructor, 423 or 416. First term prerequisite to second. M W F 10. Mr. Levin.

Classification of partial differential equations. Questions of existence, uniqueness, and continuity of the solutions of typical boundary value problems. The equations of Laplace and Poisson, principle of the maximum and the mean; the wave equation, heat equation.

521–522. MATHEMATICAL FOUNDATIONS OF QUANTUM MECHANICS

Throughout the year. Credit four hours a term. Prerequisite, 415–416 or

equivalent and Physics 572 or consent of instructor. First term prerequisite to second. T Th S 9. Fall term, Mr. Chaiken. Spring term, Mr. Faris.

Hilbert space theory. Schrödinger equation, scattering theory, relativistic field equations, problems in field theory.

627–628. SEMINAR IN PARTIAL DIFFERENTIAL EQUATIONS

Throughout the year. Credit four hours. Prerequisite, consent of the instructor. Hours to be arranged. Fall term, Mr. Sather. Spring term, Mr. Schatz.

Analysis

411–412. INTRODUCTION TO ANALYSIS

Throughout the year. Credit four hours a term. Prerequisite, 222. T Th S 10. (There will be a special honors section of this course. The instructor should be consulted.) Mr. Chaiken, Mr. H. Rosenberg.

An introduction to the theory of functions of real variables, stressing rigorous logical development of the subject rather than technique of applications. Topics include elementary topology, the real number system, continuous and differentiable functions, integration, convergence and approximation theorems, Fourier series, calculus in several variables, elementary differential geometry.

413. INTRODUCTION TO THE THEORY OF FUNCTIONS OF ONE COMPLEX VARIABLE

Fall term. Credit four hours. Prerequisite, 411–412. M W F 9. Mr. Rothaus.

A rigorous introduction to complex variable theory intended mainly for graduate students and mathematics majors. Complex numbers. Differential and integral calculus for functions of a complex variable including Cauchy's theorem and the calculus of residues. Elements of conformal mapping. Elements of several complex variables.

514. COMPLEX VARIABLE THEORY

Spring term. Credit four hours. Prerequisites, 412 and 413, or consent of the instructor. M W F 9. Mr. Marden.

A second course in complex variable theory. Topics include analytic continuation, harmonic functions, meromorphic and entire functions, sequences of analytic functions and normal families, conformal mapping, and various optional subjects.

512. REAL VARIABLES

Spring term. Credit four hours. Prerequisites, 411 and 500. M W F 3. Mr. Herz.

The modern theory of real functions. Topics will include the abstract integral, maximal ergodic theorem, theory of measure, L^p spaces, Fourier transforms and series, Radon measure, theory of functions of one real variable.

611–612. SEMINAR IN ANALYSIS

Throughout the year. Credit four hours. Prerequisite, consent of the instructor. Hours to be arranged. Fall term, Mr. Widom. Spring term, Mr. Rothaus.

613. FUNCTIONAL ANALYSIS

Fall term. Credit four hours. Prerequisites, 432 and 512. Mr. Gross.

Topological vector spaces, Banach and Hilbert spaces, Banach algebras, the spectral theorem. If time permits, topological groups.

621. MEROMORPHIC FUNCTIONS

Fall term. Credit four hours. Prerequisite, consent of the instructor. Hours to be arranged. Mr. Fuchs.

Subharmonic functions. The distribution of values of a meromorphic function. Nevanlinna's first and second Fundamental Theorem. Growth properties of meromorphic functions. Nevanlinna deficiencies and their relations with other properties of meromorphic functions.

622. RIEMANN SURFACES

Spring term. Credit four hours. Prerequisites, 514, 531, 551. Hours to be arranged. Mr. Earle.

Definition and topological properties. Harmonic functions and differentials. Uniformization theorem. Compact surfaces, algebraic functions, and the Riemann-Roch theorem. Moduli of compact surfaces.

[515. POTENTIAL THEORY]

Fall term. Credit four hours. Prerequisites, 500 and 512. Not offered in 1966–67.

[523–524. ANALYSIS ON MANIFOLDS]

Throughout the year. Credit four hours a term. Prerequisite, 512. Not offered in 1966–67.

[528. VARIATIONAL METHODS]

Spring term. Credit four hours. Prerequisites, 423, 416, or 519. Not offered in 1966–67.

[614. INTEGRAL EQUATIONS]

Fall term. Credit four hours. Prerequisite, 413. Not offered in 1966–67.

[615–616. FOURIER ANALYSIS]

Throughout the year. Credit four hours a term. Prerequisites, 500, 512, and some notions of complex variables. Not to be offered in 1966–67.

[617. ANALYTIC NUMBER THEORY]

One term. Credit four hours. Prerequisite, 514. Not offered in 1966–67.

[623. SEVERAL COMPLEX VARIABLES]

Spring term. Credit four hours. Prerequisite, 514. Not offered in 1966–67.

[625. ERGODIC THEORY]

Fall term. Credit four hours. Prerequisite, 512. Not offered in 1966–67.

[627. CALCULUS OF VARIATIONS]

One term. Credit four hours. Prerequisites, 500 and 551. Not offered in 1966–67.

Algebra

431–432. INTRODUCTION TO ALGEBRA

Throughout the year. Credit four hours a term. Prerequisite, 221 or 331. First term prerequisite to second. M W F 10. (There will be a special honors section of this course. The instructor should be consulted.) Mr. Schanuel, Mr. Michler.

A rigorous introduction to modern algebra. First term, linear algebra. Second term, introduction to algebraic systems such as groups, rings, modules, and fields.

531. ALGEBRA

Fall term. Credit four hours. Prerequisite, 432. T Th 2–3:30. Mr. Ax.

Finite groups, rings and fields, tensor algebra, Galois theory.

549–550. LIE GROUPS

Throughout the year. Credit four hours a term. Prerequisites, 500 and 531. Hours to be arranged. Mr. Grosser.

Lie algebras; the theorems of Lie, Engel, Cartan, Levi. Differential equations. Analytic manifolds. Analytic groups and Lie theory. Simply connected and compact analytic groups. Cartan subalgebras. (Maximal) compact subgroups of Lie groups. Complex analytic groups.

631–632. SEMINAR IN ALGEBRA

Throughout the year. Credit four hours a term. Prerequisite, consent of the instructor. Hours to be arranged. Fall term, Mr. Rinehart. Spring term, Mr. Ax.

633. GROUP THEORY

Sping term. Credit four hours. Prerequisite, 531. Hours to be arranged. Mr. Gruenberg.

Elementary facts on the cohomology of groups; presentation theory; cohomological dimension; extension theory; splitting theorems; fixed point free automorphisms; stability groups.

637. ALGEBRAIC NUMBER THEORY

Spring term. Credit four hours. Prerequisite, 531. Hours to be arranged. Mr. Schanuel.

Valuations and extensions of valuations. Ideal theory. Factorization of ideals in field extensions. Finiteness of the class number. The unit theorem.

641. HOMOLOGICAL ALGEBRA

Fall term. Credit four hours. Prerequisite, 531. Hours to be arranged. Mr. Silver.

Categories, functors, derived functors. Applications.

[635. THEORY OF RINGS]

Fall term. Credit four hours. Prerequisite, 531. Not offered in 1966–67.

[639. LIE ALGEBRAS]

Fall term. Credit four hours. Prerequisite, 531. Not offered in 1966–67.

Geometry and Topology

451–452. CLASSICAL GEOMETRIES

Throughout the year. Credit four hours a term. Prerequisite, 221 or 331 or 431, which may be taken concurrently. First term prerequisite to second. T Th S 9. Mr. Thomas.

Axiomatic methods in geometry. Foundations of Euclidean geometry. Non-euclidean geometry, projective geometry, other geometric theories.

454. INTRODUCTION TO DIFFERENTIAL GEOMETRY

Spring term. Credit four hours. Prerequisite, 222. M W F 9. Mr. H. Rosenberg.

An introduction to differential forms and their application to the study of curves, surfaces, and higher dimensional manifolds.

500. FOUNDATIONS OF MATHEMATICS

Fall term. Credit four hours. Prerequisite, 412. M W F 3. Mr. Henderson.

Topics in general topology, including set theory, topological spaces, mappings, product spaces, metrization theorems, topological groups, etc.

551–552. AN INTRODUCTION TO ALGEBRAIC TOPOLOGY

Throughout the year. Credit four hours a term. Prerequisites, 432 and 500. M W F 2. Mr. Greenblatt.

Homology and cohomology theories of complexes, singular theory, fundamental group and introduction to homotopy theory, manifolds, geometric applications.

653–654. ADVANCED TOPOLOGY

Throughout the year. Credit four hours a term. Prerequisites, 531 and 552. Hours to be arranged. Fall term, Mr. Kahn. Spring term, Mr. Livesay.

A selection of advanced topics from modern algebraic, differential, and geometric topology. The content of this course varies from year to year.

661–662. SEMINAR IN GEOMETRY

Throughout the year. Credit four hours a term. Prerequisite, consent of the instructor. Hours to be arranged. Fall term, Mr. Wang.

[651–652. SEMINAR IN TOPOLOGY]

Throughout the year. Credit four hours a term. Prerequisite, consent of the instructor. Not offered in 1966–67.

[663. MANIFOLDS]

Fall term. Credit four hours. Prerequisites, 552 and basic notions of general topology and algebra. Not offered in 1966–67.

[655–656. HOMOTOPY THEORY]

Throughout the year. Credit four hours a term. Prerequisite, 552. Not offered in 1966–67.

[667. ALGEBRAIC GEOMETRY]

Spring term. Credit four hours. Prerequisites, 500 and 531. Not offered in 1966–67.

Probability and Statistics

472. STATISTICS

Spring term. Credit four hours. Prerequisite, 371 and knowledge of linear algebra such as taught in 221. M W F 12. Preliminary examinations will be held at 7:30 p.m. on Mar. 1, Mar. 22, Apr. 19, May 17.

Classical and recently developed statistical procedures are discussed in a framework which emphasizes the basic principles of statistical inference and the rationale underlying the choice of these procedures in various settings. These settings include problems of estimation, hypothesis testing, large

sample theory, experimental designs, sequential analysis, and multiple decision problems. (See also the description of 370 and 572.)

571. PROBABILITY

Fall term. Credit four hours. Prerequisite, 412 or, with consent of the instructor, 416 or 422. M W F 12. Examinations and make-up lectures, when necessary, will be held on Thursday evenings at 7:30 p.m. Mr. Wolfowitz.

Fundamentals. Combinatorial problems. Distribution functions in one or several dimensions. Important probability laws. Expectation, moments, and characteristic functions. Stochastic convergence and the law of large numbers. The central limit theorem.

572. STATISTICAL INFERENCE

Spring term. Credit four hours. Prerequisite, 571. M W F 12. Mr. Farrell.

Introduction to the theory of point estimation. Consistency, efficiency, and sufficiency; the method of maximum likelihood. The classical tests of hypotheses and their power. The theory of confidence intervals. The basic concepts of statistical decision theory. The fundamentals of sequential analysis.

Intended to furnish a rigorous introduction to mathematical statistics, the course is prerequisite to all advanced courses in statistics.

574. ADVANCED PROBABILITY

Spring term. Credit four hours. Prerequisite, 571. M W F 11. Mr. Williamson.

An introduction to Markov chains. Discrete and continuous time parameter chains. Applications to birth and death processes and branching processes.

575. INFORMATION THEORY

Fall term. Credit four hours. Prerequisite, 411, or, with consent of the instructor, 416 or 421. (Familiarity with at least part of the contents of 571 would be helpful.) No prior knowledge of information theory is required for this course, but a modest amount of mathematical maturity is desirable. T Th 2–3:30. Mr. Wolfowitz.

Coding theorems and their converses for the principal noisy channels. Sequential decoding. Two-way codes. Coding with a fidelity criterion. Study of the probability of error. Recent results.

671–672. SEMINAR IN STATISTICS

Throughout the year. Credit four hours. Prerequisite, consent of the instructor. M 4–6. Fall term, Mr. Wolfowitz.

673. ANALYSIS OF VARIANCE

Fall term. Credit four hours. Prerequisite, 572. Hours to be arranged. Mr. Huber.

The classical univariate and multivariate normal procedures. Invariance, minimax and admissibility results. Ranking problems. Other models. Nonparametric methods.

