1973-74



N'illo tépore. Miff? eff angelus gabriel a deo i ciuitaté galilee cui nomen nazareth ad virgi né delpolatá viro cui no= mé crat ioleph de domo dauid:& nom n virginis maria. Et ingreflus ange= lus ad eam dixit. Aue gra tia plena dñs tecum:bene dicta tu i mulierib?. Que cũ audiflet turbata eft in lermone eius:& cogitabat

qualiseffet ista falutatio. Et ait angelusei. Ne ti meas maria inuenisi enim gram apud deu. Ec ce concipies in ytero & paries filium: & vocabis nome eius iesum. Hicerit magnus & filius altif simi vocabif. Et dabit illi dis deus sede dauid pris ei?: & regnabit'in domo iacob ineternum: & regni ei? no erit finis. Dixitatitmaria ad an= gelu. Quo fiet istud qm viruno cognosco? Et rndensangelus dixit ei. Spuffctus supueniet in te:& virt? altiffimi obubrabit tibi. I deogs & qd nascet ex te schi vocabit filius dei. Et ecce eliza beth cognata tua: & ipfa concepit filium in fene Autetua. Et hic mensisest fext° illi que vocat sterilis:quia non'erit impossibile apud deuzoe verbu. Dixit autmaria. Ecce acilla domini fiat michi fecundum verbum tuum. Deo gratias. Initium lancti euangelij: secundum Matheum. Gloria tibi domine.

Bulletin of The University of Vermont THE GRADUATE COLLEGE



OUR FRONT AND BACK COVERS REPRODUCE PAGES FROM A 16TH CENTURY ILLUMINATED BOOK OF HOURS FROM THE SPECIAL COLLECTIONS OF THE UNIVERSITY'S BAILEY MEMORIAL LIBRARY.



WHEN TRUSTEES OF THE UNIVERSITY WISHED A CONTEMPORARY WORK FOR THE ENTRANCE TO THE LIBRARY, THEY TURNED TO VERMONT SCULPTOR PAUL ASCHENBACH, A MEMBER OF THE ART FACULTY, WHO PRODUCED THE BRONZE SHOWN HERE.



THOUGH OCCUPYING MODEST QUARTERS, THE UNIVERSITY'S PRINGLE HERBARIUM COLLECTION IS KNOWN INTERNATIONALLY. IT IS NAMED TO HONOR A SELF-TAUGHT VERMONTER WHO LEFT THE UNIVERSITY IN THE MID 19TH CENTURY FOR FINANCIAL REASONS, BUT WENT ON TO A CAREER WHICH EARNED HIM THE TITLE OF "PRINCE OF BOTANICAL COLLECTORS."



THE UNIVERSITY'S FLEMING MUSEUM PROVIDES THE RESOURCES OF A FINE, SMALL ART MUSEUM FOR TEACHING, RESEARCH AND SERVICE PROGRAMS. IT OFFERS A WIDE RANGE OF EXHIBITS FROM ITS OWN AND VISITING COLLECTIONS. SHOWN HERE IS AN ETCHING, "ROTHERHITE," BY THE AMERICAN-ENGLISH ARTIST, JAMES MCNEIL WHISTLER.

# **GRADUATE COLLEGE**

# THE UNIVERSITY OF VERMONT

Burlington, Vermont

# CATALOGUE and ANNOUNCEMENTS 1973-74

BULLETIN OF THE UNIVERSITY OF VERMONT VOLUME 70 AUGUST 15, 1973 NUMBER 3 Published by The University of Vermont, 85 South Prospect Street, Burlington, Vermont 05401, 19 times a year: once in July, October, November, January, February, May and June; twice in September, December and April; three times in August and March. Second Class postage paid at Burlington, Vermont 05401. Correspondence:

All correspondence concerning applications and admission to the Graduate College should be addressed to the Graduate College Admissions Office, The University of Vermont, Burlington, Vermont 05401. Tel. (802) 656-2699. For other matters concerning the Dean, telephone (802) 656-3160.

Requests for transcripts of work done at The University of Vermont should be addressed to the Registrar, The University of Vermont, Burlington, Vermont 05401.

Requests for the Summer Session and Evening Division information should be addressed to the Office of Continuing Education, The University of Vermont, Burlington, Vermont 05401.

Please note the following deadlines: (Details Pg. 15)

March 1-for application requesting financial aid.

April 1—for application to all departments.

The University of Vermont fully supports and complies with Title VI of the Civil Rights Act of 1964 and does not discriminate in any way in any of its policies on the basis of race, color, or national origin.

Please be advised that information provided therein is subject to change without notice in accordance with the established procedures by which changes may be authorized and implemented.

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# Academic Calendar

#### • FALL SEMESTER 1973

August 30-31	Registration
September 3	Labor Day Holiday
September 4	Classes Begin
October 29-	
November 2	Pre-enrollment for spring semester
November 21-24	Thanksgiving Recess
December 11	Classes End
December 13	Exams Begin
December 19	Exams End

#### • SPRING SEMESTER 1974

January 14-15	Registration
January 16	Classes Begin
March 4-5	Town Meeting Holidays
March 18-22	Pre-enrollment for fall semester
March 25	Spring Recess Begins
April I	Classes Resume
April 17	Honors Day
May 2	Classes End
May 6	Exams Begin
May 10	Exams End
May 19	Commencement

#### • SUMMER SESSION 1974 June 24-August 16 Eight-week session July 8-August 16 Six-week session

#### • FALL SEMESTER 1974

August 29-30	Registration
September 2	Labor Day Holiday
September 3	Classes Begin
October 28-	
November I	Pre-enrollment for spring semester
November 20-23	Thanksgiving Recess
December 10	Classes End
December 12	Exams Begin
December 18	Exams End

#### • SPRING SEMESTER 1975

January 13-14	Registration
January 15	Classes Begin
March 3-4	Town Meeting Holidays
March 17-21	Pre-registration for fall semester
March 24	Spring Recess Begins
March 31	Classes Resume
April 16	Honors Day
May I	Classes End
May 5	Exams Begin
May 9	Exams End
May 18	Commencement

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# The University of Vermont

#### • ABOUT THE GRADUATE COLLEGE

The Graduate College of the University of Vermont administers all advanced degree programs except the program leading to the degree of Doctor of Medicine. As such, it serves the need of college graduates who desire a broader and more thorough knowledge of the scholarship and research in a particular field.

Many academic departments of the University have a long history of providing formal graduate study. The first master's degree was awarded in 1875. For many years graduate degree programs were under the direction of a University Committee on Graduate Study. The Graduate College was formally established with a full-time dean in 1952. Since that time it has served to provide graduate study opportunities in academic fields in which the University resources have made sound programs possible.

The Graduate College is the fastest growing college in the University of Vermont. In 1953, following its formal establishment by the trustees, 46 master's degrees were awarded. In 1973, 228 master's degrees and 24 Doctor of Philosophy degrees were awarded. The Graduate College currently enrolls over 700 students pursuing advanced degrees with about 230 pursuing the Doctorate. Scholarships, fellowships, assistantships, and special loan programs are available in limited numbers for students who have achieved a good academic record in their undergraduate and graduate programs. With the excellent facilities, library holdings and laboratories, combined with its reasonable size, the Graduate College of the University of Vermont offers unique programs of high quality graduate study.

### • ABOUT THE UNIVERSITY OF VERMONT

The University was founded in 1791, taking its place among the handful of colleges founded in this country in the eighteenth century for the higher education of young colonials and Americans of the first post-revolutionary generation. The University was the fifth New England college chartered, the second established by a state to grant the bachelor's degree, and the twentieth in the nation to do so.

Though it has enjoyed a long tradition which has seen it receive

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#### THE UNIVERSITY OF VERMONT

substantial private support, University development has been closely identified with that of the State since 1791, when Vermont's founding General Assembly granted a charter to the University and set aside about 29,000 acres throughout the State with the intent that rents from this land would support the new educational institution.

That same Vermont General Assembly established that the by-laws of the University should give no preference to any religious sect or denomination or discriminate against any, making the University of Vermont the first in this country and possibly the first in history to go on public record as supporting freedom of religion upon its campus.

The University consists of the College of Arts and Sciences, the College of Agriculture and Home Economics, the College of Technology, the College of Education, the College of Medicine, the Graduate College, and the Division of Health Sciences.

The present physical plant is valued at more than \$55,000,000, a major share made possible through the interest and support of alumni and private philanthropy.

The University Libraries The combined holdings of the University's Guy W. Bailey and Medical College Library amount to over 550,000 volumes.

Bailey Library, in addition to its general collections, is a depository for United States Documents, a partial depository for Canadian Government publications, a subscriber to U.N. Documents, and to many UNESCO publications. It also subscribes, currently, to some 6,500 journals and a variety of domestic and foreign newspapers. In its Reference Collection are the major encyclopedias, indexing and abstracting services, foreign language dictionaries, and an expanding variety of special and general bibliographies, biographical dictionaries, handbooks, and other reference resources. In its Special Collections Department, the Wilbur Collection is strong in manuscripts, early imprints, and books dealing with Vermont culture and history. Wilbur materials include letters and papers of Dorothy Canfield Fisher, John Spargo, and Warren Austin. The private library of George P. Marsh, about 12,000 volumes, enriches Bailey Library for students in the Humanities as does the Howard-Hawkins Civil War material, and the Whittingham-Stevens collection of Chiswick imprints.

The University's Medical College Library has a collection of over 30,000 volumes and subscribes to 1,000 medical journals. It is a con-

venient on-campus supplement to Bailey Library's scientific materials.

The Robert Hull Fleming Museum The Museum, an integral part of the University's teaching program, provides an educational service to the University and the people of Vermont. The permanent collection is arranged to augment the University's teaching in varied fields. Particular galleries are devoted to ancient, medieval, and renaissance art; baroque and modern painting and sculpture; American art; primitive art; and the Orient. In addition two galleries are devoted to special exhibitions which change monthly. Museum activities also include lectures, gallery talks and a film series.

The Computation Center The Computation Center of the University of Vermont was organized in 1960 to provide computing facilities for the campus community. The Center services the computation needs of the varied research projects on campus; its facilities are also used as an integral part of several graduate and undergraduate courses.

The staff of the Computation Center is available at all times to anyone who requires assistance with the use of the machines, or the programming of them. A large up-to-date program library is maintained by the Center for use by University personnel.

The George Bishop Lane Artists Series The George Bishop Lane Artists Series is one of the largest collegiate artists series in the country. It was inaugurated in 1955 by a gift of over \$300,000 from the late Mrs. Lane, in honor of her husband, George Bishop Lane of the Class of 1883.

The Lane Series makes it possible for the University to bring annually to the campus and the community a continuing program of some 34 outstanding musical, theatrical, dance and other artistic productions for a moderate admission fee. The Series is planned and produced by a student-faculty committee, with townspeople serving with student and faculty members on an advisory committee.

In addition to a major series of concerts, the Lane Series also sponsors a Chamber Arts Series in the spring semester, a Summer Series, youth concerts and special events, and concerts in several towns outside of Burlington, notably in Springfield.

The Placement Service To assist graduates in exploring and selecting among various career employment possibilities, the University operates an extensive Placement Program. Under the sponsorhip of the University Placement Service, a large number of representatives of

#### THE UNIVERSITY OF VERMONT

business organizations, governmental agencies, and school systems come to the campus each year to interview for full time positions. Related services include individual career counseling, the preparation of confidential credentials for employers and education placement.

The Physical Education Facilities The University's extensive physical education plant is available for recreation by faculty, staff and students during hours not devoted to specific instruction. Swimming, handball, skating, tennis, squash and many other individual and group activities are available for interested participants.

#### • ABOUT BURLINGTON

The University and the people of the Burlington area have long enjoyed cordial relations dating from 1800 when Burlington citizens voluntarily subscribed the necessary funds to provide Vermont's first institution of higher learning with its first building.

With a population of about 50,000, Burlington is Vermont's largest city. The greater Burlington area of approximately 100,000 inhabitants is divided between pleasant suburbs and picturesque farm and woodland. Burlington enjoys magnificent views of Lake Champlain and the Adirondack Mountains to the west and Vermont's Green Mountains to the east. Easily available outdoor activities include swimming, boating, hiking, climbing and skiing.

Some 200 miles northwest of Boston, 300 miles north of New York City and about 100 miles south of Montreal, Burlington is served by Northeast Airlines, Allegheny Airlines, Executive Airlines, Vermont Transit and Greyhound Bus Lines, and Amtrak. The expanded Vermont interstate highway system has correspondingly shortened automotive travel time.

# Degree Programs Offered

The Graduate College offers the following programs leading to the Master's degree and to the degree of Doctor of Philosophy.

#### • MASTER OF ARTS

Programs are offered in the following fields:

Communication	History
Economics	Latin
English	Music
French	Philosophy
Geography	Political Science
German	Psychology
Greek	Spanish

### • MASTER OF SCIENCE

Programs are offered in the following fields:

Agricultural Economics	Forestry
Anatomy	Geology
Animal Sciences	Home Economics
Animal Pathology	Mathematics
Biochemistry	Mechanical Engineering
Biomedical Engineering	Medical Microbiology
Biostatistics	Medical Technology
Botany	Microbiology
Cell Biology	Pathology
Chemistry	Pharmacology
Civil Engineering	Physics
Economics of Natural	Physiology and Biophysics
<b>Resource</b> Planning	Plant and Soil Science
Electrical Biophysics	Speech Pathology
Electrical Engineering	Zoology

#### **DEGREE PROGRAMS OFFERED**

#### • MASTER OF ARTS IN TEACHING

This degree is appropriate for teachers who are interested primarily in increasing their knowledge of their subject matter fields and thereby the effectiveness of their classroom instruction. Programs are offered in the following fields:

Botany	Home Economics
Chemistry	Latin
English	Mathematics
French	Music
Geography	Physics
Geology	Spanish
German	Vocational Education and
Greek	Technology
History	Zoology

#### • MASTER OF SCIENCE FOR TEACHERS

This degree is designed primarily for secondary school teachers who wish to strengthen their backgrounds in their subject matter field, and who desire flexibility in choosing courses at levels best suited to their needs. Programs are planned on an individual basis.