674. DESIGN OF EXPERIMENTS

Spring term. Credit four hours. Prerequisite, 673. Hours to be arranged. Mr. Farrell.

Algebraic and geometric construction of the classical balanced block designs. Optimum design theory. Sequential designs.

677–678. STOCHASTIC PROCESSES

Throughout the year. Credit four hours a term. Prerequisites, 512, 571, or consent of the instructor. First term prerequisite to second. Hours to be arranged. Mr. Kesten.

Definition and basic properties of stochastic processes, martingales, sample path properties of stochastic processes, invariance principles. More detailed investigations of Markov processes and Markov chains, diffusion processes.

[675. STATISTICAL ESTIMATION]

Fall term. Credit four hours. Prerequisite, 572. Hours to be arranged. Not to be given in 1966–67.

[676. DECISION FUNCTIONS]

Spring term. Credit four hours. Prerequisite, 675. Hours to be arranged. Not given in 1966–67.

Mathematical Logic

481–482. LOGIC

Throughout the year. Credit four hours a term. Prerequisite, 412, 432 or consent of instructor. M W F 9. Mr. McLaughlin.

A study of elementary and advanced topics in mathematical logic. Theorems of Herbrand, Gentzen, Church, and Gödel on provability and undecidability. Theory of recursive functions and recursively enumerable sets.

681–682. SEMINAR IN LOGIC

Throughout the year. Credit four hours a term. Prerequisite, consent of the instructor. Hours to be arranged. Fall term, Mr. Crosley. Spring term, Mr. Morley.

683. THEORY OF MODELS

Fall term. Credit four hours. Prerequisite, 481–482. Hours to be arranged. Mr. Crosley.

Axiomatic set theory. Theorems of Gödel, Cohen on consistency and independence of the axiom of choice and the continuum hypothesis.

[591–592. SEMINAR ON AUTOMATA]

Fall term. Credit four hours. Not offered in 1966–67.

[685 METAMATHEMATICS]

Spring term. Credit four hours. Prerequisite, 482. Not offered in 1966–67.

690. SUPERVISED READING AND RESEARCH

Mechanical Engineering

Faculty: Noble W. Abrahams, Thomas J. Baird, John F. Barrows, John F. Booker, Arthur H. Burr, Bart J. Conta, Terrill A. Cool, David Dropkin, George B. DuBois, Frederick S. Erdman, Howard N. Fairchild, Benjamin Gebhart, Roger L. Geer, George R. Hanselman, Sidney Liebovich, Howard N. McManus, Jr., Franklin K. Moore, Fred W. Ocvirk, Richard M. Phelan, Dennis G. Shepherd, Robert L. Wehe.

Field Representative: David Dropkin, 214 Upson Hall.

APPROVED MAJOR SUBJECTS	APPROVED MINOR SUBJECTS
Machine Design	Machine Design
Thermal Power	Materials Processing
Thermal Processes	Thermal Power
	Thermal Processes

As a prerequisite for graduate study leading to the degree of M.S. or Ph.D. in the Field of Mechanical Engineering, the candidate should hold a Bachelor's degree and should have the equivalent of the fundamental work required in an accredited undergraduate curriculum in the area of his major subject. Those lacking some of the necessary subject matter may be required to take one or more undergraduate courses or do assigned work to make up the deficiency.

The Graduate Field of Mechanical Engineering is composed of two departments — the Department of Machine Design and the Department of Thermal Engineering. The Machine Design Department is in charge of the Machine Design and Materials Processing subjects; the Thermal Engineering Department is in charge of Thermal Power and Thermal Processes subjects.

Considerable latitude is allowed in the selection of the minor subjects. It is generally expected, however, that, in Thermal Engineering, the major and minor subjects not be taken in the same Department. Appropriate minor subjects, such as mathematics, nuclear engineering, electrical engineering, etc., may be taken in other divisions of the University.

There is no foreign language requirement for the M.S. degree. Ph.D. candidates must demonstrate either: (1) reading ability in two languages additional to his native language, or (2) reading and speaking ability in one language additional to his native language, or (3) exceptional reading ability in one language additional to his native language. Required languages shall be chosen from French, German, Russian, or others to be approved by petition to the Field.

MACHINE DESIGN. Unique instruction is offered in design and related subjects, including materials processing. The thesis and courses may be concentrated in one of the following areas or may overlap them: (1) design and development of a new machine or component, (2) analysis of an existing machine or component, (3) experimental investigation to determine design data and machine or tool performance.

The department has its own laboratories for stress, vibration, and endurance testing of machine parts, and for the study of controls. It is particularly well equipped for studies of lubrication phenomena in journal bearings, and for studies requiring use of analog computers. The materials processing laboratory includes many special production machines and gaging devices, and instrumentation for tool forces and temperatures.

Interests of a design staff are necessarily broad and they overlap in a number of cases. However, based on current activities, they may be grouped as follows:

Hydrodynamic lubrication: John F. Booker, Fred W. Ocvirk, Robert L. Wehe.

Manufacturing engineering: George B. DuBois, Roger L. Geer, Alexander W. Luce.

Product design: Thomas J. Baird, George B. DuBois, Alexander W. Luce.

Stress and force analysis of mechanical components: Arthur H. Burr, Fred W. Ocvirk, Richard M. Phelan.

Vibration and controls: John F. Booker, Arthur H. Burr, Richard M. Phelan, Robert L. Wehe.

Students who major or minor in machine design usually take their other work in engineering mechanics, materials, materials processing, control sys-

tems and servo-mechanisms, mathematics, thermal engineering, agricultural engineering, or industrial engineering. Those minoring in materials processing may take supplementary studies in the Department of Materials Science and Engineering.

THERMAL ENGINEERING. There are excellent opportunities for both analytical and experimental studies at the graduate level in Thermal Engineering. The approved major and minor subjects are in two areas of special interest to the staff.

Under the subject, thermal processes, studies may be carried out in the areas of (1) fluid dynamics, including high-temperature and nonequilibrium effects, viscosity, radiative transfer, and plasma processes: John F. Barrows, Terrill A. Cool, Sidney Leibovich, Franklin K. Moore. (2) Heat transfer, including stability of convective flows, two-phase flows, boiling heat transfer, ablative heat transfer: David Dropkin, Benjamin Gebhart, Howard N. McManus, Jr. (3) Thermodynamics, including aspects of classical, statistical, and irreversible thermodynamics of concern in present-day technology: Bart J. Conta, Terrill A. Cool.

Under the heading thermal power, studies may be made of direct energy conversion, propulsion and nuclear power problems, use of solar energy, turbomachinery, combustion engines, air conditioning and refrigeration, and heat pumps: Bart J. Conta, David Dropkin, Howard N. Fairchild, Dennis G. Shepherd.

In the laboratories of the School of Mechanical Engineering, instrumentation and equipment are available for the study of thermal processes and performance of engineering components and systems. In addition to the customary instruments, such as spectrometers, oscillographs, potentiometers, hot-wire anemometer, etc., the laboratory possesses a large Mach-Zehnder Interferometer of very high precision, a plasma arc generator capable of producing plasmas with high enthalpies and temperatures up to 25,000°F, and a solar collector apparatus suitable for thermal radiation studies. Several fans and compressors are available for a range of air flow, together with a gas-fired steam generating unit.

By a choice of his minor subject or subjects, the thermal engineering major may study at an advanced level in basic sciences, such as mathematics, physics, and chemistry, or in related engineering areas, such as aerospace engineering, chemical engineering, electrical engineering, engineering physics, materials science, and theoretical and applied mechanics. The graduate student will ordinarily find it desirable to enroll in a number of the elective courses offered in the Department of Thermal Engineering, and he will be expected to participate in department seminars attended by students, staff, and visitors.

FELLOWSHIPS AND SCHOLARSHIPS

In addition to the fellowships and scholarships that are available to all students in open competition, the following are restricted to M.S. and Ph.D. candidates majoring in the Field of Mechanical Engineering: John McMullen Graduate Fellowship, Procter and Gamble Fellowship, Edgar J. Meyer Scholarship, Sibley Scholarship.

The degree, Master of Engineering (Mechanical), is available as a curricular type of professional degree, the general requirements for which are stated in the *Announcement of Engineering Courses and Curricula*. Of the 30 credit hours required, the mechanical engineering program allows 9 elective hours, together with considerable latitude in the choice of a laboratory course and the design project. In this way, an option is possible in a particular area,

e.g., machine dynamics and control, mechanical analysis and development, vehicles and propulsion, propulsion engines, thermal environment, thermal power, thermal processes, manufacturing engineering, material removal, etc.

Applications for admission for the M.Eng.(Mech.) degree *only* should be made to Graduate Professional Engineering Programs Office, 251 Carpenter Hall, Cornell University, Ithaca, New York 14850.

The professional degree, M.Eng.(Mech.), may be earned in a minimum of two terms of full-time study by the successful completion of the requirements described below.

FALL TERM	*Credit Hours*
Mathematics	3
Engineering 3361, Advanced Mechanical Analysis	3
Engineering 3651, Advanced Thermal Science	3
Engineering Laboratory* or Mechanical Engineering Elective	3
Technical Elective	3
Total	15

SPRING TERM	*Credit Hours*
Mathematics	3
Engineering 3055, Advanced Mechanical Engineering Design	3
Engineering 3090, Mechanical Engineering Design Project	3
Mechanical Engineering Elective or Engineering Laboratory*	3
Technical Elective	3
Total	15
Total for two terms	30

In the curriculum outlined above, the mathematics requirement may be satisfied by Mathematics 315, 316, or Applied Mathematics 1180, 1181, or other approved courses. The Engineering Laboratory course may be selected from Experimental Methods in Machine Design, 3372 (Fall); Advanced Flow Measurement, 3673 (Fall); or Techniques of Thermal Measurement, 3667 (Spring). Qualified students may seek approval for other laboratory courses given in the College of Engineering, if such courses are acceptable for a particular objective. Mechanical Engineering Design Project, 3090, in the spring term, provides design experience requiring individual effort and the preparation of a formal report. If the six-hour mathematics requirement is previously satisfied when fulfilling undergraduate elective requirements, 21 hours of the 30-hour requirement are, to a large extent, elective. In this way, the student has wide latitude to obtain a specific education objective.

COURSES

3055. ADVANCED MECHANICAL ENGINEERING DESIGN

Credit 3 hrs. Spring. 1 Lect., 2 Design Periods. Prerequisite, 3054 Design of Mechanical Engineering Systems or equivalent. Intended for graduate students.

Design of mechanical engineering systems, components, and equipment in the widest sense, requiring the integration of engineering disciplines at an advanced level. Staff and guest lectures.

* One Engineering Laboratory course is required, either fall or spring term.

3090. MECHANICAL ENGINEERING DESIGN PROJECT

Credit 3 hrs. Spring. Intended for students in the M.Eng.(Mech) program.

Design of an engineering system or a device of advanced nature. Projects to be carried out by individual students or by small groups with individual assignments culminating in an engineering report by each student. Staff.

3116. INTRODUCTION TO INDUSTRIAL DESIGN

Credit 3 hrs. Fall. 2 Lab. Prerequisite, permission of the instructor.

Readings; abstract and applied design problems which investigate and apply the interrelationships existing between form, function, and materials. Mr. Baird.

3361. ADVANCED MECHANICAL ANALYSIS

Credit 3 hrs. Fall. 3 Rec. Intended for graduate students but open to qualified seniors. Prerequisite, 3322 or 3331.

Advanced analysis of special clutches and brakes; theory of film-lubricated bearings; theories of failure and design equations; impact; simple and built-up cylinders subjected to pressure and rotation. Selected topics from advanced strength of materials. Thermal stresses and creep. Mr. Burr.

3362. MECHANICAL DESIGN OF TURBOMACHINERY

Credit 3 hrs. Spring. 3 Rec. Intended for graduate students. Prerequisites, 3361 and 3324.

Mechanical design of major components of high speed compressors and turbines for structural adequacy and vibration-free operation. Selected topics from among the following: design of rotor components, disks, vanes, blades, shafts, and connections. Design of bearings, seals, gaskets, expansion members. Investigation of natural frequencies and critical speeds. Selection of materials. Attention is called to a companion course 3663. Mr. Ocvirk.

3364. DESIGN FOR MANUFACTURE

Credit 3 hrs. Fall. 3 Rec., 1 Design or Lab. Period. Prerequisites, 3322 or 3331, and 3431 or equivalent, or permission of the instructor.

Principles and methods of design to improve the producibility of machines and products. Design techniques to simplify and improve the processing operations, to reduce cost, and to increase accuracy and reliability. Designs and operation sequences for small-lot and large-lot manufacture to exploit the capabilities inherent in machine tools, jigs and fixtures, and other production equipment. Applications of the foregoing by design exercises. Messrs. DuBois and Geer.

3366. ADVANCED KINEMATICS

Credit 3 hrs. Spring. 2 Rec., 1 Comp. Prerequisite, 3321.

Advanced analytical and graphical determination of velocities and accelerations in mechanisms. Special geometrical concepts on the kinematics of mechanisms. Synthesis of linkages by graphical and analytical methods. Design of linkages to give prescribed paths, positions, velocities, and accelerations. Mr. Luce.

3368. MECHANICAL VIBRATIONS

Credit 3 hrs. Spring. 2 Rec., 1 Lab. Intended for graduate students but open to qualified undergraduates. Prerequisite, 3324 or equivalent.

Further development of vibration phenomena in single and multi-degree of

freedom systems, with emphasis on engineering problems involving analysis and design. Also gyroscopic effects, branched systems, random vibrations, impact and transient phenomena, isolation of shock and vibration, and noise and its reduction. Impedance, matrix, and numerical methods. Analog and digital computer solutions and laboratory studies. Mr. Burr.

3372. EXPERIMENTAL METHODS IN MACHINE DESIGN

Credit 3 hrs. Fall. 1 Rec., 2 Lab. Prerequisite, 3322 or 3331.

Investigation and evaluation of methods used to obtain design and performance data. Techniques of photoelasticity, strain measurement, photography, vibration and sound measurements, balancing methods, and development techniques are studied as applied to machine design problems. Mr. Phelan.

3374. CONCEPTUAL DESIGN

Credit 3 hrs. Fall. 3 Rec. Prerequisite, 3322 or equivalent.

Conception and initial design of products and machines. Methods to stimulate mechanical ingenuity and improve appearance. Principles of synthesis and creativity employing association, inversion, and other techniques. Sketching, class discussion, and comparative evaluation of solutions. Mr. DuBois.

3375. AUTOMATIC MACHINERY

Credit 3 hrs. Spring. 2 Rec., 1 Field Trip. Prerequisite, 3321.

A study of automatic and semiautomatic machinery such as dairy, canning, wire-forming, textile, machine-tool, computing, and printing equipment. Mr. Wehe.

3377. AUTOMOTIVE ENGINEERING

Credit 3 hrs. Spring. 3 Rec. Prerequisite, 3322.

Analysis of various designs for the parts of an automotive vehicle, other than the engine, in relation to its performance; stability, weight distribution, traction, steering, driving, braking, riding comfort, power required and available, transmission types, acceleration, and climbing ability. Recommended together with Course 3670 for a study of automotive engineering. Mr. DuBois.

3378. AUTOMATIC CONTROL SYSTEMS

Credit 3 hrs. Spring. 2 Rec., 1 Lab. Intended for graduate students but open to qualified seniors. Prerequisite, 3324 or equivalent.

Further development of feedback control theory, including stability criteria, frequency response, and transfer functions, with emphasis on engineering problems involving the analysis of existing control systems and the design of systems to perform specified tasks. Also, non-linear systems, describing functions, sampled-data systems, and compensation techniques. Analog computer simulation and laboratory studies of hydraulic, pneumatic, and electro-mechanical components and systems. Mr. Booker.

3380. DESIGN OF COMPLEX SYSTEMS

Credit 3 hrs. Spring. Two meetings of 2 hours per week to be arranged. Intended for graduate students in engineering. Permission of professor in charge.

A seminar course relying heavily on student participation in discussing frontier problems such as salt water conversion, transportation devices and systems, systems for space and underwater exploitation. Determination of specifications for these systems to meet given needs. Critical discussion of possible

solutions based on technical as well as economic and social considerations. Reports will be required containing recommendations and reasoning leading to these considerations. Mr. Wehe.

3382. HYDRODYNAMIC LUBRICATION

Credit 3 hrs. Spring. 3 Rec. Intended for graduate students.

Designed to acquaint those having a general knowledge of solid and fluid mechanics with the special problems and literature currently of interest in various fields of hydrodynamic lubrication. General topics include equations of viscous flow in thin films, self-acting and externally pressurized bearings with liquid and gas lubricant films, bearing system dynamics, digital and analog computer solutions. Also selected special topics in elastohydrodynamic, thermohydrodynamic, and magnetohydrodynamic lubrication. Mr. Booker.

3451. MATERIAL REMOVAL SYSTEMS

Credit 3 hrs. Spring. 1 Lect., 2 Lab. Prerequisites, 3431, 6316. For graduate students and qualified undergraduates.

Advanced study of mechanics of chip formation. Forces and power dynamometry. Orthogonal and three-dimensional relationships. Cutter geometry and chip control. Non-chip techniques using chemical, electrical, ultrasonic, and other media; surface characteristics; and post-process treatments. Mr. Geer.

3461. QUALITY ASSURANCE SYSTEMS

Credit 3 hrs. Spring. 2 Lect., 1 Lab. Prerequisites, 3431, 9170. For graduate students and qualified undergraduates.

Theory and computational techniques for control by attributes or variables. Machine tool capability studies, instrumentation systems. Standards codes and applications. Equipment performance characteristics. Fixed and comparative gaging systems; non-contact, reflective, and radiation principles. Surface texture phenomena. True-position tolerancing and charting. Mr. Geer.

3475. NUMERICAL CONTROL OF PROCESSES

Credit 3 hrs. Spring. 2 Lect., 1 Lab.-Comp. Prerequisite, 3431. For graduate students and qualified undergraduates.

A thorough study of concepts, systems, and component designs for flexible-programmed processing. Machine tools as related to numerical control. Machine command-response factors, stick-slip, resonance, shaft windup, mass-inertia, and other effects. Positioning control systems and coding. Manual and computer programming. Simulation studies. Mr. Geer.

3651. ADVANCED THERMAL SCIENCE

Credit 3 hrs. Fall. 3 Rec. Prerequisites, 3622, 3623, 3625, or equivalent. Intended for graduate students in the M.Eng.(Mech) program.

Advanced level study of topics from thermodynamics, fluid mechanics, and heat transfer. Selection of subjects from irreversible thermodynamics, statistical mechanics, real gas behavior, chemical thermodynamics, unsteady flow phenomena, gas dynamics, shock tube analysis, turbulent flow of jets and wakes. compressible boundary layer, numerical methods, and variable transport properties. Staff.

3652. COMBUSTION THEORY

Credit 3 hrs. Spring. 3 Lect. Prerequisite, 3625. Intended for graduate students but open to qualified undergraduates.

Application of the basic equations of fluid flow and heat and mass transfer to homogeneous and diffusion flames. Ignition, quenching, rate processes, and dissociation effects will be examined. Consideration will be given to flame stabilization and practical systems. Mr. McManus.

3653. REFRIGERATION

Credit 3 hrs. Fall. 3 Rec. Prerequisite, 3625 or 3625 concurrently.

Introduction to refrigeration with emphasis on application of thermodynamics, fluid dynamics, and heat transfer. Cycle and component performance. Applications in air conditioning and cold storage. Overall performance under varied operating conditions. Cryogenic refrigeration; gas liquefaction, purification, storage, and special heat transfer problems. Thermoelectric cooling. Mr. Fairchild.

3654. AIR CONDITIONING

Credit 3 hrs. Spring. 3 Rec. Prerequisite, 3625 or 2625 concurrently.

Introduction to air conditioning with emphasis on application of thermodynamics, fluid dynamics, mass transfer, and heat transfer. Psychrometrics, air conditioning processes and cycles. Heat transmission in buildings; solar effects; lumped thermal circuit methods. Heat pumps. Air distribution. Component and system performance. Mr. Fairchild.

3661. ADVANCED THERMODYNAMICS

Credit 3 hrs. Fall. 3 Lect. Intended for graduate students but open to qualified undergraduates. Prerequisites, 3621, 3622, or equivalent.

A rigorous and general treatment of classical thermodynamics with emphasis on mathematical developments and philosophical interpretations. The several statements of the concepts and laws of thermodynamics and equivalence proofs, the pure substance, homogeneous and heterogeneous systems. Potential functions and Maxwell's relations, availability, irreversibility, and equilibrium. Entropy flow, entropy production, and irreversible thermodynamics. The relationship between classical thermodynamics, classical statistics, quantum statistics, and information theory. Mr. Conta.

3663. TURBOMACHINERY

Credit 3 hrs. Fall. 3 Rec. Prerequisites, 3622, 3623, or permission of instructor.

Aerothermodynamic design of turbomachines in general, followed by consideration of specific types; fans, compressors, and pumps; steam, gas, and hydraulic turbines. Energy transfer between a fluid and a rotor; flow in channels and over blades. Compressible flow, three-dimensional effects, surging and cavitation. Outline design of a high-performance compressor-turbine unit. Mr. Shepherd. Attention is drawn to 3362 as a companion course for mechanical design.

3664. INTERMEDIATE FLUID MECHANICS

Credit 3 hrs. Spring. 3 Rec. Prerequisite, 3623.

Integrated development of equations of mass, motion, and energy for fluid particles and control volumes. Applications of these governing relations to various selected areas such as hydrodynamics and conformal transformations in ideal flows; laminar and turbulent flows; boundary layers with energy transfer; two-dimensional compressible flows; variable property flows; unsteady one-dimensional flows; other topics of current interest.

3665. TRANSPORT PROCESSES

Credit 3 hrs. Fall. 3 Rec. For graduate students and qualified undergraduate students. Prerequisites, basic thermodynamics and fluid mechanics.

Description of basic microscopic modes of thermal and mass diffusion. Molecular transport mechanics in gases. Formulation of the transport equations and their application to engineering problems. Conduction and mass diffusion in solids, boundary value problems. Thermal radiation between opaque surfaces in vacuum and as a diffusion process in non-opaque media. Mass and energy diffusion by molecular and by eddy processes in convection. Analytical methods in convection investigated, limits shown, and the role of correlations discussed. Analogous phenomena. Combined mode heat transfer. Mr. Gebhart.

3667. TECHNIQUES OF THERMAL MEASUREMENT

Credit 3 hrs. Spring. 2 Lect., 1 Lab. Intended for graduate students but open to qualified undergraduates. Prerequisite, 3625.

Theory, construction, calibration, and application of liquid-in-glass thermometers, solid expansion thermometers, pressure-spring thermometers, resistance thermometers, thermoelectric thermometers, optical pyrometers, radiation pyrometers, enthalpy probes, heat flux probes. Mr. Dropkin.

3670. ADVANCED COMBUSTION ENGINES

Credit 3 hrs. Spring. 3 Rec. Prerequisite, Combustion Engines 3669 or equivalent.

Advanced study of topics in field of reciprocating engines, both spark-ignition and diesel. Methods of thermodynamic analysis and performance prediction for free-piston power plants and supercharged engines. Relation of engine performance characteristics and performance characteristics of automotive vehicles. Recommended together with Course 3377 for study in automotive engineering. Mr. Fairchild.

3671. AEROSPACE PROPULSION SYSTEMS

Credit 3 hrs. Spring. 3 Rec. Prerequisites, 3622, 3623, or permission of instructor.

Intended for graduate students and qualified undergraduates. Application of thermodynamics and fluid mechanics to the design and performance of thermal-jet and rocket engines in the atmosphere and in space. Mission analysis in space as it affects the propulsion system. Consideration of auxiliary power supply; study of advanced methods of space propulsion. Mr. Shepherd.

3672. ENERGY CONVERSION

Credit 3 hrs. Spring. 3 Lect. Intended for graduate students but open to qualified undergraduates. Prerequisite, 3622 or equivalent.

Primarily an analysis of energy conversion devices from a classification into heat engines, chemical engines, and expansion engines. An analysis of each class from the point of view of efficiency and other criteria of performance. A more detailed study of some conventional and some direct energy conversion devices including thermoelectric, thermionic, and photovoltaic converters; and fuel cells. Energy sources and energy storage, applications to terrestrial and space power systems.