- Mathematics
- Biology (Botany & Zoology)
  Physical Sciences (Chemistry & Physics)
  - (Chemistry & Physics
- Geology

Please contact the department concerned for prerequisites and minimum degree requirements.

#### • MASTER OF EDUCATION

The master of education degree is intended to give those who work in education the kind of background and professional preparation needed for leadership in teaching and functions related to it. Programs are planned on an individual basis with special attention to such fields as:

Administration and Planning Foundations of Education Reading and Language (Elementary and Secondary) School Counseling (Elementary and Secondary) Special Education Student Personnel Services in Higher Education Teacher Education Occupational and Practical Arts

#### • MASTER OF BUSINESS ADMINISTRATION

Study leading to this degree is designed to provide opportunity for the individual to develop knowledge and understanding in a wide range of business activities that will provide foundation for growth and success in a business career. Programs are planned on an individual basis.

#### • MASTER OF EXTENSION EDUCATION

This degree is designed to provide opportunity for those who work in non-school educational and counseling programs to develop knowledge and understanding in activities related to program management and educational methodology.

Programs are planned on an individual basis with special attention to fields such as:

Agriculture Home Economics Youth Organizations Family Centered Services Business and Industry

#### DEGREE PROGRAMS OFFERED

#### • DOCTOR OF PHILOSOPHY

Programs are offered in the following fields:

Anatomy	Mechanical Engineering
Animal Sciences	Microbiology
Biochemistry	Pharmacology
Botany	Physics
Cell Biology	Physiology and Biophysics
Chemistry	Plant and Soil Science
Electrical Engineering	Psychology
Mathematics	Zoology

#### • FIFTH YEAR CERTIFICATE IN EDUCATION

A special program culminating in a fifth year certificate is offered by the College of Education for students who wish to work beyond the bachelor's degree. It is especially designed to meet the needs of teachers who are developing new teaching fields, for advanced students who are meeting requirements for state certification, and for experienced teachers who desire flexibility in choice of courses at both graduate and undergraduate levels. Information about the certificate program may be obtained by contacting the Dean of the College of Education.

#### • CERTIFICATE OF ADVANCED STUDY

A Certificate of Advanced Study (sixth year certificate), a 30-36 graduate credit hour program beyond the Master's Degree, is offered by the College of Education in the field of Administration and Planning. The C.A.S. has become a professional requirement in the hiring and advancement of administrative, supervisory, and other personnel in many school districts throughout the United States and since 1965 has been a prerequisite for membership in the American Association of School Administrators (AASA). The program requires a nine credit on-campus residency unit which must include a three credit hour laboratory experience. Residency may be fulfilled during any academic semester or summer and is part of the total 30-36 program credits. Further information may be obtained from the College of Education.

### • CERTIFICATE IN RUSSIAN AND EAST EUROPEAN AREA STUDIES

A specialization on the area, leading to a Graduate Certificate, obtained in conjunction with an M.A. program in a particular discipline. The program is designed to serve as a foundation for doctoral study with specialization in the area; for teaching in the area at the secondary level; or for employment in internationally-oriented organizations. Requirements are 30 credit hours of study in the area, of which up to 18 could simultaneously be counted toward the M.A. in a discipline and a minimum of 12 hours of additional area work. For details contact the Center for Area and International Studies.

#### • CONCURRENT DEGREES

Post-sophomore fellows in medicine are permitted to use credit from appropriate medical courses toward an M.S. or a Ph.D. They are enrolled in the Graduate College for one or more years to pursue research and enroll in such courses as would normally not be included within a medical program. Such persons, therefore, are working toward an M.D. and M.S. or Ph.D., but completion of each degree may occur at a different time.

All courses for which graduate credit is received at UVM in a master's degree program, whether a master's degree is received or not, may be applied toward a Ph.D. at UVM provided they are appropriate for the Ph.D. program.

No provision is made for a person to employ the same credit to satisfy two master's degrees at the University of Vermont.

# Regulations of the Graduate College

#### ADMISSION

To be eligible for admission a student should hold a baccalaureate degree prior to the date of first enrollment or have completed work equivalent to that required for a baccalaureate. His undergraduate records should indicate a capacity for successful study at the graduate level. Graduates of unaccredited institutions must support their applications with satisfactory aptitude and advanced scores on the Graduate Record Examinations. Foreign students, see special instructions on p. 16.

Admission is limited to students who intend to become candidates for advanced degrees, other than Doctor of Medicine, and whose enrollment will consist of courses to be taken for graduate credit. Students who hold bachelors' degrees but whose entire enrollment will be in under-graduate courses should seek admission as non-degree students in the appropriate undergraduate college.

Only applicants who desire to work along lines in which the University offers graduate programs will be admitted to the Graduate College. Students in the Graduate College therefore fall into three categories: (1) duly admitted students accepted to candidacy, (2) degree candidates at other institutions who study at The University of Vermont for transfer of credit, (3) duly admitted students not yet accepted to candidacy.

The Graduate College does make provisions for students with a baccalaureate to take graduate level courses on a non-degree basis. These are generally individuals who do not desire to pursue a degree program but merely wish to expand their knowledge in certain areas. It is not necessary to make formal application for admission to the Graduate College in order to take these courses; however, the student must obtain approval of the Dean of the Graduate College before registering for such courses. Registration for non-degree students occurs after registration of all degree students. Non-degree students are limited to a total of six hours per semester and permission to exceed this amount must be obtained from the Dean. A non-degree student who has accumulated nine hours of graduate study at the university must seek the approval for further enrollment from the Graduate College.

Students seeking formal admission to the Graduate College to pursue an advanced degree must make application on an official form which can be obtained from the Graduate College Admissions Office. All applications must be supported by two official transcripts from each college or university attended and by three letters of recommendation from persons qualified to assess the applicant's capacity for graduate work. For submission of necessary test scores, see Aptitude and Achievement Tests, and Departmental Requirements, p. 17. All applications for admission must be accompanied by a \$15.00 application fee. Applications and associated correspondence should be sent directly to the Graduate College Admissions Office.

When to apply The deadline for receipt of completed applications and supporting materials for admission in the fall semester is April 1 for all departments. Most departments process them soon after all the supporting information is received. Applications will not be processed after the openings in a program have been filled. Therefore, for fall admission, it is important to file applications well in advance of April 1, as some programs can accommodate only a limited number of new graduate students.

It is sometimes possible to admit new graduate students at midyear, however, such applications should be initiated at least three months in advance of the date study is to begin.

Students who wish to be considered for financial assistance as well as admission should have applications with all supporting materials including GRE scores on file by *March 1* of the academic year preceding that for which application is made. Applications for financial assistance *must* include GRE aptitude scores. No special forms for requesting financial aid are necessary.

Admission to the Graduate College does not mean that a student is automatically accepted as a candidate for an advanced degree.

New England Regional Student Program

This program is a part of The New England Higher Education Compact. It offers:

An opportunity for qualified legal residents of New England to be enrolled, at the discretion of the participating institutions, in graduate degree programs of study which are unique or distinctive at a particular institution, or in which a specialization area within a broad subject marks a study program as one in those categories. Students admitted under these criteria will be charged only the usual resident (in-state) tuition charge of the institution at which the student enrolls.

A resident of any New England state wishing to apply for study under this Program at one of the six state universities or the Lowell Technological Institute must first obtain certification from the Dean of the Graduate School of his home state university to the effect that the program of study desired is *not available* at the home-state university. Applicants must, therefore, examine course offerings carefully. In cases where an apparently similar program of study is available at both institutions involved, this certification will normally take the form of endorsement of a statement from the chairman of the relevant department of study. In cases where a program of study is clearly unique or distinctive to the out-of-state institution, the Graduate Dean's office will certify directly. Students may request that this certification be obtained through the office of the Graduate Dean of the recipient institution, i.e., the institution at which the student wishes to enroll.

Applicants must clearly indicate, both in their initial inquiries and on their application forms, that they are seeking admission under the terms of the New England Regional Student Program. Those seeking admission to a general subject area, e.g., History, must specify precisely the area of specialization they wish to follow.

Foreign Students In general, only those students who are citizens of the United Kingdom, Australia, New Zealand and Canada should apply directly. Students from other countries studying in the U.S. must submit evidence of proficiency in English and record of academic achievement from a U.S. institution. Generally preference is given to candidates sponsored by established organizations such as the Institute of International Education (IIE), the African-American Institute, the American Friends of the Middle East and the American-Korean Foundation.

For information concerning eligibility criteria and application procedures for programs administered by IIE, a student may contact the U.S. Embassy, Consulate, or Information Service in his country.

Students from Africa, the Middle East, Korea and other areas may also request information about scholarships from the following:

For Africa: The African-American Institute, 866 U.N. Plaza, N.Y., N.Y. 10017. For the Middle East: American Friends of the Middle East, Inc., Middle East House, 1607 New Hampshire Ave., N.W., Washington, D.C. 20009.

For Korea: The American Korean Foundation, Inc., 345 E. 46 St., N.Y., N.Y. 10017. For Europe, South America, and South East Asia: Institute of International Education, 809 U.N. Plaza, N.Y., N.Y. 10017.

Application through these organizations or the U.S. Consulate is required for adequate evaluation of transcripts and academic rating of institution attended.

Foreign applicants must be highly qualified, and present evidence of independent financial support (approximately \$4,500 U.S.) per year. In the case of non-English speaking countries, applicants should submit scores of the Graduate Record Examination or Test of English as a Foreign Language. Information on these examinations may be obtained from the Educational Testing Service, Box 889, Princeton, New Jersey 08540. This information should be submitted to the Graduate College by Dec. 1 of the year prior to enrollment to insure adequate time to process the application.

Scholarships for foreign students are limited in number and awarded on academic competition, however, funding is not usually available for the first year of study.

Aptitude and Achievement Tests Applicants for admission to graduate programs in most departments must submit scores on the Graduate Record Examination or the Miller Analogies Test (see specific department).

Information on the Miller Analogies Test may be obtained from the Counseling and Testing Office, University of Vermont, or from any college testing office. Information on the Graduate Record Examination may be obtained from the Counseling and Testing Office or directly from the Educational Testing Service, Box 889, Princeton, New Jersey 08540.

All applicants requesting fellowship support must submit scores on the Graduate Record Examination prior to March 1. Arrangements should be made to take the GRE test no later than January 1974 so that test results will be available by March 1.

*Health Record* A satisfactory health record must be submitted to the Student Health Service (Wasson Infirmary) by students after being accepted for a degree program by the Graduate College and prior to enrollment.

Credentials submitted by the student, such as transcripts and letters of recommendation, become the property of the Graduate College and may not be returned.

#### • ENROLLMENT

Every student is required to enroll and register at the time and in the manner designated by the Registrar. All charges for the ensuing semester must be paid, or otherwise provided for, before registration is completed. (See Academic Calendar.)

*Enrollment Guidelines* The normal full-time graduate enrollment is 12 hours; the maximum enrollment is 15 hours. The normal range of full-time enrollment for a graduate teaching or research fellow is 6 to 10 hours. Enrollment in excess of the respective normal full-time course load must have the approval of the graduate dean. Full-time enrollment for Residence Hall Advisors is 9 hours. Completion of Thesis is considered full-time enrollment.

*Changes in Enrollment* Any changes in enrollment must be approved by the student's advisor and authorized by the Dean of the Graduate College. A student may add a course only during the first week of classes; he may drop a course without academic penalty only during the first five weeks of classes; the exact dates to add or drop courses may be found in the schedule of courses, available at the Graduate College office. Forms may be obtained from the department or Graduate College.

*Completion of Thesis* A student who has completed all credits required in his degree program, but has not completed or defended his thesis, must enroll for "Completion of Thesis" (cf. p. 33 Fees). Enrollment for completion of thesis may be accomplished by mail or in person through the Graduate College.

*Withdrawal* If it is necessary for a student to withdraw from his enrollment he must request permission in writing at that time from the Dean of the Graduate College, stating the reason for his withdrawal.

Auditing Courses With the approval of the Dean and the instructor concerned, a student paying full tuition may audit courses without additional charge. Auditors have no claim on the time or service of the instructor and no entry will be made on the permanent record. Under no circumstances will credit be allowed for courses audited.

Summer and Evening Study Information regarding graduate course offerings and enrollment may be obtained from the Office of Continuing Education. Enrollment in such courses for graduate credit does not imply admission to the Graduate College.

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Dismissal A graduate student whose academic progress or deportment is deemed unsatisfactory at any time may be requested by the Dean or the department concerned to withdraw from the Graduate College.

#### • GENERAL REQUIREMENTS

Each student is expected to be familiar with the general requirements and procedures of the Graduate College and with the specific degree requirements in his chosen field of study. The following requirements define the parameters within which the Graduate College functions. Specific instructions for each department should be referred to in addition to these general requirements.

Acceptance Acceptance to the Graduate College is valid for one year prior to initial enrollment. Applicants for the master's degree may be accepted to candidacy concurrent with admission, or candidacy may be deferred pending a period of satisfactory graduate study at the University of Vermont. Acceptance to candidacy for the master's degree is granted only to those students who have fully met all undergraduate prerequisites for the courses that are required in his graduate degree program. The approval of the department and the Dean is required.

Candidacy for the doctoral degree requires a full year of graduate study in residence at The University of Vermont. A doctoral student is accepted to candidacy upon the approval of the student's Studies Committee, the department or departments concerned, and the Dean.

Minimum Residence Requirements The residency requirement is fulfilled with courses that (1) are taken for graduate credit through the University of Vermont, either in the academic year or in summers on the main campus or off-campus locations, and (2) are taken after the student has been admitted to the Graduate College. Each candidate for the master's degree must satisfactorily complete twenty-one hours in residence. Each candidate for the doctoral degree must satisfactorily complete a minimum of fifty hours in residence.

Departments may require more than the minimum hours in residence.

Teaching Requirement Each degree candidate must acquire appropriate teaching experience in his chosen field prior to the award of his degree. The nature and the amount of this teaching, for which no academic credit is allowed by the Graduate College, will be deter-

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mined by the department concerned.