3673. ADVANCED FLOW MEASUREMENT

Credit 3 hrs. Fall. 2 Lect., 1 Lab. Intended for graduate students but open to qualified fifth year students.

Theory and operation of instruments used in fluid flow investigations; hot wire anemometers; density-sensitive optical systems, transient temperature and pressure measurements; measurements in reacting systems; error analysis and treatment of data. Mr. McManus.

3674. STATISTICAL THERMODYNAMICS

Credit 3 hrs. Fall. 3 Rec. Prerequisites, 3622 Engineering Thermodynamics, 3623 Fluid Mechanics, or equivalent.

Kinetic theory of state and transport properties of gases. Statistical mechanics and thermodynamic probability. Multi-component systems in equilibrium, and introduction to nonequilibrium flows. Mr. Cool.

[3680. ADVANCED CONVECTION HEAT TRANSFER]

Credit 3 hrs. Spring. 3 Rec. Prerequisite, 3665 or consent of instructor.

Processes of transport of thermal energy, momentum, and mass in fluids are considered in detail. Theories of transfer processes and analytic solutions. Analytical and experimental results compared. Transport equations for a fluid, delineation of kinds of processes, differential similarity, natural convection, forced convection at low and high velocities. Boundary layer solutions, similarity theories, and effects of turbulence. Transport in rarefied gases. Mr. Gebhart. Not offered in 1966–67.

3681. RADIATIVE TRANSFER

Credit 3 hrs. Fall. 3 Rec. Prerequisite, 3665 or consent of instructor.

Theory of radiative transfer of heat. Absorption and scattering; differential approximation; surface interactions. Application to atmospheres, steady and transient slab problems; effects on shock and sound wave structure, and hypersonic flow problems. Some assignment to review current literature. Mr. Moore.

[3682. SEMINAR IN HEAT TRANSFER]

Credit 3 hrs. Spring. Two meetings of 2 hours per week to be arranged. Prerequisite, permission of professor in charge.

Discussion of Fields of active inquiry and current interest in heat transfer. Considerations of major recent work and several summaries of associated contributions. Mr. Gebhart. Not offered in 1966–67.

3683. VISCOUS FLOW THEORY

Credit 3 hrs. Fall. 3 Rec. Prerequisite, 3664 or permission of instructor. Intended for graduate students.

Stress and rates of deformation tensors, derivation of the Navier-Stokes equations. Exact solutions, very slow motion, boundary layers, Tollmien-Schlichting and Taylor instability, turbulence. Mr. Barrows.

Nuclear Science and Engineering

Faculty: K. Bingham Cady, David D. Clark, Trevor R. Cuykendall, David Dropkin, Charles D. Gates, James L. Gregg, John P. Howe, Sampson Linke, Raphael M. Littauer, Ross E. McPherson, Wilbur E. Meserve, Mark Nelkin, Robert I. Von Berg.

Field Representative: John P. Howe, Nuclear Reactor Laboratory.

APPROPRIATE MAJOR SUBJECTS	APPROPRIATE MINOR SUBJECTS
Nuclear Science	Nuclear Engineering
Nuclear Engineering	

ADMISSION REQUIREMENTS. A Bachelor's degree in science or engineering including one year of advanced calculus and a one year course in atomic and nuclear physics. Students with less preparation may be admitted if their undergraduate performance is outstanding, but they should expect to take longer to complete the degree requirements. Applicants who are U.S. citizens are normally expected to apply for the Atomic Energy Commission Special Fellowships in Nuclear Science and Engineering. Applications may be obtained from the Fellowship Office, Oak Ridge Institute for Nuclear Studies, Oak Ridge, Tennessee 37831.

LANGUAGE REQUIREMENTS. The language requirement for the Ph.D. is a reading knowledge of one language other than English. There is no language requirement for the M.S.

EXAMINATION REQUIREMENTS. Before the beginning of his second term of graduate study the student is expected to form his Ph.D. Special Committee. This committee will normally be composed of (1) a chairman, who will be the student's major advisor, (2) a faculty member representing a minor subject outside the Field, and (3) a second member of the Field faculty appointed by the Field Representative. Additional members representing other minor subjects are permitted. As soon as the committee is formed it will administer an informal oral examination designed primarily to guide the course of the student's future study and research. Before the end of the fifth term of graduate study, the committee will administer the examination for admission to Ph.D. candidacy. This examination is both written and oral, and covers the core of the graduate course program. Advanced courses in special topics will be taken by most students after this examination, but the passing of this examination signifies a shift in primary emphasis from course work to research.

RESEARCH AND STUDY OPPORTUNITIES

Research and development connected with nuclear energy requires knowledge of a number of scientific and engineering disciplines. Thus the organization of the program permits and encourages this kind of interdisciplinary study, training, and research. Work involving nuclear phenomena, radiation, isotope production, and the like will be done for the most part in the Nuclear Reactor Laboratory which was designed specifically for this purpose. At the present time, five faculty members and all graduate students in nuclear science and engineering work in this laboratory.

The Nuclear Reactor Laboratory was occupied in 1961 and contains: (1) a TRIGA reactor which may be operated steadily at 100 kw producing a neutron flux of 1 to 5 x 10^{12}/cm^2 sec. In addition, the reactor may be pulsed to a peak power of approximately 250 megawatts for the study of phenomena of fairly short duration. The width of the pulse at half maximum is approximately 40 millisec. Eight beam ports and a thermal column allow flexible use of neutrons and radiation. (2) A zero power reactor of versatile design for basic studies of reactor physics. (3) Subcritical assemblies for similar studies. (4) A shielded cell for chemo-nuclear work with up to 10,000 curie gamma sources and other radioactive materials. Accompanying laboratory space permits work with radioactive materials at low levels. A 3-mev 0 to 10 milliampere Cockroft Walton accelerator for studies of radiation effects and low energy nuclear levels and reactions has been in operation since 1964.

Faculty research interests are:

K. Bingham Cady, Nuclear engineering, reactor physics.
David D. Clark, Nuclear and reactor physics, radiation detection.
Trevor R. Cuykendall, Nuclear engineering.
David Dropkin, Heat Transfer, thermal processes.
Charles D. Gates, Radioactive waste disposal, sanitary engineering.
James L. Gregg, Nuclear materials and metallurgy.
John P. Howe, Thermionic energy, conversion, nuclear materials.
Sampson Linke, Energy Conversion.
Raphael M. Littauer, Nuclear instrumentation, pulse electronics.
Ross E. McPherson, Nuclear Physics and Nuclear Chemistry.
Wilbur E. Meserve, Control theory.
Mark Nelkin, Neutron scattering, transport and kinetic theory.
Robert L. Von Berg, Radiation chemistry, chemical engineering.

Examples of current research topics in nuclear science are: Nuclear isomers of 0.01 to 10 sec half-life produced by pulsed TRIGA reactor; neutron spectroscopy below 1 MeV.; the theory of slow neutron inelastic scattering from liquids; kinetic theory of time dependent correlations in fluids.

Current examples in nuclear engineering include: reactor physics of cores with large water gaps; space dependent reactor kinetics and noise analysis; stochastic theory of neutron transport; thermionic energy conversion; radiation chemistry.

The detailed program of studies is not prescribed as a curriculum, but is planned by each individual student and the faculty members of his Special Committee. There is, however, a core of subject matter common to study in this Field. This includes the material covered in courses 8309, 8312, and 8351 as listed in the following, a knowledge of applied mathematics through Mathematics 416 or 423, a knowledge of theoretical physics including the graduate quantum mechanics course, Physics 572, and at least one two-term graduate course sequence in some area of engineering. Students majoring in nuclear engineering will also take additional courses from the following list. Students majoring in nuclear science will normally take additional courses in physics at the graduate level.

COURSES

8309. LOW-ENERGY NUCLEAR PHYSICS

Credit 3 hrs. Spring. 3 Lect. Prerequisite an introductory course in atomic and nuclear physics, including quantum mechanics.

Low energy nuclear physics as an organized body of experimental facts. Properties of ground and excited states of nuclei; models of nuclear structure; low energy nuclear reactions-scattering, absorption, fission, resonance effects, coherent scattering effects. At a level between *Introductory Nuclear Physics* by Halliday, and *Nuclear Physics* by Fermi. Mr. Clark.

8312. NUCLEAR REACTOR THEORY

Credit 3 hrs. Fall. 3 Lect. Prerequisites, one year of advanced calculus and an introductory course in atomic and nuclear physics.

The physical processes in neutron chain reactors are described. The theory of neutron diffusion and slowing down is developed and applied to these processes. Neutron transport theory is introduced. At the level of *Nuclear Reactor Theory* by LaMarsh. Mr. Nelkin.

8313. REACTOR THEORY II

Credit 3 hrs. Continuation of 8312 primarily intended for students planning to do research in the fields of reactor physics and reactor engineering.

Delayed neutron kinetics, fission product poisioning, non-linear kinetics, perturbation theory, temperature coefficients, control rod theory, hydrogenous reactors, neutron transport, and heterogeneous reactor theory. At the level of *The Physical Theory of Neutron Chain Reactors* by Weinberg and Wigner. Offered informally, Spring 1967. Mr. Cady.

8314. NEUTRON TRANSPORT THEORY

Credit 2 hrs. Prerequisite, 8213 or consent of instructor.

The linear Boltzmann equation describing neutron migration in matter is intensively studied. Topics will vary, but may include Milne's problem, neutron thermalization, deep penetration of radiation, as well as a formal development of approximate methods of solution. At the level of *Neutron Transport Theory* by Davison. Offered informally, Fall 1966. Mr. Nelkin.

8333. NUCLEAR REACTOR ENGINEERING

Credit 3 hrs. Fall. 3 Lect. Prerequisite, consent of instructor.

A selected set of topics representing the fundamentals of nuclear reactor engineering; energy conversion and power plant thermodynamics, fluid flow and heat transfer, thermal stresses, radiation protection and shielding, materials for nuclear reactors, economics of nuclear power and fuel cycles, instrumentation and control. At the level of *Nuclear Engineering* by Bonilla. Mr. Cady.

8334. NUCLEAR ENGINEERING SEMINAR

Credit 3 hrs. Spring. Prerequisite 8333.

A group study of a reactor systems analysis or a reactor safeguards report. Emphasis on the interplay of requirements of safety and economics in the design of nuclear power systems. Mr. Cady.

8336. NUCLEAR MATERIALS (same as Materials Science 6872)

Credit 3 hrs. Spring. 3 Lect. Prerequisites, Materials Science, Physical Chemistry or equivalent, and consent of instructor.

Application of materials science to choice and design of systems used in nuclear reactors. Emphasizes effects of basic phenomena, conditions or variables encountered in reactors such as irradiation, temperature, temperature differences, composition, and structure. Brings in preparation, fabrication, and use of reactor materials and components. Mr. Howe.

8351. NUCLEAR MEASUREMENTS LABORATORY

Credit 3 hrs. Either term. Two 2½ hour afternoon periods. Prerequisite, some knowledge of nuclear physics.

Laboratory experiments plus lectures on interaction of radiation with matter and on radiation detection, including electronic circuits. Some twenty different experiments are available in the the areas of nuclear and reactor physics. Among these are experiments on emission and absorption of radiation; on radiation detectors and nuclear electronic circuits; on interactions of neutrons with matter (absorption, scattering, moderation, and diffusion); on activation analysis and radiochemistry; and on properties of a subcritical assembly. Many of the experiments use the TRIGA Reactor. The student is expected to perform eight to ten experiments, selected to meet his needs.

Some stress is laid on independent work by the student. Messrs. Clark and McPherson.

8352. ADVANCED NUCLEAR AND REACTOR LABORATORY

Credit 3 hrs. Either term. Two 2½ hour afternoon periods. Prerequisites, 8351 and 8309 or 8312.

Laboratory experiments plus lectures on experimental methods in nuclear physics and reactor physics. Some ten different experiments are available, among them ones using the Zero Power Reactor critical facility. Messrs. Clark and McPherson.

Physics

Graduate Faculty: Vinay Ambegaokar, Neil W. Ashcroft, LeRoy L. Barnes, Karl Berkelman, Hans A. Bethe, Raymond Bowers, Andrew A. Browman, Peter A. Carruthers, David G. Cassel, Geoffrey V. Chester, David D. Clark, Robert M. Cotts, John P. Delvaille, John W. DeWire, Donald A. Edwards, Douglas B. Fitchen, Thomas Gold, Kurt Gottfried, Kenneth I. Greisen, Franz L. Gross, Louis N. Hand, Paul L. Hartman, Donald F. Holcomb, Toichiro Kinoshita, James A. Krumhansl, David M. Lee, Raphael M. Littauer, Herbert Mahr, Boyce D. McDaniel, N. David Mermin, Mark S. Nelkin, Herbert F. Newhall, Jay Orear, Lyman G. Parratt, Robert O. Pohl, A. Lincoln Read, John D. Reppy, Henri S. Sack, Edwin E. Salpeter, Albert J. Sievers, Robert H. Silsbee, Albert Silverman, Gale C. Sprague, Robert L. Sproull, Peter C. Stein, Richard M. Talman, Watt W. Webb, D. Hywel White, John W. Wilkins, Kenneth G. Wilson, Robert R. Wilson, George J. Wolga, William M. Woodward, and Donald R. Yennie.

Visiting Faculty: Henry V. Bohm, Lester H. Germer, and James S. Langer.

Also on the faculty, but not serving on graduate students' Special Committees, are 15 Ph.D. instructors and 30 Ph.D. research associates.

Field Representative: D. Hywel White, 113 Clark Hall and 118 Newman Laboratory.

RESEARCH AND STUDY OPPORTUNITIES

THEORETICAL PHYSICS. Many-body theory, theory of superconductors, superfluidity, statistical mechanics and irreversibility, phonon physics and transport processes, low temperature physics, electrodynamic phenomena and defects in solids, dispersion relations and strong interactions — high energy limits, "bootstrap" dynamics, models of reaction processes — internal symmetries and their connection with strong interaction dynamics, quantum electrodynamics, quantum field theory and renormalization, astrophysics, stellar structure. About half of the theory group is primarily associated with the Laboratory of Nuclear Studies and about half primarily with the Laboratory of Atomic and Solid State Physics; however, continual interaction within the entire group takes place. Professors Ambegaokar, Ashcroft, Bethe, Carruthers, Chester, Gottfried, Gross, Kinoshita, Krumhansl, Mermin, Nelkin, Salpeter, Wilkins, K. Wilson, and Yennie.

EXPERIMENTAL HIGH-ENERGY NUCLEAR RESEARCH. Photoproduction processes involving intermediate mass mesons and hyperons, energy levels of excited states of the proton, detailed study of the structure of the proton, synchrotron radiation, gamma ray interactions with matter, Compton

scattering, photo-disintegration of nuclei, cosmic ray research including air showers and methods of detection of neutral primary radiations, properties of elementary particles, and high-energy nucleon-nucleon pion-nucleon, and meson-nucleon interactions. Large machine shop and electronics shop; 2 Gev electron synchrotron (10 Gev synchrotron under construction), spark chambers, large DC magnets, etc. Cornell staff and students participate in research with the AGS 30 Gev proton synchrotron at Brookhaven. Professors Berkelman, Browman, Cassel, Clark, Delvaille, DeWire, Edwards, Greisen, Hand, Littauer, McDaniel, Orear, Parratt, Read, Silverman, Stein, Talman, White, R. Wilson, and Woodward.

EXPERIMENTAL ATOMIC AND SOLID STATE PHYSICS. Phonon physics, superconductivity, optical spectroscopy, low temperature physics, magnetoplasma waves, spin resonance, x-ray emission and absorption spectra, electron diffraction, thermal conductivity, and spin relaxation. Large machine shop and glass-blowing shop; several large stable DC magnets, superconducting solenoids, vacuum UV spectrographs, IR to UV monochromators, spin resonance spectrometers, and x-ray spectrometers. Available through association with the Materials Science Center of Cornell University are: central facilities for electronics, crystal growing, analytical chemistry, technical operations, high pressure, x-ray and metallography, crystal irradiation, and electron microscopy. Professors Bowers, Cotts, Fitchen, Germer, Hartman, Holcomb, Lee, Mahr, Newhall, Parratt, Pohl, Sack, Sievers, Silsbee, Webb, and Wolga.

SPACE PHYSICS. Astrophysics, stellar structure, cosmic rays, radio astronomy, aurora, and upper atmosphere. Facilities are available through the Cornell Center for Radiophysics and Space Research and the Visual Aurora Section of World Data Center A located at Cornell. These include a lunar surface laboratory, radio astronomy and ionospheric laboratories, the Radio Telescope in the Arecibo Ionospheric Laboratory in Puerto Rico, and aurora observation and data processing equipment. Professors Delvaille, Gold, Greisen, Salpeter, and Dr. Sprague.

APPLIED PHYSICS, MATERIALS SCIENCE, ASTRONOMY AND SPACE SCIENCES, APPLIED MATHEMATICS, ETC. Many of the faculty of the Field of Physics are also members of other Fields and Centers, and many graduate students in these Fields are almost indistinguishable from students in the Field of Physics. Physics faculty and students benefit from the cross-boundary informalities and especially from the availability of much more extensive research facilities.

APPROPRIATE MAJOR SUBJECTS	APPROPRIATE MINOR SUBJECTS
Experimental Physics	Experimental Physics
Physics	Physics
Theoretical Physics	Theoretical Physics

The major or minor subject for either the Master's degree or the doctorate may be Physics only if accompanied by a minor or major subject outside the Field of Physics.

The major subject for either the Master's degree or the doctorate may be experimental physics only if accompanied by theoretical physics as a minor, and may be theoretical physics only if accompanied by experimental physics as a minor.

Each student has a Special Committee that (a) represents his major and minor interests and (b) serves as an examining and advisory committee. This Special Committee consists of at least three members with at least two from

the Field of Physics. The initial committee of three is normally appointed, but the student himself is expected to choose his "permanent" committee (to replace the appointed committee) as soon as his major and minor interests become reasonably firm. The chairman of the "permanent" committtee is normally the member who agrees to represent the major and to supervise the thesis.

For a doctorate in the Field of Physics it suffices to have only one minor subject, either inside or outside the Field, but the student's Special Committee may require two minors. If two minors are required, at least one must be outside the Field of Physics.

ADMISSION. The large majority of entering students have completed the equivalent of an undergraduate physics major program including such junior-senior courses as analytical mechanics, electricity and magnetism, optics and wave motion, electronics, atomic physics, thermodynamics, quantum mechanics, and solid state and nuclear physics. The undergraduate training also typically includes some senior-course laboratory work in physics. Knowledge of differential equations and vector calculus is essential.

In admitting students, however, emphasis is on the quality of the undergraduate work and on the promise for graduate work rather than on the extent of undergraduate study in physics and related subjects. It is not unusual that an entering student will enroll in one or more undergraduate courses to make up deficiencies.

Almost all students are admitted directly into the Ph.D. program. (If an applicant's academic background in physics is either deficient or questionable, he may be admitted *provisionally* into the Ph.D. program; this is fairly common for students from foreign countries.) Some students prefer to work toward the Master's degree either as a terminal degree or on the way toward a Ph.D. degree. Most students, however, prefer to proceed directly for the Ph.D. degree.

A student who wishes to interrupt his graduate work with a leave of absence for longer than one year must apply for re-admission on the same basis as a new student, i.e., he must obtain the recommendation of the Field Committee on Admissions.

ASSISTANTSHIPS AND FELLOWSHIPS. Essentially all first-year graduate physics students are either teaching assistants or fellows. The faculty emphasizes the training importance of teaching experience and encourages all qualified students to teach. Regular teaching assistantships involve about 16 hours per week, usually in undergraduate classrooms or laboratories or as readers in graduate courses. Any fellow who wishes it, and whose fellowship conditions allow it, is a teaching assistant, usually with reduced duties and with a reduced stipend.

Most third-year students are appointed research assistants, nominally 20 hours per week, for work on or closely allied to the student's doctoral thesis which is normally undertaken at the end of the second year of graduate work.

Holding an assistantship appointment, either teaching or research, does not significantly delay the completion of the requirements for an advanced degree.

EXAMINATIONS. The graduate examination structure in physics is as follows: For a Master's degree, the Master's Final Examination (see, however, the Ph.D. Comprehensive Examination). For a Ph.D. degree, (a) a Qualifying Examination taken normally at the beginning of the second year of graduate work, (b) a Comprehensive (Ph.D. Candidacy) Examination taken normally after the second year of graduate work (and before Christmas recess of the

third year), and (c) a Ph.D. Final Examination. For a few students making especially good progress their first year, the Qualifying Examination is oral only; for all others it is written and oral. It may be taken a second time, a year later, but only one re-take is allowed. If the Comprehensive is passed at a satisfactory Master's level, the Special Committee may at its discretion recommend the award of a Master's degree without a thesis and without further examination. The Ph.D. Final Examination is oral and is confined to the subject of the thesis.

No foreign language is required for a Master's or a Ph.D. degree with a major subject in the Field of Physics. However, a good proficiency in at least one foreign language (preferably Russian, German and/or French) is very desirable, and it is strongly recommended that this proficiency be acquired before graduate work is undertaken.

COURSES OF INSTRUCTION

Courses at the undergraduate level are listed in the Announcement of the College of Arts and Sciences. Of those, a few junior-senior courses are frequently taken by graduate students whose backgrounds are somewhat deficient. Such courses are Physics 319, 325, 326, 342, 360, 443, 444, and 454.

Graduate physics courses are numbered 500 or higher, and are listed below. Before looking at the courses, note that almost all first-year physics graduate students (essentially all of whom are fellows or teaching assistants) typically take three courses each term; occasionally a fellow takes four courses. Students are encouraged to compete their "core" courses (courses to be taken before the Master's Final or the Ph.D. Comprehensive Examination) early; to expedite this, with three courses per term, students are urged to take course Physics 510 and/or 561 during the summer *preceding* their first academic year. A typical first-year program for a student having "average" preparation, a program without much leeway, is the following (P = physics and M = mathematics):

First Term: P-510; P-561 or 572; M-415.
Second Term: P-562; P-572; M-416 or Master's thesis.

In addition to the formal courses, students and staff meet over coffee or tea at weekly physics colloquia and topical seminars. For first-year graduate students a special seminar is held biweekly to acquaint the newcomers with Cornell and the Physics Department. Every graduate student is allotted a study desk in one of the physics buildings, and he is encouraged to assume the life of an active physicist as one of a community of physicists as soon as possible. It may be mentioned that two factors help make the Cornell community of physicists a close-knit one — it is (1) a rather large group in (2) a small college town. The professors are generally available to students for consultation.

500. INFORMAL GRADUATE LABORATORY

Either term. Credit one to three hours a term. Associated with the Physics 510 laboratory. Primarily for graduate students who do not have the prerequisites for Physics 510. T W or Th F 1:40–4:30. Messrs. Berkelman, Batterman, Cassel, Cotts, Cuykendall, DeWire, Loh, Mahr, Mistry, Reppy, Rhodin, Siegel, Sievers, Talman, Webb, and Woodward.

505–506. DESIGN OF ELECTRONIC CIRCUITRY

Throughout the year. Credit two hours each term. Prerequisites, Physics 360, Mathematics 315, familiarity with complex representation of a-c signals, or consent of the instructor. Course 505 is prerequisite to 506. T Th 9. Mr. Littauer and staff.

Circuit techniques and design in electronic measurement and instrumentation with emphasis on pulse waveforms. At the level of *Pulse Electronics* by Littauer.

510. ADVANCED EXPERIMENTAL PHYSICS

Either term. Credit three hours per term. Prerequisites, Physics 410 and 443, or consent of the instructor. At least one term of Physics 510 is ordinarily required of a graduate physics student during his first year at Cornell. Laboratory, T W or Th F 1:40–4:30. Instructing staff same as for Physics 500.

About seventy different experiments are available among the subjects of mechanics, acoustics, optics, spectroscopy, electrical circuits, electronics and ionics, heat, X-rays, crystal structure, solid state, cosmic rays, and nuclear physics. The student is expected to perform four to eight experiments, selected to meet his individual needs. Stress is laid on independent work.

520. ADVANCED EXPERIMENTAL PROJECTS

Either term. Credit three hours per term. Prerequisites, Physics 510 and consent of the instructor. Hours to be arranged. Mr. Littauer and staff.

Projects of modern topical interest that involve some independent development work by the student. An opportunity for more initiative in experimental work than is possible in course Physics 510. Typically, two projects in different areas comprise a term's work (e.g., with the Cornell synchrotron and with a liquid helium cryostat).