Language Requirements The language requirement may be completed in two ways: (1) Satisfactory performance on the Educational Testing Service's Foreign Language Examination which is offered three times a year on campus. (All candidates will submit their registration forms and fees directly to the Graduate Schools Foreign Language Tests, Educational Testing Service, Princeton, New Jersey 08540. Further information may be obtained from the Counseling and Testing Service, University of Vermont.), or (2) An examination may be requested by the student's department and administered by them or in conjunction with the appropriate language department.

If the department wishes to substitute competence in Computation Science, it may be achieved by satisfactory completion of Math 31 and Math 216 or by satisfactory completion of an examination (on a passfail basis) set and graded by the staff of the Computation Center.

Grade Requirements Letter grades are used to indicate levels of performance in courses as follows: A, excellent; B, good; C, fair; F, failure. Designations of S, satisfactory and U, unsatisfactory are used to indicate levels of performance for credits received in Thesis Research and may be used to indicate levels of performance in Seminar.

A candidate for a graduate degree must complete his program with a minimum overall quality point average of 3.0. For the purpose of determining a quality point average, 4 points are allowed for each credit hour of A, 3 points for each credit hour of B, 2 points for each credit hour of C, and 0 points for each credit hour of F. A course may be repeated for credit only when failed and only once. Only the second grade is then considered.

A student may be dismissed from the Graduate College if he receives more than two grades below a B, or if he receives the designation of U in Thesis Research or Seminar.

The designation "*Inc*" is used to indicate that the work of the course is incomplete for a reason approved by the Dean and must be completed within a time specified by the department and the Dean.

Graduate students may elect to take an undergraduate course on a pass-fail basis provided permission is obtained, prior to enrollment, from the department chairman and the dean of the Graduate College and that a letter grade is not required by the Studies Committee for any type of evaluation.

MASTERS DEGREE	
Full Time Student	3 Years
Fellow or Trainee (Non-Federal)	3 Years
Salaried University Employee	5 Years
Day—Part Time	5 Years
Evenings Only	5 Years
Summers Only	7 Years
-	

Maximum Time Limits for Degree Completion

DOCTORAL DEGREE

All Students

9 Years

These time limits apply both to study at the University of Vermont and to courses presented for transfer of credit. Individual departments may set deadlines within these time limits.

Withdrawal from Degree Program Students must notify the Graduate College in writing of their withdrawal from a degree program.

If a student does not register at the University of Vermont for course work, thesis research, or completion of thesis for a period of two years and does not notify his department or the Graduate College in writing, he will be considered to have withdrawn from his degree program and his file deactivated.

Transfer of Credit Upon request of the department, transfer of credit for appropriate courses completed at other institutions may be accepted by the Graduate College. A maximum of nine hours credit in the case of master's candidates and twenty-four hours in the case of doctoral candidates may be accepted in transfer for appropriate courses completed in residence in other institutions. Such courses must have been taken in a fully accredited college or university which offers graduate study and must be acceptable at that institution in partial fulfillment of its requirements for an advanced degree. Credit cannot be transferred for (1) courses which would not, if taken at The University of Vermont, receive graduate credit, (2) courses in which a grade lower than 80 (B-) was received, (3) correspondence courses, (4) courses which are inappropriate for inclusion in any degree program offered by the Graduate College, (5) courses which were taken more than seven years prior to the completion of a degree program, (6) thesis credits received at another university.

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*Credit by Examination* A student may, under certain circumstances receive credit for a course by taking an examination. The total number of credits which may be earned either by examination or transfer may not exceed the total credits which may be transferred into a master's program (9) or into a doctoral program (24). A fee of \$10 per credit is charged.

Validation of Credit In order to insure effective planning of a graduate program, usually not more than nine hours of graduate credit acquired at the University of Vermont as a non-degree student prior to admission to the Graduate College may be validated on the students record as applicable toward the credit requirements of an advanced degree. If an applicant is enrolled as a non-degree student in appropriate graduate courses during the semester in which his application is approved for admittance, these credits will also be applied to his degree program and do not reduce the number of validation credits available.

Conferring of Degrees Degrees are conferred only at Commencement at the end of the academic year. If a student has completed all the requirements for a degree prior to that time, he will be issued a letter certifying that he has completed his graduate degree program and that the degree will be conferred at the next Commencement.

In unusual circumstances, a student may appeal any of the Regulations of the Graduate College by written request to the Executive Committee of the Graduate Faculty.

#### • REQUIREMENTS FOR A MASTER'S DEGREE

All master's degree programs require a minimum of thirty semester hours of graduate credit. In programs that require a thesis, the number of credit hours to be earned in thesis research may vary between six (minimum) and fifteen (maximum); these credits are included in the minimum of thirty required for the degree.

#### MASTER OF ARTS AND MASTER OF SCIENCE

Field of Specialization At least twenty-one hours of graduate credit, including credit for the thesis and research leading to the thesis, must be earned in the field of specialization. All course credits included in these twenty-one hours must have been earned in courses which have been approved for graduate credit.

*Related Study* A graduate program may include advanced courses outside the field of specialization. In order to be included as part of the master's program, these courses must be approved in advance by the studies committee of the department in which the student is specializing.

Studies Committee A Studies Committee will be appointed by the Department Chairman for each candidate for the master's degree. It shall be the responsibility of this committee to supervise the student's program and review his progress at regular intervals.

Language Requirement Certain departments require a reading knowledge of an appropriate foreign language. The methods for satisfying the language requirement are described on page 28.

*Research and Thesis* If a thesis is required, each candidate will undertake a problem of original research under the direction of a member of the department in which he is specializing. At the conclusion of the investigation the student must present a thesis which embodies the results of his work and which demonstrates his capability for independent research.

In order to be eligible for an advanced degree in a particular academic year, a master's candiate must submit three copies of his thesis to the Graduate College by the date specified in *Guidelines for Thesis Writing* which is available from the Office of the Dean. However, each department may stipulate an earlier deadline.

Thesis Examining Committee Upon submission of a completed thesis, the advisor will appoint a Thesis Examining Committee for oral examination of the candidate. The committee will consist of 3 members: 2 from the department and one from another field. The representative from the outside field will generally be designated as the chairman.

The thesis must be prepared and submitted in compliance with the detailed instruction sheet which is obtained in the Office of the Graduate College.

#### Examinations

- a. A written comprehensive examination in the field of specialization.
- b. An oral examination in defense of the thesis.

Success in the written examination is prerequisite to taking the oral examination. All examinations are taken on the University campus in Burlington. One re-examination only is permitted for any final comprehensive examination.

Three copies of the corrected thesis must be forwarded to the Dean of the Graduate College after the successful defense of thesis.

#### MASTER OF ARTS IN TEACHING

The program leading to the degree of Master of Arts in Teaching is designed primarily for teachers with the purpose of enhancing their teaching ability and strengthening their background in their subject matter field. Each MAT program is a cooperative venture between the specialist department and the College of Education. Students with questions regarding the education component of their program should consult with the office of the Dean of the College of Education.

A minimum of thirty semester hours is required in courses numbered above 200, of which not less than six semester hours shall be in education taken at the University of Vermont. No thesis is allowable in this degree program; a student must complete at least twenty-one hours, and usually twenty-four, in a single department offering courses for graduate credit or in any acceptable combination of such departments. In order to be accepted to candidacy for this degree, a student must have completed an undergraduate major within the area of his specialization, have submitted satisfactory scores on the Graduate Records Examination (Verbal and Quantitative), and be acceptable to the departments concerned. Advanced GRE scores are required for certain programs as indicated.

In his undergraduate program, a candidate is expected to have completed the necessary courses in education to meet minimum requirements for a teaching certificate. If candidates have not qualified for teaching certification, they cannot expect to complete the degree in one academic year. To qualify for the degree of Master of Arts in Teaching, the candidate must present at least eighteen semester hours in education in his combined undergraduate and graduate program. This requirement is specified to ensure that the degree recipient can meet minimum certification requirements. Students without prior teaching experience will be required to complete satisfactorily an internship or an equivalent field experience which would be in addition to the minimum MAT education course requirements.

#### **Examinations**

- a. A written comprehensive examination in the field of Education.
- b. A written comprehensive examination or a comprehensive oral examination in the field of specialization. The choice between written and oral examination is to be determined by the department after consultation with the candidate.

All examinations are taken on the University campus in Burlington. One re-examination only is permitted for any final comprehensive examination. It is the responsibility of the candidate to notify the respective department and the College of Education to schedule the required examinations.

#### MASTER OF EDUCATION

Before acceptance to candidacy for the degree of Master of Education, the student must present a satisfactory score in the Graduate Records Examination (Verbal and Quantitative). Before the degree is awarded, the candidate must have completed one year of successful teaching experience or other educational service. This requirement may be fulfilled by satisfactory completion of student teaching, an internship, or a practicum.

The graduate program of each student admitted to candidacy for the degree of Master of Education is planned and supervised by an advisor in the respective program area. Program planning takes into consideration the student's undergraduate curriculum, his professional experience, and his aims and purposes in pursuing the master's degree.

Each program must include either thirty semester hours of approved course work or twenty-four hours earned in courses and six hours in thesis research. Contingent on a candidate's background and interests and on program specification, additional credit hours may be required. If a student's preparation is inadequate for him to begin study at the graduate level in certain aspects of his program, additional undergraduate courses will be required. Each Master of Education degree program must include a minimum of six semester hours of graduate work in the humanistic foundations of Education, unless this requirement or its equivalent has been previously met. Graduate courses which currently fulfill this requirement include: Education 202, 204, 205, 206, 252, 254 and 255.

In order to insure effective planning of a graduate program for the

degree of Master of Education, not more than nine hours credit will be accepted in partial fulfillment of degree requirements for courses taken prior to acceptance to the Graduate College.

#### Examinations

A comprehensive examination is required. However, it may be written or oral. The choice between a written or an oral examination, or the decision to require both, will be made by faculty members in the area of specialization after consultation with the advisor and the candidate.

- a. The written comprehensive examination will cover the field of Education, with emphasis on the area of specialization,
- b. The oral comprehensive examination will emphasize the area of specialization.

All examinations are taken on the university campus in Burlington. Only one re-examination is permitted for any final comprehensive examination. It is the responsibility of the candidate to schedule the required examination with the College of Education. Since each program has different options for meeting the oral and written comprehensive requirements, candidates should contact the respective program chairman or advisor regarding that program policy.

If the thesis option is elected, there will be an oral examination in defense of the thesis.

#### MASTER OF SCIENCE FOR TEACHERS

Refer to specific departments for requirements for this degree program.

#### MASTER OF BUSINESS ADMINISTRATION

A minimum of thirty semester hours is required in courses numbered above 200. Specific course requirements include Economics 207, 228, 252, and 289, a total of twelve hours. An additional twelve hours (4 courses) of approved electives plus six hours of thesis credit comprise the minimum of thirty credits. The twelve hours of elective credit provides the candidate with the opportunity of concentrating his study in an appropriate field.

Each candidate will have the option of pursuing a thesis research topic consistent with his area of concentration and overall educational objective, at the conclusion of which the student must present a thesis

which embodies the results of his work and demonstrates his capability. If the student desires and the department concurs, he may substitute nine additional hours of course work in lieu of the thesis.

#### Examinations

- a. A written comprehensive examination with emphasis in the field of specialization.
- b. An oral examination in defense of the thesis (if submitted).

Normally the comprehensive examination is administered upon completion of all course work for the degree. Success in the written comprehensive is a prerequisite to taking the oral examination. All examinations are taken on the University campus in Burlington. One reexamination only is permitted for any final comprehensive examination.

Information on the M.B.A. evening courses may also be found in the University of Vermont Continuing Education Bulletin.

Not more than six credit hours of graduate work completed prior to admission to the Graduate College will be applied toward the degree requirements.

#### MASTER OF EXTENSION EDUCATION

A minimum of 30 semester hours is required in courses numbered above 200. Each candidate is expected to complete 12 semester hours of course credit in Agriculture and/or Home Economics or related basic courses; including a minimum of 6 semester hours in Vocational Education and Technology and/or Home Economics Education. The minimum of 18 semester hours of approved electives provides the candidate with the opportunity of concentrating his study in an appropriate field.

The application of each student seeking admission to candidacy for the Master of Extension Education is reviewed by the chairman of the departments of Home Economics and Vocational Education and Technology. An advisor will be assigned from the appropriate department.

A student must present a satisfactory score in the Miller Analogies Test. The candidate must have completed one year of successful professional experience before the degree is granted.

The candidate is at liberty to select the manner in which he will complete the requirements for the degree either through Summer Sessions, Evening Division and/or full time residency.

#### Examinations

a. A written comprehensive examination in field of specialization. b. A comprehensive oral examination in the field of specialization. Success in the written examination is prerequisite to taking the oral examination. All examinations are taken on the University campus in Burlington. One re-examination only is permitted for any final comprehensive examination.

#### • REQUIREMENTS FOR DEGREE OF DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy requires of candidates a minimum of *seventy-five* credit hours to be earned in courses and in thesis research.

Studies Committee Upon admission to the Graduate College, the prospective candidate for the Ph.D. degree will be assigned an interdepartmental Studies Committee by the department chairman. This committee will meet at least once a semester with the candidate to advise him and to help plan his program of study. All courses taken in the program must be approved by this committee, the department chairman concerned, and the Dean of the Graduate College.

*Courses* A minimum of fifteen hours in courses used for compilation of the grade point average must be taken in residence at The University of Vermont. The first year of each doctoral program consists almost entirely of required courses; in the following years appropriate courses are selected by the Studies Committee in consultation with the candidate. Details of each program can be obtained from the appropriate department chairman or from the Dean.

Language Requirements The determination of language requirements is established by each individual department. Please refer to specific departmental entries. If a knowledge of a foreign language is required, the method of satisfying this requirement will be determined by each individual department, as well as the evaluation of the results.

The language requirement must be fulfilled before the written comprehensive examination is taken and before admission to candidacy.

Completion of an appropriate foreign language at the intermediate college level with a grade of B or better in the final semester may be accepted in fulfillment of a reading knowledge of a foreign language. *Research and Thesis* Each candidate, while in residence at The Uni-

versity of Vermont, must complete an acceptable original research project which contributes new knowledge or techniques in his academic field. Each candidate must enroll in a minimum of *twenty* credits of thesis research.