561. THEORETICAL PHYSICS I

Fall term. Credit four hours. Prerequisites, Physics 319 and 325, or 338, or 431, and co-registration in Mathematics 415 or 423, or consent of the instructor. M 10 and T Th S 11. Mr. Chester.

Mechanics (about 7 weeks): Variational principles, Langrangian mechanics with applications, Hamiltonian mechanics and Poisson brackets, small vibrations and normal modes, and symmetry principles. Electrodynamics (about 8 weeks): Maxwell's equations, electromagnetic potentials, stress energy, wave guides, Fresnel theory, and introduction to relativity. At the level of *Mechanics* by Landau and Lifshitz and of *Electricity and Magnetism* by Jackson.

562. THEORETICAL PHYSICS II

Spring term. Credit four hours. Prerequisite, Physics 561 and at least co-registration in Physics 572, or consent of the instructor. M 10 and T Th S 11. Mr. Mermin.

Electrodynamics and Relativity (about 6 weeks): Radiation, Lienard-Wiechert potentials, multipoles, relativity (continued), and relativistic applications. Statistical Physics (about 9 weeks): Laws of thermodynamics, introduction to phase change, ensemble theory, thermodynamic fluctuations, Fermi-Dirac and Einstein-Bose statistics with applications, transport phenomena, and interacting systems. At the level of *Electricity and Magnetism* by Jackson, and of *Statistical Physics* by Landau and Lifshitz.

572. QUANTUM MECHANICS

Either term. Credit four hours. Prerequisites, Physics 443, 561, and at least co-registration in Mathematics 415 or 423, or consent of the instructor. M W F 11 and S 9. Fall term, Mr. K. Wilson. Spring term, Mr. Nelkin.

Principles of wave mechanics. Illustrative solutions of the Schrödinger equation, scattering, Dirac's formulation of quantum mechanics, transformation theory, and approximation methods. Symmetries: angular momentum, spin, the exclusion principle. At the level of *Quantum Mechanics* by Messiah.

574. INTERMEDIATE QUANTUM MECHANICS

Spring term. Credit four hours. Prerequisites, Physics 572 and at least co-registration in Physics 562 and in Mathematics 416, or consent of the instructor M W F S 10. Mr. Bethe.

Discussion of various applications of quantum mechanics such as collision theory, theory of spectra of atoms and molecules, theory of solids, emission of radiation, and relativistic quantum mechanics. At the level of *Quantum Mechanics of One- and Two-Electron Atoms* by Bethe and Salpeter.

612. EXPERIMENTAL TECHNIQUES IN ATOMIC AND SOLID STATE PHYSICS

Spring term. Credit three hours. Prerequisites, Physics 510, 561, and 562, or consent of the instructor. Hours to be arranged. Mr. Fitchen and staff.

Lectures on techniques and design principles, with emphasis on the study of solids with electromagnetic fields. Topics discussed include sources and detectors, scanning and resonance techniques, signal-processing, sample characterization, and environmental control. Illustrative examples from the recent literature are examined in detail.

614. EXPERIMENTAL TECHNIQUES IN HIGH-ENERGY PHYSICS

Spring term. Credit three hours. Prerequisites, Physics 510, 561, and 562, or consent of the instructor. Two lectures and one problem discussion section per week. T Th F 2. Mr. Browman and staff.

Design principles of high-energy apparatus: accelerators, beam transport, detection systems, etc., with examples of their applications. Practice in the use of relativistic kinematics. Statistical analysis in the design and interpretation of experiments. Discussion of the pitfalls encountered in actual experiments, with examples from the recent literature.

635. SOLID STATE PHYSICS

Fall term. Credit three hours. Prerequisite, Physics 572 or consent of the instructor. T Th S 11. Mr. Mermin.

An introduction to solid state physics including studies of lattice vibrations, the electronic structure of metals and of insulators, with applications to electrical, thermal and transport properties.

636. ADVANCED SOLID STATE PHYSICS

Spring term. Credit three hours. Prerequisite, Physics 635 or consent of the instructor. T Th S 11. Mr. Chester.

The concepts developed in Physics 635 are applied to a survey of the Fermi surface in metals, localized states, magnetism, neutron and light scattering, and phenomenological superconductivity.

645. NUCLEAR PHYSICS

Fall term. Credit three hours. Prerequisite, Physics 572 or consent of the instructor. M W F 11. Mr. Hand.

Properties of nuclei, detection of particles, alpha decay, fission and thermonuclear reactions, gamma decay, beta decay, two-nucleon systems, nuclear models, and nuclear reactions.

646. HIGH-ENERGY PARTICLE PHYSICS

Spring term. Credit three hours. Prerequisite, Physics 574 or 645 or consent of the instructor. M W F 11. Mr. Silverman.

The physics of nucleons, mesons, and strange particles from an experimental point of view. High energy phenomena, as opposed to classical nuclear physics, will be discussed. At the level of *An Introduction to Elementary Particles* by Williams.

NOTE: In courses above 650 the final grades will be only S or U.

651. ADVANCED QUANTUM MECHANICS

Fall term. Credit three hours. Prerequisite, Physics 574 or consent of the instructor. M W F 10. Mr. Yennie.

Relativistic quantum mechanics with emphasis on perturbation techniques. Extensive applications to quantum electrodynamics. Introduction to renormalization theory. At the level of *Relativistic Quantum Mechanics* by Bjorken and Drell.

652. QUANTUM FIELD THEORY

Spring term. Credit three hours. Prerequisite, Physics 651 or consent of the instructor. M W F 10. Mr. Gottfried.

Canonical field theory, model field theories, Green's functions, renormalization. Introduction to analytic properties of scattering amplitudes and dispersion relations. Applications to strong interactions. At the level of *Relativistic Quantum Fields* by Bjorken and Drell.

653. STATISTICAL PHYSICS

Fall term. Credit three hours. Prerequisites, Physics 562 and 572, or consent of the instructor. T Th S 10. Mr. Wilkins.

A survey of topics in contemporary statistical physics, such as the Boltzmann equation, plasmas, sound propagation, phenomenological Fermi liquid theory, critical phenomena of simple fluids and ferromagnetics, classical fluids, introduction to Kuo formulae and Green's functions, and superfluids. At the level of *Statistical Physics* by Landau and Lifshitz.

654. THEORY OF MANY-PARTICLE SYSTEMS

Spring term. Credit three hours. Prerequisites, Physics 574 and 635, or consent of the instructor. T Th S 10. Mr. Ambegaokar.

The equilibrium and transport properties of microscopic systems of many particles are studied at zero and finite temperatures. The thermodynamic Green's function techniques are developed and applied to a variety of systems. Probable topics for discussion are the electron gas at high densities, the normal Fermi liquid, superconductivity, ferromagnetism, and the anharmonic crystal.

(657. THEORY OF NUCLEI)

Fall term. Credit three hours. Prerequisites, Physics 574 and 645, or consent of the instructor. Offered in alternate years and only if registration exceeds nine students. M W F 9. Mr. Bethe. Not offered in 1966–67.

661. HIGH-ENERGY PHENOMENA

Fall term. Credit three hours. Prerequisite, Physics 651 or consent of the instructor. Offered only if registration exceeds nine students. M W F 10. Mr. Carruthers.

Topics of current interest in the theory of strong interactions. At the level of *Dispersion Relations* by Klein.

680. SPECIAL TOPICS

Either term. Credit one to three hours a term. Upon sufficient demand, seminars will be arranged in topics not currently covered in regular courses. Typical topics are group theory, analyticity, weak interactions, superfluids, stellar structure and evolution, plasma physics, cosmic rays, relativity theory, low-temperature physics, X-ray spectroscopy or diffraction, magnetic resonance, etc. For 1966–67: Fall Term: Group Theory, Mr. Ambegaokar; and Stellar Structure, Mr. Salpeter; Spring Term: Real Metals, Messrs. Wilkins and Ashcroft; and High-Energy Electron Interactions, Mr. Yennie.

690. INDEPENDENT STUDY IN PHYSICS

Either term. Credit one to three hours a term. Special study in some branch of physics, either theoretical or experimental, under the direction of any professorial member of the staff. Permission of the staff member under whose direction the work is to be done *must be obtained before registration.*

GRADUATE STUDENT STATISTICS

Number of full-time graduate physics students: about 210
Number of part-time graduate physics students: about 1
Number of graduate fellows in physics: about 60
Number of first-year graduate physics students: about 55
Number of Ph.D. degrees granted in physics each year: about 27
Median number of years spent in graduate study by those receiving the Ph.D. degree in physics: about 5.0

The faculty is unanimous in the conviction that five years between the Bachelor's and the Ph.D. degree is too long; efforts are under way to reduce this median time.

FURTHER INFORMATION

A copy of the booklet *Graduate Study in Physics at Cornell,* containing additional information for the prospective graduate student, along with materials needed to file an application for an assistantship, may be obtained by writing to the Chairman of the Department of Physics, Clark Hall, Cornell University.

Statistics

(See page 240.)

Theoretical and Applied Mechanics

Faculty: Henry D. Block, Harry D. Conway, Edmund T. Cranch, Michael D. Greenberg, Herbert H. Johnson, Richard H. Lance, Geoffrey S. S. Ludford, John P. Moran, John R. Moynihan, Yih-Hsing Pao, David N. Robinson, Geoffrey E. Smith.

Field Representative: Richard H. Lance, 235 Thurston Hall.

APPROPRIATE MAJOR AND MINOR SUBJECTS

Fluid Mechanics
Solid Mechanics
Mechanics of Materials

The graduate program in mechanics emphasizes fundamental understanding of the newest developments in engineering and applied science. Graduate students may pursue in depth mechanics of liquids, gases, particles, rigid and deformable solids and related areas of materials, mathematics, and physics. The analytical and experimental nature of the studies encourages research that cuts across various fields. Graduate students pursue programs in the following areas of specialization: (1) space mechanics — including research on trajectories and orbits of space vehicles and satellites as well as the theory of light-weight, thin-walled structures; (2) wave propagation in solids — with research on the dynamic response of plates, structures, and machine elements; (3) structural mechanics including static and dynamic loading, vibrations, and buckling; (4) theory of elasticity and plasticity; (5) theoretical fluid mechanics — with research in magnetohydrodynamics.

Students whose major is engineering, physics, or applied mathematics are encouraged to apply for admission. The Field basically requires a mature and sound background in mechanics and mathematics but expects the applicant to satisfy no additional formal entrance qualifications beyond those of the Graduate School. (See Admission, page 6.)

The flexibility of the M.S. and Ph.D. programs in mechanics permits students to draw on several divisions of the University for supporting work in pure and applied science. Graduate students in theoretical and applied mechanics and applied mathematics find these allied subjects of interest: mathematics, structures, engineering physics, servomechanisms, machine design, aerospace engineering, soil mechanics, and physics. To encourage the development of broad interests and skills a student normally is expected to select his two minors from approved subjects in other Fields.

The Field of Theoretical and Applied Mechanics requires that each doctoral candidate demonstrate reading ability in one language other than his native language. Examination policy for proficiency is set by the Language Board of the Graduate School. The language selected must be approved by the Special Committee. It is presumed that all admitted graduate students have sufficient command of English to be proficient.

Financial aid for students in the Field consists of University fellowships, teaching assistantships in the Department of Theoretical and Applied Mechanics, and a limited number of research assistantships in the same Department. Applications for financial aid and admission should be submitted to the Graduate School, clearly marked with the Field's name, or to the Graduate Field Representative.

COURSES

1159. EXPERIMENTAL MECHANICS

Credit 3 hrs. Spring. 1 Rec., 2 Lab. Primarily for graduate students and qualified undergraduates.

Brittle coating method of experimental stress analysis. Electrical resistance type strain gages, including factors influencing alloy sensitivity, gage construction, gage factors, and stress gages. Instrumentation for static and dynamic strain gage work including a brief coverage of amplifiers, galvanometers, recorders, and oscilloscopes. Photoelastic methods of stress analysis, photostress. Mr. Robinson.

1160. APPLIED MECHANICS OF SOLIDS

Credit 3 hrs. Fall. 3 Lect. Graduates and qualified undergraduates.

A unified approach to elastic, plastic and time dependent material behavior, with special emphasis on the relationship between the physical aspects of the

subject and mathematical theory. Kinematics of the continuum, balance of momentum, stress hypothesis, compatibility, boundary conditions, uniqueness, extremum principles including energy methods, constitutive equations. Special topics selected from finite elasticity theory, Stokesian fluids, plasticity, linear viscoelasticity, hypoelasticity. Mr. Lance.

1162. THEORY OF VIBRATION

Credit 4 hrs. Fall. 3 Lect., 1 Lab. Prerequisite, 1180 or equiv. or consent of instructor. Graduates and qualified undergraduates.

Vibration of lumped systems including free and forced vibration, damping, impedance methods, resonance, vibration isolation. Matrix methods. Continuous systems including strings, membranes, torsion and bending of beams, plates. Rayleigh-Ritz Method. Impact and transient response. Applications include vibrations of structures and machine elements. Mr. Pao.

1163. APPLIED ELASTICITY

Credit 3 hrs. Fall. 3 Lect. Graduates and qualified undergraduates.

Analysis of thin curved bars. Plane stress and plane strain in the circular cylinder, effects of pressure, rotation, and thermal stress. Small and large deflection theory of plates, classical and approximate methods. Strain energy methods. Symmetrically loaded thin cylindrical shell. Torsion of thin-walled members. A first course in the mechanics of elastic deformable bodies with structural applications. Mr. Conway.

1164. THEORY OF ELASTICITY I

Credit 3 hrs. Spring. 3 Lect.

General analysis of stress and strain. Plane stress and strain. Airey's stress function solutions using Fourier series, Fourier integral, and approximate methods. St. Venant and Michell torsion theory. Simple three-dimensional solutions. Bending of prismatical bars. Axially loaded circular cylinder and half space. Mr. Conway.

[1165. THEORY OF ELASTICITY II]

Credit 3 hrs. Spring. 3 Lect. Graduate students.

Development in tensor form of the basic equations of large deformation elasticity; solution of certain large deformation problems. Linearization to infinitesimal elasticity. Boussinesq-Papkovich potentials and their application to three-dimensional problems; contact problems; plane stress by method of Muskhelishvili; application of conformal mapping; Cauchy integral techniques in elasticity; torsion problems. Not offered in 1966–67.

1166. STRESS WAVES IN SOLIDS

Credit 3 hrs. Spring. 3 Lect. Prerequisites, 1162, 1163, or equivalent. Graduate students.

General equations of elastodynamics. Waves in extended elastic media. Reflection and refraction of waves. Surface waves and waves in layered media. Vibrations and waves in strings, rods, beams and plates. Dispersion in mechanical wave-guides. Transient loads. Scattering of elastic waves and dynamical stress concentration. Waves in anisotropic media and visco-elastic media. Mr. Pao.

1167. THEORY OF PLATE AND SHELL STRUCTURES

Credit 3 hrs. Spring. 3 Lect. Graduate students and qualified undergraduates.

Analysis of deformation and stress in plates and flat slabs under transverse loads. Various boundary conditions. Numerical methods. Membrane stresses and displacements in shells under various loading. Bending theory of shells. Applications to shell-type structures such as submarines, aerospace structures, shell roofs, pressure vessels. Mr. Smith.

1168. THEORY OF PLASTICITY

Credit 3 hrs. Spring. 3 Lect. Graduate students and qualified undergraduates.

Theory of inelastic behavior of materials. Plastic stress-strain laws, yield criteria and flow laws. Flexure and torsion of bars, thick-walled cylinders, metal forming and cutting, stress analysis in metals and soils. Yield hinges. Limit analysis. Shakedown of simple statically indeterminate members. Mr. Lance.

[1169. THEORY OF ELASTIC AND INELASTIC STABILITY]

Credit 3 hrs. Fall. 3 Lect. Graduate students and qualified undergraduates.

General criteria for stability of static and dynamic elastic and inelastic structures. Energy methods. Buckling of columns, plates, and shells under conservative and nonconservative loading. Post-buckling behavior of technologically important structural elements. Not offered 1966–67.

1170. ADVANCED DYNAMICS

Credit 3 hrs. Spring. 3 Lect. Graduate students and qualified undergraduates.

Newton's equations of motion for a system of masses, their solution, momentum, energy. Systems with variable mass, rocket equations. Variational principles of mechanics, d'Alembert's principle, Legrange's equations, Hamilton's equations. Stability of motion, Liapunov's method. Rigid body motion, Euler's equations, tops, gyroscopes. Theory of small oscillations. Mr. Cranch.

[1171. ARTIFICIAL SATELLITE THEORY]

Credit 3 hrs. Fall. 3 Lect. Graduate students and qualified undergraduates.

Potential of earth; two-body problem; Hamilton Jacobi theory; orbit about spherical and nonspherical earth; Von Zeipel's method; vector theory of perturbations; Hansen's method; atmospheric drag and solar radiation effects on orbit; charged satellite in earth's magnetic field; lunar and solar perturbations; orbits of lunar satellites; attitude control of satellites. Not offered 1966–67.

[1172. SPACE FLIGHT MECHANICS]

Credit 3 hrs. Spring. 3 Lect. Graduate students and qualified undergraduates.

Three-body problem; regularization; Jacobi integral; restricted three-body problem; Hill curves: libration points and stability; motion in cislunar space; interplanetary trajectories; space navigation; limiting problems in space travel; theory of optimal trajectories; Pontryagin maximum principle; rendezvous problems. Not offered 1966–67.

[1175. OSCILLATIONS IN NONLINEAR SYSTEMS]

Credit 3 hrs. Spring. 3 Lect.

A study of the methods of analysis of nonlinear electrical and mechanical systems. Theory of differential equations, phase plane analysis, stability criteria, comparison between linear and nonlinear methods. Equations of van der Pol, Duffing, Mathieu, Floquet, Hill. Poincaré-Bendixson theorem, orbital stability. Methods of van de Pol, Poincaré, Kryloff and Bogoliuboff, Galer-

kin, Ritz, harmonic balance, equivalent linearization, graphics, perturbations. Hysteresis. Application of Banach Space techniques. Not offered 1966–67.

1180. METHODS OF APPLIED MATHEMATICS I

Credit 3 hrs. Fall. 3 Lect. Prerequisite, one-semester course in ordinary and partial differential equations.

Ordinary differential equations; series, orthogonal functions and Sturm-Liouville theory; Green's function; Fourier and Laplace transforms; functions of several real variables; vector analysis; matrices; partial differential equations; with application to engineering problems. Mr. Greenberg.

1181. METHODS OF APPLIED MATHEMATICS II

Credit 3 hrs. Spring. 3 Lect. Prerequisite, 1180. Continuation, from 1180, of partial differential equations; complex variable; tensor analysis; calculus of variations; with application to engineering problems. Mr. Greenberg.

1182. METHODS OF APPLIED MATHEMATICS III

Credit 3 hrs. Fall. 3 Lect. Prerequisite, 1181 or equivalent.

Application of advanced mathematical techniques to engineering problems. Conformal mapping; complex integral calculus; Green's function; integral transforms; asymptotics including steepest descent and stationary phase; Wiener-Hopf technique; general theory of characteristics; perturbation methods; singular perturbations including PLK method and boundary layers. Development will be in terms of problems drawn from vibrations and acoustics, fluid mechanics and elasticity, heat transfer, electro-magnetics. Mr. Ludford.

1183. METHODS OF APPLIED MATHEMATICS IV

Credit 3 hrs. Spring. 3 Lect. Prerequisite, 1182 or equivalent.

More extensive treatment of 1182 in same spirit. Topics include: method of matched asymptotic expansions, W.K.B. approximation; Hilbert-Schmidt and Fredholm theories of integral equations; singular integral equations, Wiener-Hopf equations with application to finite interval, Carleman equation and its generalization, effective approximations; further methods in partial differential equations, slot problems. Mr. Ludford.

1184. NUMERICAL METHODS IN ENGINEERING

Credit 4 hrs. Fall. Prerequisite, 1181 or equivalent.

Methods for obtaining numerical solutions to problems arising in engineering and for expressing analytical solutions numerically. Accelerating convergence of sequences and series; continued fractions, quotient-difference algorithms. Interpolation, quadrature, and solution of initial-value problems for ordinary differential equations. Least-squares and Chebyshev approximation. Iterative methods for nonlinear equations. Boundary-value problems for ordinary differential equations; quasilinearization. Direct and iterative methods for solving systems of equations; matrix inversion and eigenvalue problems. Partial differential equations of elliptic, parabolic, and hyperbolic types; finite difference methods, method of characteristics, heuristic methods. Mr. Moran.

1196. RESEARCH IN THEORETICAL AND APPLIED MECHANICS

Credit as arranged. Thesis or independent research in the Field of Theoretical and Applied Mechanics. Such research must be under the guidance of a staff member. Staff.

1197. SELECTED TOPICS IN THEORETICAL AND APPLIED MECHANICS

Credit as arranged, any term.

Qualified students wishing to do work in any area of Theoretical and Applied Mechanics should register for this course after consultation with the department. Students work with appropriate members of the staff in the chosen area. Typical areas of work include theory of elastic stability, theory of plates and shells, rocket theory and design, wave propagation, elasticity, vibrations, and experimental mechanics. Staff.

WATER RESOURCES

Faculty: David J. Allee, Richard D. Black, Leonard B. Dworsky, Alfred W. Eipper, Louis M. Falkson, Charles D. Gates, Lawrence S. Hamilton, George A. Kiersch, Gilbert Levine, Walter R. Lynn, David A. Woolhiser, Paul J. Zwerman.

Field Representative: C. D. Gates, 263 Hollister Hall.

APPROVED MINOR SUBJECT

Water Resources 4

This Field offers qualified engineers and biological, physical, and social scientists an opportunity to gain breadth of knowledge in water resources planning and management at the same time that they increase their depth of knowledge in their own disciplines. Study in the major subject is complemented by an integrated and interdisciplinary program of study in a minor subject designated as water resources and required of all candidates choosing this Field.

The water resources minor will represent for each candidate that combination of courses, including core courses, seminars, and projects, outside his own discipline, most likely in the judgment of his committee to meet his needs and interests in the comprehensive aspects of the program.

Complementing major and minor subjects ordinarily will be chosen from the following list (Fields and faculty as shown):

Aerial photographic studies (Civil Engineering): D. J. Belcher, T. Liang, G. B. Lyon, A. J. McNair.

Areal geology (Geological Sciences): A. L. Bloom, W. S. Cole, G. A. Kiersch, S. S. Philbrick.

Chemical engineering (Chemical Engineering): H. F. Wiegandt, C. C. Winding.

Econometrics and economic statistics (Economics): T. C. Liu.

Economic development and planning (Economics): J. Fei, C. Morse.

Economic theory (Economics): L. M. Falkson, B. P. Stigum, J. Vanek.

Fishery biology (Conservation): A. W. Eipper, J. L. Forney, H. A. Regier, D. A. Webster.

Geohydrology (Geological Sciences): G. A. Kiersch, S. S. Philbrick.

Hydraulics (Civil Engineering): W. H. Brutsaert, W. H. Graf, J. A. Liggett.

Hydraulic engineering (Civil Engineering): W. H. Brutsaert, W. H. Graf, J. A. Liggett.

Hydrogeology and engineering geology (Geological Sciences): G. A. Kiersch, S. S. Philbrick.

International economics and development (Agricultural Economics): D. K. Freebairn, J. W. Mellor, T. T. Poleman, S. L. Barraclough.

Limnology (Entomology and Limnology): C. O. Berg, D. J. Hall, J. M. Kingsbury.

Meteorology (Agronomy): B. E. Dethier.
Natural resources conservation (Conservation): L. S. Hamilton, G. A. Swanson.
Oceanography (Conservation): J. P. Barlow.
Operations research (Industrial Engineering and Operations Research): R. W. Conway, W. L. Maxwell, B. W. Saunders, H. M. Taylor.
Physical geography (Geological Sciences): A. L. Bloom.
Policy and prices (Agricultural Economics): K. L. Robinson, D. G. Sisler, W. G. Tomek.
Public administration (Agricultural Economics): E. A. Lutz.
Public finance (Economics): R. W. Kilpatrick.
Regional planning (City and Regional Planning): J. C. Fisher, B. G. Jones, K. C. Parsons, J. W. Reps.
Resource economics (Agricultural Economics): D. J. Allee.
Sanitary engineering (Civil Engineering): V. C. Behn, L. B. Dworsky, C. D. Gates, W. R. Lynn, D. A. Woolhiser.
Soil and water engineering (Agricultural Engineering): R. D. Black, G. Levine.
Soils (Agronomy): N. C. Brady, M. G. Cline, G. R. Free, H. A. Kerr, R. D. Miller, E. L. Stone, P. J. Zwerman.