In order to be eligible for an advanced degree in a particular academic year, a doctoral candidate must submit four copies of his thesis to the Graduate College by the date specified in *Guidelines for Thesis Writing* which is available from the office of the Dean, however, each department may stipulate an earlier deadline.

The thesis must be prepared and submitted in compliance with the detailed instruction sheet which is obtained in the Office of the Graduate College.

Thesis Examining Committee Upon submission of the completed thesis, the Dean of the Graduate College will approve a Thesis Committee, appointed by the department, for the oral examination of the candidate. The Committee shall consist of the Dean, as chairman, the members of the Studies Committee, and at least two faculty members from outside of the department who will be nominated by the chairman of the department concerned for a total membership of six. The acceptability of the thesis will be determined by the Thesis Examining Committee.

#### **Examinations**

- (a) A comprehensive written examination in the field of study must be passed by the candidate at least six months before the thesis is submitted. This examination will be prepared by the department concerned, in consultation with the candidate's Studies Committee. One re-examination only will be permitted.
- (b) An oral examination, in which the candidate will be expected to defend his thesis, will be scheduled no sooner than one month after the thesis has been submitted to the department. One re-examination only will be permitted.

Success in the written examination is prerequisite to taking the oral examination. All examinations are taken on the University campus in Burlington.

Four copies of the corrected thesis must be forwarded to the Dean of the Graduate College after the successful defense of thesis.

# Definition of "Vermont Resident"

ADOPTED BY BOARD OF TRUSTEES, OCTOBER 2, 1971

The Vermont Legislature has established a lower rate of tuition for students who are Vermont residents. Such a policy appears to have as its objective the attempt to more evenly distribute the cost of operating and supporting the University of Vermont between Vermont residents whose taxes have previously supported the University and non-residents who have not done so.

The Legislature has stated that enrollment at an institution for higher learning or presence within the State for purposes of attending an institution of higher learning shall not constitute residence for tuition purposes.

In determining whether a student is a "Vermont Resident" for tuition purposes the following shall apply:

- 1. A student who has attained the age of majority or is an emancipated minor shall be deemed to be a Vermont Resident if the student shall have had his domicile in Vermont for a period of one (1) year preceding the beginning of the semester in which the student seeks to register.
- 2. A student who is an unemancipated minor at the beginning of a semester shall be deemed to be a Vermont Resident during such semester if and only if, his parents, guardian or whoever stands in loco parentis to the student, had their domicile in Vermont for one (1) year preceding the beginning of such semester.
- 3. A student who at the beginning of a semester has his domicile fixed by a special rule of law (as a student under guardianship, a married woman, etc.) shall be deemed to be a Vermont Resident during such semester if, and only if, the circumstances claimed to have made the student a resident shall have taken place at least one (1) year prior to the beginning of such semester; provided, however, that a guardianship of a minor student shall not be deemed a basis for residence, if the primary purpose of the guardianship is to qualify the minor for resident tuition.
- 4. Whenever a resident student shall lose his Vermont domicile (as in the case of a minor whose parent or guardian moves from Vermont but excepting women who lose such domicile by marrying non-residents) the student shall be reclassified as a non-resident effective at the beginning of the next semester for which the student enrolls; and it shall be incumbent upon any student whose status so changes from Vermont Resident to non-resident to inform the Dean of his college, or the Registrar, promptly,

of the facts relating to his residence.

- 5. The term "domicile" shall mean the place where a person is physically present and where he intends to permanently remain as a true, fixed and permanent home.
- 6. A student who has attained the age of majority or is an emancipated minor shall be deemed to have his domicile in Vermont if:
  - a. his parents, guardian or whoever stands in loco parentis to the student were domiciled in Vermont at the time he reached his majority or was emancipated, and the student has not acquired a domicile in another state, or
  - b. he has established a bona fide domicile in Vermont in accordance with paragraph 5.
- 7. A student who is present in Vermont for the primary purpose of attempting to qualify for resident tuition status shall not be deemed to have a bona fide domicile in Vermont.
- 8. Neither a student's presence in Vermont for purposes of attending an educational institution, registration in Vermont for the purpose of the draft and voting, Vermont motor vehicle registration and drivers license, employment in Vermont, the ownership of real property in Vermont, or the payment of Vermont taxes shall, by themselves necessarily be determinative of a bona fide domicile in Vermont.
- 8a. A student who is eligible for tuition purposes to enroll as a resident student in another state shall not be enrolled as a "Vermont Resident."
- 9. A student from another state who enrolls in an educational institution of higher learning in Vermont shall create a rebuttable presumption that he is in Vermont for purposes of attending such institution and will not be deemed to have established a bona fide Vermont domicile.
- 10. In determining whether a student has established a bona fide domicile in Vermont it shall be relevant to ascertain whether the student is receiving support from or is being claimed as an income tax exemption by his parent, guardian or person standing in loco parentis.
- 11. Students enrolling at the University of Vermont shall be classified by the Director of Admissions or the appropriate dean\* as a resident or non-resident for Admissions and Tuition Purposes. The decision by the Director of Admissions or the appropriate dean\* shall be based upon information furnished by the student and other relevant information. The Director of Admissions or the appropriate dean\* is authorized to require such written documents, affidavits, verifications, or other evidence as he deems necessary.
- 12. The burden of proof shall in all cases rest upon the student claiming to be a Vermont resident.
- 13. The decision of the Director of Admissions or the appropriate dean\* on the

#### **DEFINITION OF VERMONT RESIDENT**

classification of a student as a resident or non-resident may be appealed in writing to the Residence Committee.

- 14. The Residence Committee may make exceptions to the above rules whenever justice requires.
- 15. Appeals from the decision of the Residence Committee may be made, in writing, to the Board of Trustees, whose decision shall be final.
- \*The appropriate dean for graduate admissions is the Dean of the Graduate College; for Medical admissions, the Dean of the College of Medicine.

# Student Expenses

Application Fee All applications for admission must be accompanied by a \$15 application fee. This is non-refundable.

*Tuition* Rates for the academic year 1973-74 will be as follows: For Vermont residents, \$40 per credit hour, \$475 flat rate for 12 hours, and \$40 per credit hour in excess of 12 hours.

For nonresidents of Vermont, \$110 per credit hour, \$1275 flat rate for 12 hours, and \$110 per credit hour in excess of 12 hours.

The lower rates for Vermont residents are made possible by a subvention to the University from the State of Vermont.

Completion of Thesis Fee A fee of \$25 per semester is charged each graduate student who has already paid tuition for all credits required in his degree program but who has not completed or defended his thesis.

Library Bond Fee A fee of \$15 per semester is required of each student enrolled in twelve credit hours or more; a fee of \$7.50 per semester is required of each student enrolled for less than twelve credit hours and more than five credit hours. No fee is assessed for registration of one to five credit hours. This fee is assessed by legilsative act and turned over to the State of Vermont each year to the extent necessary to fund the debt retirement on the bond issue that was used to fund the construction of Bailey Library.

Student Health Fee A fee of \$25 per semester is charged all full time degree students enrolled at the university.

Athletic Bond Fee A fee of \$15 per semester is required of each student enrolled in twelve credit hours or more. Payment of the Athletic Fee gives each student the privilege of using the facilities in the University gymnasium. This fee is assessed by legislative act and turned over to the State of Vermont each year to the extent necessary to fund the debt retirement on the bond issue that was used to fund the construction of Patrick Gymnasium.

*Penalty Payment* Failure to complete financial arrangements and registration by specified dates will result in a penalty of \$10.00.

Advanced Degree Fee A fee is charged to each recipient of an advanced degree according to the following schedule:

Ph.D.

\$25.00

#### STUDENT EXPENSES

Masters 3	Degree (With thesis)	20.00
Masters 3	Degree (No thesis)	10.00

This fee may be paid at any time but must be paid prior to the last date established for submission of theses in each of the three graduation periods (i.e. for 1973-74 the dates are September 10, January 25, and May 6.)

It is the responsibility of the degree candidate to pay the appropriate amount at the Cashiers' Office and present a receipt of this to the Graduate College Dean by the above dates in order to have a degree awarded.

Living Expenses The University provides no housing for single graduate students. These students have traditionally found suitable housing in the greater Burlington area. A limited number of University owned apartments are available for married students. Detailed rental information may be obtained from the Off-Campus Housing Office, 600 Dalton Drive, Winooski, Vermont, 05404.

Up-to-date listings for available apartments, houses, and rooms for rent in the area are maintained by the Off-Campus Housing Office. This service allows community landlords and rental agents a way to make known their housing availability to persons associated with the University. It is impractical to send information concerning individual listings by mail. A catalog of available listings is issued each May, August, and December.

Rents in the Burlington area vary from approximately \$20.00 per week for a single furnished room to \$160.00 or more per month for a furnished, two-bedroom apartment. A single student should expect overall living expenses of \$225.00 to \$250.00 per month. If desired, meals may be obtained in University Dining Halls.

*Time Payments* The University offers a payment plan whereby total charges for tuition and fees may be divided into monthly payments. For further information contact the Cashiers' Office.

#### **Tuition Refunds**

In the event of voluntary withdrawal from college, during the first week of any semester the full tuition is refunded; thereafter, 20 percent is retained by the University for each week that has elapsed.

Any student who has paid in full the tuition for a semester and who withdraws for reasons of health or other causes beyond his control be-
fore the end of the semester, may, with the permission of the dean and in lieu of any refund, elect to enroll for a final semester without charge for tuition.

If a student is suspended, no cash refund is made; the student and his parents are informed that a credit balance for the amount actually paid for tuition by the student or his parents will be retained on the University's books and applied to his tuition charges, if he re-enrolls within three years of his suspension; no scholarship grants will be included in such credit.

If a student is dismissed for cause, a refund of tuition is made proportionate to the number of weeks remaining in the semester at the time of dismissal.

In case of death of a student, tuition paid is refunded in full.

A student who changes his status from full-time to part-time (fewer than twelve hours) by an approved change of enrollment during the first three weeks of a semester may be entitled to partial refund of tuition, gymnasium, and library fees, since the charges will be adjusted to fit his new status.

### Financial Aid

Students who wish to be considered for fellowships as well as admission must submit completed applications, with supporting material, by March 1 for the academic year preceding that for which application is made. All applicants requesting fellowship and traineeship support must submit scores received on the Graduate Record Examination.

Application for fellowships should be made by completion of the appropriate section on the application form. No separate form is required.

### • GRADUATE COLLEGE FELLOWSHIPS

The Graduate College offers Graduate College Fellowships of \$1000 each, plus a full tuition scholarship to cover the minimum number of credit hours needed to fulfill the requirements for a Master's Degree and not to exceed thirty-six hours.

These fellowships are open to applicants in any field in which the University offers a graduate degree program. Holders of Graduate Fellowships are expected to carry a full-time graduate program towards an advanced degree. These Fellowships are not renewable and are not given to students previously enrolled in the Graduate College.

### • GRADUATE TEACHING FELLOWSHIPS AND GRADUATE RESEARCH FELLOWSHIPS

Graduate Teaching and Research Fellowships are awarded in departments offering graduate work. Graduate Teaching Fellows are appointed for nine months with stipends averaging \$2600. Teaching Fellows may enroll for a maximum of 10 hours per semester. Graduate Research Fellows are appointed for eleven months with a stipend of \$3100. Research Fellows have no special restriction on enrollment.

Fellowship award includes a tuition scholarship in addition to the stipend for the period of the fellowship.

A maximum of half-time assistance in the department is expected of Graduate Teaching Fellows and Graduate Research Fellows, and they must expect that more than one academic year will be necessary to complete the requirements for the master's degree. If a Teaching Fellow or Research Fellow is a candidate for the doctoral degree, he must expect to spend at least four calendar years before his academic program can be completed. While it is customary, it is not obligatory that Fellows select their fields of concentration in the departments in which they are appointed.

Appointments will be announced on or about April 2.

### • GRADUATE RESIDENT ADVISORSHIPS

Graduate students, men and women, are eligible to apply for Graduate Resident Advisorships. The candidates selected to fill these positions will normally be assigned administrative and advisory positions in the residence halls. Student Personnel Fellows have the opportunity to gain valuable experience in the areas of group advising, administration, personal advising and educational programming. Such positions are open to either married or single students who have been accepted for graduate work in any of the academic programs of the University of Vermont. Selection is based upon academic record, character, recommendations, and quality of related experiences. A personal interview is required. Graduate Resident Advisors receive a stipend of \$2600 plus a tuition scholarship for a nine-month period. The award is renewable only once. Room and board is deducted from this stipend. Requests for applications and additional information should be addressed to the Dean of Students office. Applications received after March 1 will be considered only for unanticipated openings. Appointments will be announced on or about May 1.

### • GRADUATE TRAINEESHIPS

Graduate traineeships have been made available to certain departments through grants from various divisions of the U.S. Public Health Service. Traineeships are available to graduate students enrolled in the following departments: Biochemistry, Biostatistics, Education, Medical Technology, Physiology and Biophysics, and Communication. These traineeships generally carry stipends of \$2,400 upwards plus payment of tuition. The chairman of the department concerned should be contacted for information on the availability of these awards.

### • GRADUATE ASSISTANTSHIPS

Graduate Assistantships are generally available when a department member receives a grant from a source external to the University. The appointment is for twelve months and supplies a salary starting at about

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### FINANCIAL AID

\$4300 per year. Part of the salary is for tuition at the in-state rate with a maximum enrollment of nine credit hours each semester and six credit hours during the summer.

A maximum of one-half time assistance on the research project is expected and more than one academic year will be necessary for the completion of the master's degree and at least four calendar years for completion of the doctoral degree. For information on the availability of an assistantship, contact the chairman of the department concerned.

### • GEORGE H. WALKER DAIRY FELLOWSHIP

The George H. Walker Dairy Fellowship, which is awarded periodically, provides a stipend plus a full tuition scholarship. It is available to graduate students who, during their undergraduate courses, have studied "agriculture, chemistry, and bacteriology" and who desire to study the problems relating to the production of a sanitary milk supply on comparatively small plants and farms. Applications should be addressed to the Chairman of the Department of Animal Sciences.

### • HOOD INTERDISCIPLINARY FELLOWSHIP

This fellowship is awarded for study leading to a degree in a field where the principles of physics or physical chemistry are applied to biological or medical science. Applicant must be recommended by the department chairman. Stipend \$3,400 plus tuition, fees, and travel allowance. In order to be eligible, applicant must have equivalent of an M.S. in physics or physical chemistry.

### • THE HUMPHREY CHEMICAL COMPANY FELLOWSHIP IN HYDROCARBON SYNTHESIS

This fellowship is awarded annually to a qualified student in the chemistry department working toward a Ph.D. in organic chemistry. The amount of the stipend is consistent with that paid by other departments. The fellowship also provides tuition and non-refundable fees.

### • THE WEBB FELLOWSHIPS

These fellowships are awarded to students in the department of history who are involved in such areas as the history of art and architecture, U.S. and Vermont history including social history, the history of technology and museum work. The program is operated through the Shelburne Museum and the University's departments of history and art. Fellowships carry a stipend of \$1,000 per year plus tuition. A personal interview may be required of an applicant.

### • LOANS

Limited financial aid in the form of loans may be available through The University of Vermont. Prospective graduate students should make evey effort to secure loans through their local banks or credit unions under federal or state insured educational loan programs. Inquiries concerning loans available through UVM should be made to the Director of Financial Aid, Waterman Building, UVM, prior to March 1.

### Courses of Instruction

### Course Numbering

Courses numbered 400 or above are limited to candidates for the degree of Doctor of Philosophy; courses numbered 300 to 399 are limited to graduate students; courses numbered 200 to 299 are graduate courses open to advanced undergraduates. Courses numbered 100 to 199 may not be taken for graduate credit except upon recommendation of a student's Studies Committee and with the authorization of the Dean. Under no circumstances will graduate credit be allowed for a course numbered below 100.

The form 201, 202 indicates that each semester may be taken independently for credit.

The form 201-202 indicates that they may not be taken independently for credit and, unless otherwise stated, must be taken in the sequence indicated.

The number of credit hours per semester is indicated in each description.

All prerequisites cited refer to courses as numbered at The University of Vermont.

A student who lacks the stated prerequisites for a course, but is otherwise qualified to take it, may be permitted to enroll by the instructor.

While every attempt has been made to list only courses that actually will be offered, the College necessarily must reserve the right to withdraw scheduled offerings or substitute for them should circumstances make such changes necessary.

### • AGRICULTURAL ECONOMICS

See Resource Economics

### • ANATOMY

Professor W.J. Young (Chairman); Associate Professors Freedman, Ring and Wells; Assistant Professors Boushey, Horst, Krupp and Paull.

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Research activities include: electron microscopy and histological studies of the renal glomerulus and kidney in bats and a variety of other animals; neural control of reproduction; experimental neuroanatomy and autoradiography of the mammalian and avian central nervous systems; histology and electron microscopy of "simple" nervous systems; biochemical genetics and cytogenetics in the Drosophila X-chromosome; electron microscopy of the developing hypothalamo-hypophysial neuroendocrine system; histochemical and electron microscopic studies of calciton in secreting cells under various experimental conditions.

## PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Year courses in Physics, Organic Chemistry; year course or equivalent in Advanced Biology, satisfactory standing on Graduate Record Examination.

### **MINIMUM DEGREE REQUIREMENTS**

Anatomy 301, 302, 311, Physiology 301, Medical Biochemistry 301-302 or equivalent; dissertation and comprehensive examination.

### PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Bachelor's degree; one year of Biology and Organic Chemistry; Physics; Mathematics through Analytical Geometry and Calculus. GRE required.

### **MINIMUM DEGREE REQUIREMENTS**

Anatomy 301, 302, 311, 341, 351; Biochemistry; Physiology and Biophysics 301; additional elective courses and teaching assignments as arranged with the Department; thesis research; credits as required by the Graduate College.

### **COURSES OFFERED**

Note: Departmental permission for all courses.

301 GROSS ANATOMY The course as given to medical students. Study of the gross structure of the human body by means of general dissection, cross-sections, special dissection, and demonstration. Six hours. Staff.

302 NEUROSCIENCE A correlated presentation of the neuroanatomy and neurophysiology of the mammalian central nervous system. The course consists of lectures, demonstrations, laboratory, and patients with neurological deficits are presented. Same course as Physiology 302. *Prerequisites:* Permission of the instructor. Four hours. Anatomy and Physiology Staff.

311 MEDICAL HISTOLOGY The regular medical course. Microscopic study of cells, tissues and organs using routine techniques, three hours. Staff

#### ANATOMY

323 NEUROENDOCRINOLOGY A consideration of the diencephalic regulation of hormonal activity. Initial lectures will cover morphological features of the hypothalamus and hypothalamo-hypophysial pathways. The major portion of the course will be devoted to hypothalamic mechanisms controlling each principal pituitary hormone. These topics will be covered in a brief lecture followed by a discussion based upon text and journal assignments. *Prerequisites:* Anatomy 302. 2 credits. Alternate years. Staff

324 ADVANCED NEUROANATOMY A detailed analysis of the morphology of the nervous system is presented through lectures and laboratory. A regional approach to the anatomy is supplemented by units on development, blood supply, and the autonomic nervous system. Laboratory exercises will consist of brain dissection and microscopic examination of brain stem sections. *Prerequisites:* Anatomy 302. 3 credits. Staff

341, 342 SPECIAL DISSECTIONS IN GROSS ANATOMY Special dissections of particular regions of the human body, utilizing either adult or fetal material. *Prerequisite:* consent of instructors. Credit as arranged. Staff.

351, 352 SPECIAL TECHNIQUES IN HISTOLOGY A study of selected cells, tissues or organs by means of special techniques. Specific work as agreed upon. *Prerequisite:* 311; consent of instructors. Credit as arranged. Staff.

374 CYTOGENETICS The structure and function of chromosomes and associated organelles (centriole, spindle, nucleolus) will be analyzed by critical review of the current literature. The seminar will include pertinent observations in human somatic and meiotic cells, as well as in selected plant and animal species. *Prerequisites:* Zoology 115 or equivalent, with permission of the instructors (same course as Botany 374). 2 credits. Mr. Young, Mr. Hyde (Botany). Alternate years.

381 SEMINARS IN ANATOMY Critical review of the literature in various areas of the anatomical sciences. *Prerequisite:* graduate standing. Credit as arranged.

391 MASTER'S THESIS RESEARCH Credit as arranged.

491 DOCTORAL THESIS RESEARCH Credit as arranged.

### • ANIMAL PATHOLOGY

### Professor Bolton (Chairman); Associate Professors Doremus and Murray.

Research interests include causes of abortions and breeding problems in dairy cattle. Current studies involve the role of viruses as primary causative

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#### ANIMAL PATHOLOGY

agents. Infectious bovine rhinotracheitis (IBR); bovine virus diarrhea (BVD); and parainfluenza-3 (PI-3) are of special interest. Fluorescent antibody techniques are being evaluated as diagnostic aids.

### PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

The degree of Doctor of Veterinary Medicine.

#### **MINIMUM DEGREE REQUIREMENTS**

Candidates will elect a major concentration in Anatomy, Animal Science, Biochemistry, Microbiology, Pathology or Physiology and Biophysics; additional courses in related fields; thesis research (12-15 hours).

### **COURSES OFFERED**

217-218 LABORATORY ANIMALS (2-2) Life cycles, feeding, housing, breeding requirements, nutrition, disease prevention, maintenance of germ-free colonies, preoperative and postoperative care, and humane methods of handling. *Prerequisite:* microbiology and biochemistry 55 or medical microbiology 201, chemistry 131, 132. Three hours. Dr. Henry Doremus.

220 LABORATORY ASSIGNMENTS (1-6) Rotating assignments in the Animal Pathology Laboratory and Division of Animal Services in the College of Medicine. Students work with groups of experimental animals under the guidance of the professional staff. *Prerequisite:* 107, 217. Three hours. Staff. 391 MASTER'S THESIS RESEARCH Credit as arranged.

### • ANIMAL SCIENCES

Professors Atherton, Balch, Duthie, Smith, (Chairman) and Welch; Associate Professors Carew, Foss, Nilson and Simmons; Adjunct Associate Professors Mercia and Woelfel, and Adjunct Assistant Professors Gibson and Leamy.

Research activities in basic and applied science encompass a broad range of interests. The areas of study and research include nutrition; physiology; dairy and food plant management, chemistry, or bacteriology; and quality control aspects of the food industry.

### PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An acceptable undergraduate major in the Animal Sciences; Chemistry; Biology; or a related field. Satisfactory scores on the aptitude and advanced section of the Graduate Records Examination must be presented.

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### ANIMAL SCIENCES

### MINIMUM DEGREE REQUIREMENTS

15-21 hours in Animal Sciences and related fields; Thesis research (9-15 hours).

### PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Satisfactory scores on the aptitude and advanced sections of the Graduate Record Examination must be presented. The applicant must satisfy the prcrequisites of the Graduate College and pass the general qualifying examination administered by the Department of Animal Sciences.

### MINIMUM DEGREE REQUIREMENTS

The Department of Animal Science believes each graduate program has its individual needs and must be arranged accordingly. The candidate must meet all requirements as prescribed by the graduate college for the degree of the Doctor of Philosophy. In addition, all courses and seminars as established by the Studies Committee must be satisfactorily met, doctoral research must be completed, and an acceptable thesis written and defended. In accord with the policy of the Animal Sciences Department, all doctoral students will be provided the opportunity to participate in the department's undergraduate teaching program. Proficiency in a modern foreign language or computer language and programming is optional at the discretion of the studies committee.

### **COURSES OFFERED**

211 ICE CREAM AND FROZEN DAIRY PRODUCTS Fundamentals of ice cream manufacturing, the physico-chemical and biological factors involved; calculation of formulas; sherberts and specialties; merchandising; and sanitary control. *Prerequisite:* 104; credit or concurrent enrollment in 109. Three hours. Mr. Nilson. Alternate years, 1973-74.

246 ADVANCED NUTRITION (See Home Economics 246) Three hours. Mr. Welch.

249 NUTRITION SEMINAR (See Home Economics 249) Three hours. Miss Morse and Mr. Welch.

251 ADVANCED DAIRY CATTLE MANAGEMENT The organization and operation of dairy enterprises. Theories and methods of application of feeding, breeding, and management programs and principles. *Prerequisite:* 43. Three hours. Mr. Woelfel. Alternate years, 1973-74.

256 DAIRY PLANT MANAGEMENT Organization. and operation of milk processing and manufactured milk products plants. *Prerequisite:* 153, Rs. Ec. 62. Three hours. Mr. Nilson. Alternate years, 1974-75.

271 ENDOCRINOLOGY Anatomy, physiology, glandular interrelation-

ships, and assay methods of the endocrine glands and their hormones. *Pre-requisite:* Departmental permission. Three hours. Mr. Simmons.

275 PHYSIOLOGY OF REPRODUCTION AND LACTATION Fundamental principles of the physiology of reproduction and lactation with the primary emphasis on farm animals. Three hours. Mr. Simmons. Alternate years, 1974-75.

281, 282 ANIMAL SCIENCES SEMINAR Reports and discussions of problems and special investigations in selected fields. One-three hours. Maximum credit three hours. Staff.

291 SPECIAL PROBLEMS IN ANIMAL SCIENCES Reading, discussion, and special laboratory investigation in the field of animal sciences. *Prerequisite:* Departmental permission. Three hours. Staff.

294 HISTORY OF NUTRITION (See Home Economics 294). One hour. Miss Morse.

307 ADVANCED CONCEPTS IN NUTRITION Study of chemistry and physiology of digestion, absorption and metabolism of nutrients. Methods of estimating and meeting dietary requirements for maintenance, growth, and reproduction of several species. Genetic and nutritional interrelationships. Basic study of growth per se. *Prerequisite:* one of the following: Animal Sciences 246, Home Economics 246, or a 200 level course in biochemistry. Three hours. Staff. Alternate years, 1973-74.

308 EXPERIMENTAL TECHNIQUES IN NUTRITION Methods of conducting research in nutrition with the various animal species including humans. Physical, physiological and biochemical aspects considered. Experimental design and analyses. *Prerequisite:* a 200 level course in nutrition and in bio-chemistry. Two hours. Staff.

391 MASTER'S THESIS RESEARCH Credit as arranged.

491 DOCTORAL THESIS RESEARCH Credit as arranged.

### • ANTHROPOLOGY

Associate Professors Haviland, Mitchell, Woolfson; Assistant Professors Magnarella, C. Pastner, S. Pastner; Instructor Basa.

#### No Master's Program offered

Research activities in anthropology include the investigation of prehistoric social organization and change among the Maya; the study of French Vermonters and biculturalism; the ethnography of pastoral nomads; the archaeology of Vermont; and tradition and change in Turkey. 212 CULTURE AND PERSONALITY The crosscultural comparison of personality development; the problem of delineating modal personality types. *Prerequisite:* 21, sociology 10 and one 100 level course in sociology or anthropology. Three hours. Messers Mabry, Magnarella, Steffenhagen.

225 CURRENT ANTHROPOLOGICAL THEORY Schools of Anthropological thought: evolutionism, cultural ecology, functionalism, relativism, diffusionism, structuralism and cognitive schools, examined in relation to data on nonwestern societies and the historical/social context in which the anthropologist works. *Prerequisite:* 21 plus one 100 level course. Three hours. Messers Magnarella and Pastner, Ms. Pastner.

228 SOCIAL ORGANIZATION The study of social relationships of peoples living in various cultures and different parts of the world; focuses on such topics as residence, descent and kinship in tribal organization and community life. *Prerequisite:* 21 and one 100 level course. Three hours. Messers Magnarella and Mitchell.

229 POLITICAL AND ECONOMIC ANTHROPOLOGY The analysis of traditional exchange and subsistence systems and the ways these relate to interestbased, or political behaviors. *Prerequisite:* 21 and one 100 level course. Mr. Pastner.

283 CULTURE CHANGE The study of socio-cultural transformations in nonwestern countries with emphasis on such topics as industrialization, urbanization and modernization and their impact on the lives of previously traditional peoples. *Prerequisite:* 21 and one 100 level course, or 21 and six hours in the social sciences. Three hours. Mr. Magnarella.