GRADUATE SCHOOL OF MEDICAL SCIENCES

The opportunity for graduate work leading to advanced general degrees was first offered in the Medical College in 1912 in cooperation with the Graduate School of Cornell University. In June, 1950, the Sloan-Kettering Institute of Cancer Research, by approval of the trustees of Cornell University, became a graduate division of the Medical College, making possible the extension of graduate work into specialized areas of the basic biological and physical sciences.

That expansion of the New York City component of the Graduate School resulted in the establishment in January, 1952, of the Graduate School of Medical Sciences which, with the approval of the faculty of the Graduate School of Cornell University, was given the full responsibility for administrative matters related to the advanced general degrees granted for study in residence at the New York City campus of Cornell University.

DEGREES. The general degrees of Ph.D. and M.S. are awarded for advanced study and scholarly, independent research in the fields of anatomy, biochemistry, biomathematics, biophysics, immunology, microbiology, pathology, pharmacology, physiology, preventive medicine, and public health.

FACILITIES. The facilities for graduate work at the Graduate School of Medical Sciences include those of the Medical College and of the Sloan-Kettering Division. The five buildings of the Medical College extending along York Avenue from 68th to 70th Street in New York City contain the lecture rooms, student laboratories, library, and research facilities for graduate and undergraduate work. The Sloan-Kettering Division is located in the Sloan-Kettering Institute and the Kettering Laboratory on East 68th Street in New York City, and in the Walker Laboratory in Rye, New York. The special facilities and experienced investigators of the Sloan-Kettering Division offer ample opportunity for advanced graduate work in the basic science aspects of research related to cancer and allied diseases.

FURTHER INFORMATION. For full information regarding the program of the Graduate School of Medical Sciences, the Announcement of this school should be consulted. Requests for this Announcement should be addressed to the Graduate School of Medical Sciences, Cornell Medical College, New York 10021.

ADVANCED PROFESSIONAL DEGREES

Advanced professional degrees are designed as preparation and training for a special profession.* The admissions, requirements, and curricula for such degrees, as approved by the Graduate Faculty, are announced by the faculty of a professional school or college, which, for this purpose, acts as a Division of the Graduate Faculty. Degrees are awarded upon recommendation of the Division to the Graduate Faculty. Detailed information regarding admission or academic requirements for any professional degree is included in the Announcement of the separate school or college in which the degree is offered. Inquiries addressed to the Graduate School will be forwarded to the proper official. The professional degrees listed below are approved by the Graduate Faculty.

ARCHITECTURE, FINE ARTS, REGIONAL PLANNING

The following three degrees are administered by the Division of Architecture and Fine Arts of the Graduate School. Inquiries should be addressed to the listed professor.

For more detailed information on these degrees, as well as those in architectural structures, architectural history, and art, see also the Humanities section of this Announcement.

MASTER OF ARCHITECTURE (M.Arch.). Training in urban design. Only graduates of a five-year professional program in architecture or graduates of a program in city planning or landscape architecture are admitted as candidates. (Professor Colin Rowe.)

MASTER OF FINE ARTS (M.F.A.). Advanced training in the practice of painting or sculpture. (Professor James O. Mahoney.)

MASTER OF REGIONAL PLANNING (M.R.P.). Training for a professional career in the fields of city planning or regional planning. (Professor Kermit C. Parsons.)

EDUCATION

Two professional degrees are administered by the Field of Education of the Graduate School. The programs leading to each of the degrees include courses, seminars, projects, and investigations which will develop the student's ability to perform acceptably the professional duties required of the several types of educational specialization.

---

* The following are advanced degrees which are also first degrees of a school or college and therefore are not subject to the jurisdiction of the Graduate Faculty. For information regarding them, address the school or college indicated.

Bachelor of Laws	Law School
Master of Engineering (Aerospace)	Graduate School of Aerospace Engineering
Master of Business Administration Master of Public Administration	Graduate School of Business and Public Administration
Doctor of Medicine	Medical College, New York City
Doctor of Veterinary Medicine	Veterinary College

MASTER OF ARTS IN TEACHING (M.A. in T.). This program is designed for and limited to those preparing for teaching in elementary and secondary schools. The student and his Special Committee will select those courses and seminars in his teaching specialty and in education which are deemed most appropriate for developing competence as a teacher. The student will be required to demonstrate his or her teaching skill in a supervised field experience. Completion of a twelve-month program, or two and two-fifths residence units is required.

DOCTOR OF EDUCATION (Ed.D.). The program for this degree is designed to prepare the candidate within a broad cultural context for positions of professional leadership in the Field of Education. The program of studies must include advanced work in each of the following: educational psychology, history or philosophy of education, educational measurement and statistics, and research in education. At least fifteen hours of credit must be earned in courses other than those in professional education. A minimum of 65 credit hours beyond the Bachelor's degree is required, of which 35 hours should be completed beyond the Master's degree or its equivalent. A candidate is required to complete a minimum of five residence units beyond the Bachelors' degree and a year of directed field experience.

Professional Teaching

MASTER OF SCIENCE FOR TEACHERS (M.S.T.). This is a coordinated program of training in the biological and physical sciences for prospective and practicing teachers. Each degree candidate must satisfy a broad core program in mathematics and science and complete advanced work in his selected Field of study. This degree is administered by the Division of Professional Teaching of the Graduate School. Detailed information may be obtained from the Graduate School Office, Sage Graduate Center.

ENGINEERING

The degree of Master of Engineering is administered by the Engineering Division of the Graduate School. Specially oriented graduate programs of study are in the areas of agricultural, chemical, civil, electrical, industrial, materials, mechanical, and nuclear engineering, and in engineering physics. The following titles designate the professional Masters' degrees offered in engineering: Master of Engineering (Agricultural), Master of Engineering (Chemical), Master of Engineering (Civil), Master of Engineering (Electrical), Master of Engineering (Engineering Physics), Master of Engineering (Industrial), Master of Engineering (Materials), Master of Engineering (Mechanical), Master of Engineering (Nuclear).

The general requirements for the degrees listed above are:

1. A minimum of 30 credit hours of advanced technical course work in the specific field or in related subjects.
2. A minimum of three credit hours (included in the above) of engineering design experience involving individual effort and formal report.

3. A minimum grade point average of 2.5 and a minimum final grade of C minus for all courses counting toward the degree.

There are no residence requirements, although all course work must, in general, be completed under Cornell University staff instruction. The degree requirements must normally be completed within a period of four calendar years.

Graduates of Cornell University who hold Bachelor of Engineering degrees may be granted up to 15 hours credit for advanced courses taken during their fifth undergraduate year, provided they enter the Master of Engineering program not later than the fall term following the sixth anniversary of their receiving the Bachelor of Engineering degree.

The booklet *Graduate Study in Engineering at Cornell* should be consulted for complete descriptions of requirements for these degrees.

INDUSTRIAL AND LABOR RELATIONS

MASTER OF INDUSTRIAL AND LABOR RELATIONS (M.I.L.R.). The program leading to this degree provides a basic course of graduate study for those with professional interests in industrial and labor relations and further provides limited opportunities for specialized professional study where broad competence has been established. This degree is administered by the Division of Industrial and Labor Relations of the Graduate School. A description of the program is found at page 197 of this Announcement. More information may be obtained by writing to the School of Industrial and Labor Relations.

LAW

The following two degrees are administered by the Division of Law of the Graduate School. The *Announcement of the Law School* should be consulted for a complete description of the program and requirements.

MASTER OF LAWS (LL.M.). This degree is intended primarily for the student who desires to increase his knowledge of the law by working in a specialized Field.

DOCTOR OF THE SCIENCE OF LAW (J.S.D.). This degree is intended primarily for the student who desires to become a proficient scholar by original investigation into the functions, administration, history, and progress of law.

MUSIC

DOCTOR OF MUSICAL ARTS (A.Mus.D.). This degree is appropriate for mature composers who seek further professional training as well as knowledge of the other arts and humanities, both to enrich their creative perspectives and to prepare them for composition teaching at the university level. It is administered by the Department of Music, acting as a Division of the Graduate School for this purpose.

NUTRITIONAL AND FOOD SCIENCE

The following two degrees are administered by the Division of Nutrition of the Graduate School. More information may be obtained by writing to the Graduate School of Nutrition, Savage Hall, Cornell University.

MASTER OF NUTRITIONAL SCIENCE (M.N.S.). This program emphasizes fundamental study in the basic sciences that can lead to specialization in such areas as nutritional biochemistry, public health nutrition, human and clinical nutrition, and international nutrition. In addition, for candidates interested in the biological sciences, the program serves as a valuable preliminary for more advanced graduate study.

MASTER OF FOOD SCIENCE (M.F.S.). The fundamental sciences, chemistry, biochemistry, and bacteriology, that are involved in food processing and utilization, are emphasized. Electives are available to meet individual needs in engineering, economics, marketing, business administration, and international programs. The specialized training serves as a preparation for technical work as related to the food industry or for more advanced graduate study.

VETERINARY MEDICINE

DOCTOR OF SCIENCE IN VETERINARY MEDICINE (D.Sc. in V.M.). This degree is characterized by a professional rather than a general research objective, and it is designed especially for experienced persons in the basic and clinical sciences who need more specific, advanced, scientific, and professional knowledge in order to equip themselves for careers in teaching and research. This degree is administered by the Division of Veterinary Medicine of the Graduate School.

The University expects that all graduate students at Cornell University shall, at all times, act with a mature and morally responsible attitude, recognizing the basic rules of society and the common rights of others.

Announcements of the schools and colleges of Cornell may be obtained by writing to the Announcements Office, Day Hall, or to the Graduate School Office, Sage Graduate Center, Cornell University, Ithaca, New York 14850.

Index of Fields of Instruction and Approved Subjects

General Index

REVISED UNIVERSITY CALENDAR

FALL TERM

	1967–68
Registration, new students	Sept. 8
Registration, old students	Sept. 9
Fall term instruction begins, 7:30 a.m.	Sept. 11
Last day for filing statement of courses form and change of committee form and for new students to file candidacy forms	Sept. 22
Language Examinations, French, German, and Russian	*(To be announced)*
Last day for old students to take qualifying examinations in order to have them considered as of the beginning of the term	Oct. 11
Last day for change of course registration	Nov. 17
Thanksgiving recess: Instruction ends, 1:10 p.m.	Nov. 22
Instruction resumes, 7:30 a.m.	Nov. 27
Fall term classes end, 1:10 p.m.	Dec. 16
Christmas recess	
Independent study period begins	Jan. 3
Final examinations begin	Jan. 8
Last day for completing all requirements for February degrees	Jan. 13
Final examinations end	Jan. 16
Intersession begins	Jan. 17

SPRING TERM

Registration, new students	Jan. 26
Registration, old students	Jan. 27
Spring term instruction begins, 7:30 a.m.	Jan. 29
Last day for filing fellowship and scholarship applications for the following year	Feb. 1
Language examinations, French, German, and Russian	*(To be announced)*
Last day for filing statement of courses form and change of committee form and for new students to file candidacy forms	Feb. 9
Last day for old students to take qualifying examinations to have them considered as of the beginning of the term	Mar. 1
Spring recess: Instruction suspended, 1:10 p.m.	Mar. 23
Instruction resumed, 7:30 a.m.	Apr. 1
Last day for change of course registration	Apr. 5
Last day for completing all requirements for June degrees	May 10
Spring term classes end, 1:10 p.m.	May 11
Independent study period begins	May 13
Final examinations begin	May 20
Final examinations end	May 28
Commencement	June 3

SUMMER

Summer Research period begins	June 4
Registration for Summer Session	June 19 (8-week) June 28 (6-week)
Last day for filing statement of courses form and change of committee form and for new students to file candidacy forms	July 5
Language examinations, French, German and Russian	*(To be announced)*
Summer Session ends	Aug. 11
Last day for completing all requirements for September degrees	Aug. 16
Summer Research period ends	Sept. 12