284 URBAN ANTHROPOLOGY The study of urbanization and urban life in nonwestern countries including such topics as urban-rural ties, peasant migrations, and socio-cultural adjustment to urban living. *Prerequisite:* 21 and one 100 level course, or 21 and six hours in the social sciences. Three hours. Mr. Magnarella.

### • ART

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Professors J. Davison, and R. Janson (Chairman); Associate Professor Aschenbach; Assistant Professors W. Davison, Hewitt, Lipke, Owre, Parris, Roland, Sherman; Instructors Fengler, Higgins, Okino, Spivak, Versweyveld.

### No Master's degree program offered.

207 STUDIES IN AMERICAN ART Topics in art and design, particularly as represented in the Fleming and Shelburne Museums. *Prerequisite:* By permission to students of Art History, American history or literature. Three hours. Mr. Janson or Mr. Lipke.

#### ART

210 STUDIES IN MODERN ART Topics in 19th and 20th century art, stressing research and reports. *Prerequisite:* instructor's permission. Three hours. Mrs. Roland or Mr. Lipke.

281, 282 DIRECTED STUDIES Special topics, combining independent projects and group critiques in a particular area. *Prerequisite:* six hours advanced in chosen area and permission. Three or six hours. Staff.

285, 286 MUSEUM STUDIES Museum methods as concerning the research, care and administration of a collection (Fall) and as furthering aesthetic insight and the communication of ideas (Spring). *Prerequisite:* instructor's permission. Three hours. Mrs. Parris and Mr. Lipke.

### • **BIOCHEMISTRY**

Professors Melville (Chairman), Lamden; Associate Professors Meyer, Thanassi, Woodworth and Wuthier; Assistant Professors Hart, Schofield, and Willard; Instructor Ishikawa.

Current research programs include studies of the physiology and ecology of procaryotic photosynthetic organisms, with emphasis on carbon dioxide fixation and its regulation (B.A. Hart); the effects of ascorbic acid on the metabolism of bone and other tissues (M.P. Lamden); the biosynthesis and function of ergothioneine and related compounds (D.B. Melville and Y. Ishikawa); hormonal and enzymatic control mechanisms in muscle (W.L. Meyer); the relationship between structure and function of nucleic acids with particular reference to transfer-RNA and ribosomal-RNA (P. Schofield); catalytic mechanisms involved in transamination and decarboxylation reactions (J.W. Thanassi); the enzymatic mechanisms of carbon dioxide fixation (J.M. Willard); the nature of the binding of metals to proteins, particularly the ironbinding proteins of blood plasma (R.C. Woodworth); and the relationship of lipid metabolism to bone formation (R.E. Wuthier).

### PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Year courses in organic chemistry, physical chemistry, and physics (equivalent to Chemistry 131-132, Chemistry 141-142, and Physics 14-15); quantitative chemistry; mathematics through differential and integral calculus; a year course in a biological science.

### MINIMUM DEGREE REQUIREMENTS

Fifteen hours from graduate courses offered by the Department of Biochemistry including Biochemistry 301-302 or 305-306, 303, and participation

### BIOCHEMISTRY

throughout residence in Biochemistry Seminars; fifteen hours of Master's Thesis Research.

## PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Year courses in organic chemistry, physical chemistry, and physics (equivalent to Chemistry 131-132, Chemistry 141-142, and Physics 14-15); quantitative chemistry; mathematics through differential and integral calculus; a year course in a biological science.

### MINIMUM DEGREE REQUIREMENTS

Twenty hours from graduate courses offered by the Department of Biochemistry including Biochemistry 301-302 or 305-306, 303, and participation throughout residence in Biochemistry Seminar; nine hours from graduate courses offered by the Department of Chemistry; ten additional hours from courses in physical or biological sciences; thirty hours of Doctoral Thesis Research; a reading knowledge of German or other appropriate foreign language.

### **COURSES OFFERED**

301-302 GENERAL BIOCHEMISTRY Comprehensive survey of biochemistry for students majoring in the sciences. Topics include the chemistry, structure, metabolism, and function of proteins, amino acids, carbohydrates, lipids, and nucleic acids; enzymes; bioenergetics; respiratory processes; cellular and physiological control mechanisms. *Prerequisite:* Chemistry 131-132 and permission of the department. Three hours per semester. Staff.

303 BIOCHEMISTRY LABORATORY Experimental work designed to demonstrate important principles and to illustrate methods and techniques of modern biochemistry. *Prerequisite:* 301-302 or 305-306, or concurrent registration therein, and permission of the department. Five hours. Staff.

305-306 MEDICAL BIOCHEMISTRY Primarily for medical students. A survey of physiological and molecular biochemistry with special reference to man. Topics include the metabolism and function of proteins, amino acids, carbohydrates, lipids, and nucleic acids; vitamins and nutrition; enzymes and bioenergetics; respiration, hemoglobin, plasma proteins, and iron metabolism; acid-base balance, water balance, and mineral metabolism; hormones and control mechanisms. *Prerequisite:* Chemistry 131-132 and permission of the department. Given on a trimester basis in the College of Medicine calendar; equivalent to three hours per semester for two semesters. Staff.

320 GENERAL ENZYMOLOGY A general consideration of enzyme nomenclature, purification, assay, introductory kinetics, mechanisms, cofactors, active sites, subunit structure, allosteric and regulatory properties, and the

#### **BIOMEDICAL ENGINEERING**

control of multienzyme systems. *Prerequisite:* 301-302 or 305-306; Chemistry 141-142. Two hours. Mr. Meyer.

321 ENZYME KINETICS AND MECHANISMS Topics include derivation of rate equations for enzyme-catalyzed reactions, mechanistic interpretations, allosterism and enzyme stereochemistry. *Prerequisites:* 301-302 or 305-306; Chemistry 141-142. Two hours. Mr. Willard.

331 NUCLEIC ACIDS The structure and function of ribonucleic acids and deoxyribonucleic acids. *Prerequisite:* 301-302 or 305-306. Two hours. Mr. Schofield.

340 ORGANIC BIOCHEMISTRY Organic reaction mechanisms as related to substances of biochemical interest, with emphasis on catalytic mechanisms. *Prerequisite:* 301-302 or 305-306. Two hours. Mr. Thanassi.

350 RADIOISOTOPE LABORATORY The practical aspects of the use of radioisotopes as tracers in biochemical research. *Prerequisites:* 301-302 or 305-306, 303 and permission of the department. Three hours. Mr. Ishikawa.

371 PHYSICAL BIOCHEMISTRY Protein interaction, solubility and fractionation, electrophoresis, sedimentation, phase rule study, diffusion, viscosity, spectrophotometry, and related topics. *Prerequisites:* 301-302 or 305-306; Chemistry 141-142. Two hours. Mr. Woodworth.

381 SEMINAR A review of recent developments and current literature in the various fields of biochemistry. *Prerequisite:* permission of the department. One hour per semester.

391 MASTER'S THESIS RESEARCH Credit as arranged.

491 DOCTORAL THESIS RESEARCH Credit as arranged.

### • **BIOMEDICAL ENGINEERING**

A cooperative program offered by the Department of Electrical Engineering (W. Roth, Chairman) and the Department of Physiology and Biophysics (N.R. Alpert, Chairman).

### **PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE**

An accredited bachelor's degree in Electrical Engineering satisfies the principal requirements. Courses in biology and chemistry may be recommended as prerequisites. Applicants with backgrounds other than Electrical Engineering will generally be required to make up undergraduate deficiencies.

#### BIOSTATISTICS

#### **MINIMUM DEGREE REQUIREMENTS**

Physiology and Biophysics 301; twelve hours in Electrical Engineering, Physics and Mathematics; additional approved courses; thesis research (6-12 hours) in the Department of Electrical Engineering.

Biomedical engineering is one of the areas of research interest in the PhD program in Electrical Engineering.

### • BIOSTATISTICS

This is an interdisciplinary statistics program administered through the Biostatistics Division of the Department of Community Medicine. Dr. K.R. Lamborn is the program director.

The Department offers a concentrated program in Biostatistics leading to the M.S. Degree. The program takes full advantage of statistics courses taught in the Department of Mathematics, Biostatistics and Community Medicine courses taught in the Department of Community Medicine and includes experience in a wide variety of health, biomedical, and related research projects at the University of Vermont. The program will aim to give trainees maximal opportunity to use their academic training and program experience to assist in defining problems, formulating rational methods of inquiry, and gathering, analyzing and interpreting data as they relate to the specific problem under investigation.

### PREREQUISITE FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major which includes an indication of statistical ability and an interest in applying statistical methodologies and concepts to health and biomedical problems. Students without a background in linear algebra and various topics included in Mathematics 271 will be required to make up deficiencies as part of their graduate degree program.

#### MINIMUM DEGREE REQUIREMENTS

- Plan A: Twenty-four Semester hours of coursework. This would generally consist of nine hours of Probability and Mathematical Statistics, nine hours of Statistical Methodology and Sample Survey Methods, six hours of Community Medicine and Biometry; six hours of approved thesis research.
- Plan B: Thirty Semester hours of coursework. This would generally consist of nine hours of Probability and Mathematical Statistics, nine hours of Statistical Methodology and Sample Survey Methods, six hours of

Community Medicine and Biometry, and six hours of approved electives; no thesis required.

All students are expected to participate in the projects of the Biometry Facility as part of their training. During the latter part of his training the student will be expected to take major responsibility for some project, including the presentation of the final report for this project.

The person entering with a strong statistics background may, upon approval, substitute more advanced statistics courses or courses in allied fields for the requirements listed above. In such cases it is possible to substitute thesis research for up to six hours of course work (Plan A).

### **COURSES OFFERED**

BIOSTATISTICS 200, 201 STATISTICAL METHODOLOGY I, II For description see Mathematics 200, 201.

BIOSTATISTICS 202 SAMPLING METHODS For description see Mathematics 202.

BIOSTATISTICS 203 ELEMENTS OF PROBABILITY For description see Mathematics 203.

BIOSTATISTICS 204, 205 MATHEMATICAL STATISTICS I, II For description see Mathematics 204, 205.

BIOSTATISTICS 206 EXPERIMENTAL DESIGN For description see Mathematics 206.

BIOSTATISTICS 209 NONPARAMETRIC METHODS For description see Mathematics 285.

BIOSTATISTICS 201 POPULATION ANALYSIS For description see Sociology 210.

BIOSTATISTICS 281 COMMUNITY MEDICINE Consideration of social science in medicine, environmental health problems, community health services, and the application of epidemiologic principles and techniques to selected infectious and noninfectious diseases. Lectures, demonstrations and seminars. Two hours.

BIOSTATISTICS 300 MEDICAL SOCIOLOGY For description see Sociology 300.

BIOSTATISTICS 371 BIOSTATISTICS WORKSHOP Study of specialized methods and procedures of statistics which are especially important in health and related studies. Participation by students in current research problems. Two hours. Staff.

BIOSTATISTICS 391 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

#### BOTANY

### BOTANY

Professors Dodge (Visiting), Gershoy (Emeritus), Hyde (Chairman), Klein, Marvin, Sproston, Taylor and Vogelmann; Associate Professors Cook and Etherton; Assistant Professor Worley; Adjunct Assistant Professor Jagels.

The Botany Department has active research projects in plant tissue culture and morphogenesis; the effects of light on sexual reproduction in ascomycetous fungi; the isolation and identification of naturally-occurring fungicides; translocation and other physiological problems of woody plants; forest ecology; biosystematics of vascular plants; histochemical studies of the algae and studies of host parasite relationships between algae and aquatic fungi; physiology and pathogenicity of parasitic microorganisms; ultrastructural changes in the nucleus associated with development; cellular electrophysiology, biogeography of the Bryophytes. Interdisciplinary research programs may be developed in many areas of biology.

### PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Six semester courses in Botany; supporting courses in other sciences and in Mathematics. Satisfactory scores on the aptitude and advanced sections of the Graduate Record Examination.

### MINIMUM DEGREE REQUIREMENTS

15-21 hours in Botany; and closely related fields; thesis research (9-15 hours). The department also offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 24.

## PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE FOR TEACHERS (BIOLOGY)

A bachelor's degree from an accredited institution and certification as a teacher of biology or an associated field. Three years teaching experience at junior high or high school level. Satisfactory scores on the aptitude section of the Graduate Record Examination.

### MINIMUM DEGREE REQUIREMENTS

Thirty hours of course work to include a selection of courses in the Department of Botany and Zoology which will broaden and balance the undergraduate work in biology. At least two 200 level courses in each department. Courses in four of the five following areas: anatomy; morphology and systematics; genetics; developmental biology; and environmental biology. Up to 12 hours of 100 level courses may be used for the above requirement. Students will be encouraged to select courses in related science departments, mathematics, and in education to complete the required thirty hours. No thesis is required, however, each degree recipient must complete a written and oral examination.

### PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

The following courses must have been satisfactorily completed: four semesters in Botany; two semesters in Zoology; a year in Organic Chemistry (Chemistry 131-132 at the University of Vermont or its equivalent); a year of Mathematics comparable to Mathematics 11-12 and in some cases Mathematics 121 or its equivalent; one year in Physics, *i.e.*, Physics 11, 12 or its equivalent. Satisfactory scores in the Graduate Record Examination. In addition, a candidate must have completed one academic year, but not more than two years, in graduate study at the University of Vermont. (With the approval of the Dean of the Graduate College and the Department of Botany, a Master's degree may be accepted as partial or complete fulfillment of this requirement.) The specific language requirement for the candidate is to demonstrate ability to comprehend the contents of articles in the biological sciences in a modern language appropriate to the student specialty and approved by the studies committee.

### **MINIMUM DEGREE REQUIREMENTS**

The candidate is required to accumulate a minimum of 75 credits from course work and thesis research. The course requirements are as follows: a total of at least 40 credit hours of which at least 20 must be taken in Botany and at least 20 in other sciences. Supervised teaching to the extent of not less than 6 semester contact hours is also requisite.

### **COURSES OFFERED**

201 ELECTRON MICROSCOPY Theory and practice of electron microscopy including microscope operation, specimen preparation, and interpretation of electron micrographs. *Prerequisite:* departmental permission. Four hours. Mr. Jagels.

205 MINERAL NUTRITION OF PLANTS (See Plant and Soil Science 205)

207 WATER RELATIONS OF PLANTS (see Forestry 207)

210 PLANT RESPONSE TO ABIOTIC TOXICANTS Examples of damage and current hypotheses relating to injury response. Interactions of biotic and

#### BOTANY

abiotic factors; air and water pollutants; nutritional disorders; pesticides. *Prerequisites:* 104 or Biology 103. Three hours. Staff. Alternate years, 1974-75.

213 PLANT COMMUNITIES Plant sociology; structure and organization of the plant community; sampling methods and analysis of data; climatic and edaphic factors; field work. *Prerequisite:* 109 or departmental permission. Three hours. Mr. Vogelmann. Alternate years, 1973-74.

232 BOTANY FIELD TRIP Trips to selected environments outside Vermont. Led by several faculty members representing different fields of Botany. Emphasis will be on overall, integrated approach to ecology, structure, and function. One hour. Staff. Christmas or spring vacation or end of school year.

250 MICROTECHNIQUE Theory and practice in the preparation of biological materials for anatomical and cytological study, including histochemistry and photomicrography. *Prerequisite:* introductory chemistry; some knowledge of organic chemistry, anatomy, or cytology is desirable. Three hours. Mr. Cook and Mr. Jagels. Alternate years, 1973-74.

253 MYCOLOGY Reproductive processes and classification of the common mushrooms, molds, and yeasts. Physiological studies; antibiosis. *Prerequisite:* Chemistry 131, 132 or departmental permission. Four hours. Mr. Sproston. Alternate years, 1973-74.

255 GENETICS AND CYTOGENETICS Advanced analysis of recombination in plants and animals. Molecular nature of meiotic processes and control of gene expression with particular reference to the nucleolus. *Prerequisites:* 101; Chemistry 16 or 131, 132. Three hours. Mr. Hyde.

256 CYTOLOGY Principles of structure in biological macromolecules and cellular organelles such as membranes, chloroplasts, and chromosomes. Their composition, origin and relationship between their structure and function. *Prerequisite:* Biology 103 or permission of the instructor; Chemistry 16 or 131, 132. Three hours. Mr. Hyde.

257 PHYSIOLOGY OF THE PLANT CELL Detailed study of photosynthesis, plant cell membrane function, and plant cell growth. *Prerequisites:* Botany 104; Chemistry 131, 132 or Chemistry 16; Physics 11, 12 or 15, 16; Four hours. Mr. Etherton and staff.

259 PLANT GROWTH AND DEVELOPMENT Chemical and physical factors regulating growth and development of plant tissues and the plant body. Morphogenesis and differentiation. *Prerequisites:* 104, departmental permission. Four hours. Mr. Klein. Alternate years, 1974-75.

260 PHYCOLOGY The morphology, classification and general biology of the algae, with special consideration of the freshwater forms. *Prerequisites:* 105 or 2 courses in Zoology or Botany above 100. Four hours. Mr. Cook. Alternate years, 1973-74.

270 BIOPHILOSOPHY AND SURVIVAL Biological rhythms, polarity,

holism, dichotomy, spirals, and their significance in evolution and survival. *Prerequisites:* two intermediate courses in botany or zoology and permission of the department. Three hours. Mr. Sproston.

281 BOTANY SEMINAR Presentations of personal research by faculty and graduate students from within and outside the University. Attendance required of botany graduate students and seniors in botanical research programs. Without credit. Staff.

295 SPECIAL TOPICS *Prerequisite:* permission of the department. Credit as arranged.

374 CYTOGENETICS (see Anatomy 374)

381 SELECTED PROBLEMS IN MODERN BOTANY Subject matter varies but will stress recent botanical inquiries, particularly where they border on mathematics, physics, and chemistry. *Prerequisite:* departmental permission. One to three hours credit. Staff.

391 MASTER'S THESIS RESEARCH Credit as arranged. Staff.

491 DOCTORAL THESIS RESEARCH Credit as arranged. Staff.

### • CELL BIOLOGY (Interdisciplinary)

Participating faculty are from the following departments: Botany; Biochemistry; Medical Microbiology; Medical Technology; Microbiology and Biochemistry; Pathology; Pharmacology; Physics; Physiology and Biophysics; Zoology.

An interdisciplinary program leading to M.S. and Ph.D. degrees in Cell Biology is offered under the direction of a committee composed of faculty members drawn from the participating departments. The program provides the flexibility necessary for a student to gain competence in the area of his choice. The extensive research facilities of the participating departments are available to all graduate students enrolled in the program. Inquiries should be directed to the Cell Biology Program Chairman, Dr. David Weller, Dept. of Microbiology and Biochemistry.

Research includes: structure and function of insect visual systems; pathogenesis of lung diseases using electron microscopy; biology and fine structure of mites and ticks; biochemistry and pathology of embryonic growth and development; cytology and cytochemistry of host-parasite interactions between algae and aquatic fungi; pathogenesis of viral infections and viral oncogenesis; population growth in fresh-water flatworms; electrophysiology of plant cells; biochemistry of plant proteins; plant cytogenetics and ultrastructure; establishment of bilateral symmetry in amphibian eggs; cellular contributions in regeneration; cell wall formation and salt secretion in marine monocotyledons; chloroplast morphology and physiology; consultant on biochemical capacity of microbial cells; electro-

#### **CELL BIOLOGY**

physiology of cultural cardiac cells; gene control during development; histological and histochemical studies of the reproductive cycle in the shrimp *Artemia*; protein metabolism in eukaryotic systems; nitrogen heterocycles, chemotherapy of neoplastic and protozoal diseases; physiological control of neural proteases, ribonucleases and esterases in normal and diseased skeletal muscle; synthesis and assembly of bacterial pili and their function in conjugation; biophysics of ultrasound; biochemistry of plant proteins; microbial ecology of Lake Champlain; control of cell division; biochemistry of conidial morphogenesis in fungi; mechanisms of cell division; structure and function of ribosomes; physical chemistry of nucleic acids and proteins; production and biology of naturally occurring carcinogenic compounds; biochemistry of iron-binding and transport proteins; biological mineralization and membrane function.

## PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Biology (3 semesters, including Genetics), Chemistry through Organic, Mathematics through Calculus, Physics (2 semesters). Satisfactory scores on Graduate Records Examination. Students who do not have all of the courses listed but who have a good academic record will be considered for admission to the program. Minor deficiencies can be made up after matriculation.

### MINIMUM REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

30 graduate credit hours which include the following courses or their equivalents; Botany 256 Cytology, or Anatomy 374 Cytogenetics; Zoology 231 Cell Physiology, or Botany 257 Physiology of the Plant Cell; Microbiology and Biochemistry 201 General Biochemistry, and 202 Advanced Biochemistry; other courses. In addition, thesis research, advanced courses in science or mathematics as appropriate to the student's program and regular participation in Cell Biology seminar.

### PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

15 graduate credit hours of courses as listed under Master of Science requirements. Minimum of one semester of Physical Chemistry, equivalent to Chemistry 140. Reading knowledge of French, German or Russian. Satisfactory completion of an oral qualifying examination administered by the Studies Committee with the participation of the Cell Biology faculty not later than the third semester in residence.

### MINIMUM REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Minimum of 20 additional hours of course work. Studies Committee will advise

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course selection. Thesis research, minimum 20 credits. Regular participation in seminar program.

### **COURSES OFFERED**

- 381 SEMINAR One hour. Staff.
- 391 MASTER'S THESIS RESEARCH Credit as arranged. Staff.

491 DOCTORAL THESIS RESEARCH Credit as arranged. Staff.

### CHEMISTRY

Professors Flanagan, Gregg, Kice (Chairman), Krapcho, Kuehne and White; Associate Professors Allen, Whitcher and Wulff; Assistant Professors Brown, Strauss, Weltin.

Current research in organic chemistry includes studies on organic sulfur compounds; the nucleophilic reactions of bivalent carbon species; the reactivity of spiro systems; the synthesis of naturally occurring compounds; problems relating to biogenesis; mechanisms of aromatic rearrangements; molecular orbital correlation of reactivity; enzyme studies; neighboring group participation; nucleophilic aromatic substitution; molecular complexes.

Physical chemistry research projects include heterogeneous kinetics the thermodynamics of hydrogen-palladium systems; electrochemical studies; aqueous and non-aqueous solution thermochemistry; cryogenic calorimetry; and quantum mechanical calculations for small molecules.

Research in inorganic chemistry includes investigations of coordination complexes, and studies of the syntheses, structures, reactivities, and spectroscopic properties of phosphorus-nitrogen and sulfur-nitrogen compounds.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE FOR TEACHERS OF PHYSICAL SCIENCES

The requirements for admission to candidacy for the degree of Master of Science for Teachers of Physical Sciences are: (1) Completion of at least one full year of teaching, (2) Successful completion of Physics 128, Chemistry 131 and 141, and Mathematics 121, or their equivalents. (These courses may have been taken at the undergraduate level, as part of this graduate program, or credit may be obtained by transfer or examination.) Satisfactory scores on the Graduate Record Examination.

### MINIMUM REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE FOR TEACHERS OF PHYSICAL SCIENCES

The above prerequisites for admission to candidacy must be supplemented by: (1) Completion of thirty hours of credit, of which at least eighteen must be in

#### CHEMISTRY

Physical Sciences Option (A) or (B) as described below. The remaining twelve credits may be chosen, with the consent of the Joint Advisory Committee, from appropriate courses above 100 in science, engineering, mathematics and education (Credit in education courses is limited to six semester hours.) (2) Successful completion of a comprehensive examination administered by the Joint Advisory Committee.

Physical Sciences Option (A): Nine semester hours of Physics numbered 128 and above, Chemistry 212 and six semester hours of Chemistry chosen from Chemistry 142, 213, 201, 246 and 251. This option is primarily for teachers of chemistry.

Physical Sciences Option (B): Nine semester hours of Chemistry numbered 131 and above and nine hours of Physics in courses numbered above 200. This option is primarily for teachers of Physics.

### PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

The requirements for admission to candidacy for the master of science degree are: (1) proficiency in three areas of chemistry evidenced by the biannual qualifying examinations or completion of designated courses at this university; (2) one semester of residence; (3) at least fifteen hours of formal course work including (a) six hours of graduate-level courses in the chemical field of specialization, (b) three hours of graduate-level chemistry courses not in the area of concentration, (c) Chemistry 372 (only for those electing Option A) (d) Chemistry 381-382 (Seminar), and (e) Chemistry 212; and (4) maintenance of an overall point-hour ratio of 3.00. Students studying in the master of science degree program are advised to take the cumulative examinations in their specialty.

### MINIMUM REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

The above prerequisites for admission to candidacy must be supplemented in either of the following two ways:

*Plan A:* (1) Completion of 12 hours of Masters Thesis Research (Chemistry 391) and submission of a satisfactory thesis; (2) completion of at least 30 hours of graduate credit (courses and Masters Thesis Research); and (3) Chemistry 383-384 (Seminar).

*Plan B:* (1) Completion of 6 hours of Independent Literature Research Project (Chemistry 375); (2) completion of at least 30 hours of graduate credit (courses and Literature Research Project); and (3) Chemistry 383-384 (Seminar).

An M.S. student should decide at the beginning of his program whether he

will pursue Option A or Option B and inform the department and Graduate College of his decision.

A reading knowledge of German is also expected.

### PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

It is expected that a student will ordinarily complete the following requirements for admission to candidacy by the end of his second year of residence: (1) at least fifteen hours of research (Chemistry 491-493); (2) satisfactory performance in the cumulative examinations in his specialty field; (3) demonstration of basic competence in three fields of chemistry (inorganic, organic, and physical) through the biannual qualifying examinations or completion of prescribed courses at the University of Vermont; (4) three hours of teaching; (5) one year of residence; (6) The following courses are required: Chemistry 372, and 381-384. No other courses are required, nor is any fixed number of course credits required. Each student's program will be determined by a departmental studies committee on the bases of qualifying examination performance, background, and research interests. In the normal course of events a student should expect to devote much of his first year to formal course work, and (7) maintenance of an overall point-hour ratio of 3.25.

### MINIMUM REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

In addition to the above requirements a student must: (1) complete his doctoral research, write an acceptable thesis, and defend it; (2) present a total of 75 hours of credit in course work and thesis research, and (3) make an oral and written presentation of an original research proposal (at least six months prior to the submission of the thesis). The student must also demonstrate a reading knowledge of scientific German and of either French, Russian or computer programming.

### **COURSES OFFERED**

201, 202 ADVANCED CHEMISTRY LABORATORY Modern analytical, physical and synthetic techniques. Syntheses requiring advanced methods such as controlled atmosphere box, autoclave, etc. Development of techniques used for measurement of a variety of phenomena, e.g. thermochemistry, kinetics, electrochemistry, spectroscopy. Students wishing to take one semester only may concentrate in a particular area of interest, such as instrumental analysis. *Prerequisite:* Chem 11, 12 or 123; credit for or concurrent enrollment in 141 and 142. Four hours each semester. Messrs. Allen, Brown, Flanagan and Wulff.

#### CHEMISTRY

212 ADVANCED INORGANIC CHEMISTRY Electronic structure of atoms and molecules; valence bond and molecular orbital treatments of chemical bonding; inorganic stereochemistry; ionic crystals; inorganic thermochemistry; inorganic equilibria in solution; theories of acids and bases. *Prerequisite:* 141 or the equivalent. Three hours. Mr. Brown.

213 ADVANCED INORGANIC CHEMISTRY Descriptive chemistry of the elements and of various classes of inorganic compounds; electron deficient compounds; organometallic chemistry; inorganic reaction mechanisms. *Prerequisite:* 212 (or equivalent). Three hours. Mr. Allen.

231 PHYSICAL ORGANIC CHEMISTRY—PRINCIPLES Structure-reactivity relationships, molecular properties and their interpretation, Methods and results of investigations of mechanisms of common organic reactions. *Prerequisites:* 132; 142. Three hours. Messrs. White, Strauss or Krapcho.

235 MOLECULAR ORBITAL THEORY An introduction to the Huckel molecular orbital method. Energy levels and orbitals, molecular properties and their interpretation. Effects of substituents on electonic structure. Extensions of the Huckel method. *Prerequisites:* 132, 142, or equivalent. Three hours. Mr. Weltin.

242 CHEMICAL KINETICS AND MECHANISMS Theoretical and experimental aspects of chemical kinetics. Use of kinetics to deduce mechanisms of organic and inorganic reactions. Gaseous reactions, catalysis, isotope and solvent effects, chain reactions and very fast reactions. *Prerequisite:* 132, 142. Three hours. Messrs. Flanagan, Kice, Krapcho and White.

246 FUNDAMENTALS OF SPECTROSCOPY A general discussion of molecular spectroscopy, rotational and vibrational states of molecules, symmetry of vibrations; introduction to electronic spectra. *Prerequisite:* 142, Mathematics 124 or permission of the instructor. Three hours. Alternate years, Mr. Weltin.

247 INTRODUCTION TO QUANTUM MECHANICS General considerations of quantum mechanics. Development of techniques pertinent to the application of quantum mechanics to chemical problems. *Prerequisite:* 141, 142 or equivalent. Three hours. Offered as demand warrants. Mr. Weltin.

248 CHEMICAL THERMODYNAMICS Systematic study of the application of thermodynamics to chemical problems. Concepts of statistical thermodynamics to be introduced. *Prerequisite:* 141, 142 or equivalent. Three hours. Mr. Flanagan.

249 CHEMICAL STATISTICAL MECHANICS Development of statistical mechanics and its application to problems of chemical interest. *Prerequisite:* 141, 142 or equivalent; 247 recommended. Three hours. Alternate years, Mr. Mr. Wulff.

251, 252 ADVANCED ORGANIC CHEMISTRY Detailed discussion of fundamental principles and reactions in organic chemistry. Stereochemistry, conformational analysis, ring strain, reactivity criteria in the main reaction classes, reaction mechanisms, and important synthetic methods are discussed. *Prerequisite:* 132, credit for or concurrent enrollment in 141, 142, 251 for 252. Three hours. Messrs. Kuehne, Krapcho and Strauss.

282 ORGANOMETALLIC CHEMISTRY A systematic survey of the syntheses, properties, structures, bonding and reactions of organometallic compounds. Variation of the structure and stability of the metal-carbon bond throughout the periodic system. *Prerequisite:* 212. Three hours. Messrs. Allen and Brown. Alternate years.

284 PHYSICAL INORGANIC CHEMISTRY Ligand field theory, magnetic properties, magnetic resonance techniques (NMR, ESR, and NQR), Mossbauer spectroscopy, and optical activity. *Prerequisites:* 213 or equivalent, 246 or permission of the instructor. Three hours. Alternate years. Mr. Allen.

332 NATURAL PRODUCTS—THE ALKALOIDS The major classes of alkaloids will be surveyed from a biogenetic point of view. Classical and modern degradation methods, total syntheses and biosynthetic incorporation of labeled compounds will be discussed. *Prerequisite:* credit or concurrent enrollment in 252 or permission of the instructor. Three hours. Alternate years. Mr. Kuehne.

334 NATURAL PRODUCTS—THE TERPENES The chemistry of monosesquidi and triterpenes, including degradations, structure proofs, total syntheses, rearrangement reactions and biogenesis. *Prerequisite:* credit or concurrent enrollment in 252 or permission of the instructor. Three hours. Alternate years. Mr. Kuehne.

336 SPECIAL TOPICS IN ORGANIC CHEMISTRY Advanced level discussion of specific topics in organic chemistry of current interest such as photochemistry, carbenes, bio-organic chemistry, magnetic resonance, etc. *Prerequisite:* permission of instructor. Credit as arranged. Staff.

344 QUANTUM CHEMISTRY Applications of quantum mechanical techniques to problems of chemical interest. *Prerequisite:* 247. Three hours. Offered as occasion warrants. Mr. Weltin.

345 SPECIAL TOPICS IN PHYSICAL CHEMISTRY Advanced level discussion of specific topics in physical chemistry and chemical physics; group theory, solid state theory, irreversible thermodynamics, solution theory. Credit as arranged. Offered as occasion warrants. Staff.

350 SPECIAL TOPICS IN INORGANIC CHEMISTRY Advanced theoretical treatment of bonding and of physical properties of transition metal complexes; detailed consideration of the chemistry of various classes or inorganic compounds; detailed treatment of inorganic reaction mechanisms. Credit as

#### CIVIL ENGINEERING

arranged. Offered as occasion warrants. Staff.

372 METHODS OF CHEMICAL INVESTIGATION Introduction to advanced modern chemical methods. *Prerequisite:* permission of department chairman. Two hours. Staff.

375 INDEPENDENT LITERATURE RESEARCH PROJECT Reading and literature research culminating in the preparation of a comprehensive and critical review of a topic of current interest in chemistry. Credit as arranged. Staff.

380 RESEARCH PROBLEM CONCEPTION AND SOLUTION Independent origination of research problems and the methods of their solution. Required of all doctoral candidates. *Prerequisites:* Two years of graduate work and permission of department chairman. One hour. Staff.

381 SEMINAR Current problems and literature. One hour. Staff.

391 MASTER'S THESIS RESEARCH Credit as arranged. Staff.

491 DOCTORAL THESIS RESEARCH Credit as arranged. Staff.

### • CIVIL ENGINEERING

Professor Oppenlander (Chairman); Associate Professors Dawson, Downer and Fay; Assistant Professor Olson. Engineer Dunham; Adjunct Professors Kiley and Knight; Adjunct Assistant Professor Stearns.

The Department of Civil Engineering is presently conducting research in environmental engineering, structures, transportation, urban planning, soil mechanics, and construction engineering.

### PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

A Bachelor's degree and the approval of this Department. Additional course work may be required of candidates who lack a strong science background.

#### **MINIMUM DEGREE REQUIREMENTS**

The above prerequisites for acceptance to candidacy must be supplemented in either of the two following ways.

*Plan A:* Completion of advanced courses in civil engineering, mathematics, other approved courses and six to nine hours of thesis research for a total of thirty hours.

*Plan B:* Completion of thirty-six hours of advanced courses in civil engineering, mathematics, and other approved courses in lieu of the thesis. The student should decide which option he intends to pursue at the beginning of his program.

### **COURSES OFFERED**

200 MECHANICS OF MATERIALS II The study of stresses and strains at a point under plane and three-dimensional loading using Mohr's circle; failure theories and energy methods; and plastic design and buckling of plates and shells. *Prerequisite:* 172 or concurrent enrollment. Three hours. Staff.

210 AIRPHOTO INTERPRETATION Techniques in aerial photographic interpretation; principles of stereoscopic viewing and identification of the airphoto features related to landform, vegetation, drainage, soil color tone, and topography; and the use of airphoto interpretation in soil identification. Three hours. Mr. Olson.

220 CONSTRUCTION ENGINEERING Discussion of construction processes; relationship of techniques to design details and specification requirements; sequence studies by means of CPM and PERT; measurements of construction efficiency, cost estimating, specifications, and case studies of local projects. Three hours. Mr. Dunham.

225 ENGINEERING ECONOMY Mathematical comparison of alternatives to maximize the financial return on engineering decisions and processes; project feasibility studies and design decision making; the effect of taxes on engineering decisions; and analysis of risk and uncertainty. Three hours. Staff.

226 CIVIL ENGINEERING SYSTEMS ANALYSIS Development of operations research techniques including linear and dynamic programming, inventory theory, replacement theory, queuing models, networks, and scheduling; procedures for solving complex problems; and application of systems analysis to problems in civil engineering. Three hours. Mr. Oppenlander.

230 URBAN PLANNING TECHNIQUES Theories on the size, spacing, and functions of cities; economic, social, and physical determinants of various land-use elements; basic studies for urban planning; and the process of landuse planning including location and space requirements and the development of the land-use plan. Three hours. Mr. Oppenlander.

231 URBAN PLANNING ANALYSIS History and development of urban planning; approaches to planning with attention to city design and appearance, quantitative methods in planning, and social welfare planning; plan implementation; organization and administration of planning agencies; and financial planning. Three hours. Mr. Oppenlander.

232 COMMUNITY DESIGN Basic principles and methods of planning and designing the total community; site selection and elements of physical layout and design. Design projects dealing with community elements such as subdivisions, industrial parks, new towns, etc. Three hours. Messrs. Oppenlander and Sargent.

#### CIVIL ENGINEERING

233 REGIONAL PLANNING (see Resource Economics 233).

240 TRAFFIC ENGINEERING CHARACTERISTICS Basic components of highway travel including driver, vehicle, roadway, environmental, and pedestrian characteristics; traffic flow and intersection characteristics; highway and intersection capacities; performance of traffic systems; and techniques for measuring traffic characteristics. Three hours. Staff.

241 TRANSPORTATION SYSTEMS ENGINEERING Interdisciplinary aspects of transportation systems and their technological characteristics; mathematical analysis and synthesis of system problems; economic consideration of transportation; fiscal studies and financial planning; and administration of transportation systems. Three hours. Staff.

242 TRAFFIC ENGINEERING OPERATIONS Design and application of traffic control devices including signals, signs, and markings; regulation of traffic flows, speeds, and parking; safety engineering; design of off-street parking facilities; design of street lighting, and evaluation of traffic engineering improvements. *Prerequisite:* 240. Three hours. Staff.

243 HIGHWAY GEOMETRIC DESIGN Theory and practice of geometric design for rural and urban highways; route location; design controls and standards, and design of geometric elements including sight distance, horizontal and vertical alinements, cross-section, intersections and interchanges. Three hours. Mr. Oppenlander.

244 URBAN TRANSPORTATION SYSTEMS Transportation planning process for urban areas; inventory, use, and desire studies for urban transportation; techniques of travel forecasting and trip generation, distribution, and assignment; planning, design, and operation of mass transit systems; location and design of terminal facilities. Three hours. Mr. Oppenlander.

250 DESIGN OF WATER TREATMENT FACILITIES Design of treatment systems to provide water for domestic and industrial use; source evaluation, demand projections, specific treatment processes, distribution systems, economics; and case studies. *Prerequisite:* 150. Three hours. Staff.

251 DESIGN OF WASTEWATER TREATMENT FACILITIES Design of treatment systems for processing wastewaters from municipal and industrial sources; and population projections, site location, collection systems, lift stations, choice and sizing of unit processes, specification writing, cost estimates, and bid document preparation. *Prerequisite:* 151. Three hours. Staff.

252 INDUSTRIAL WASTE DISPOSAL Fundamental chemical, physical, and biological processes employed in treatment and disposal of pollutants from the following industries: mining and metal processing, refinery and petrochemical, pulp and paper, food and meat processing, textiles, and electric generation. *Prerequisite:* 151. Three hours. Staff.

253 AIR POLLUTION ABATEMENT Identification of specific air pollutants and their effects on humans, plants, and materials; concepts, principles, and

application of air pollution control processes; and electrostatic precipitation, scrubbing, cyclonic separation, filtration, absorption, catalytic oxidation, and dispersion. *Prerequisite:* Chemistry 5 and Physics 25. Three hours. Staff.

254 SOLID WASTES The significance of solid wastes generated from municipal, industrial, agricultural, and mining sources; the optimization and design of collection, disposal, and/or recycle systems; and sanitary landfills, incineration, composting, and material recovery. *Prerequisite:* Chemistry 5 and Physics 25. Three hours. Staff.

255 UNIT OPERATIONS OF WATER AND WASTEWATER TREAT-MENT Examination of major physical, chemical, and biological processes used in treating water and wastewater; theory and methods of obtaining data from bench through full scale units; analysis of data to obtain process optimization and design. *Prerequisite:* 150, 151. Three hours. Staff.

260 HYDROLOGY The basic theory of precipitation, run-off, infiltration, and ground water; precipitation and run-off data; and application of data for use in development of water resources. *Prerequisite:* 160 or Mechanical Engineering 142. Three hours. Mr. Downer.

261 OPEN CHANNEL FLOW Application of the basic laws of fluid mechanics to flow in open channels; boundary layer theory; design of channels and transition structures; non-uniform flow; and non-uniform, spatially-varied flow problems. *Prerequisites:* 160, Mathematics 271. Three hours. Mr. Downer.

263 MEASUREMENTS IN APPLIED HYDROLOGY Design of hydrologic experiments; observational methods, equipment and problems in data reduction and handling techniques; and application to the instrumentation and study of the hydrology of a small watershed. *Prerequisite:* 163 or 260. Three hours. Mr. Downer.

270 INDETERMINATE STRUCTURES II Analysis of trusses with redundant members; elastic weights and column analogy methods for indeterminate frames; energy methods for curved frames and closed rings; arch theory; and cable analysis. *Prerequisite*: 171. Three hours. Mr. Eldred.

271 PRESTRESSED CONCRETE STRUCTURES Ultimate strength theory for concrete structures with emphasis on prestress effects; prestressed beam analysis, load balancing methods, column and pile design, bent analysis, yield-line theory, and circular prestressing in domes and tanks; and discussion of current design specifications. *Prerequisite:* 173. Three hours. Mr. Dunham.

280 APPLIED SOIL MECHANICS Use of soil mechanics in the evaluation of building foundations, braced excavations, earth structures, lateral earth pressures, pile foundations, pier and caisson foundations, slope stability, and construction problems. *Prerequisite:* 180. Three hours. Mr. Olson.

281 HIGHWAY AND AIRPORT PAVEMENT DESIGN Structural design of

#### CIVIL ENGINEERING

flexible and rigid pavements; types of wheel and axle configurations; frost action; design of bases and subbases; theory of stresses; methods of design; and pavement evaluation. *Prerequisite:* 140, 180. Three hours. Mr. Olson.

282 ENGINEERING PROPERTIES OF SOILS Study of soil properties that influence the engineering behavior of soils; subject areas include soil mineralogy, physiochemical concepts, plasticity properties, permeability, and compaction; and laboratory study of soil index properties, permeability, and compaction tests. *Prerequisite:* 180. Three hours. Mr. Olson.

283 ADVANCED ENGINEERING PROPERTIES OF SOILS Detailed study of soil properties that affect the compressibility and shear strength of natural soil deposits. Laboratory work includes extensive studies of consolidation and compressibility and use of the latest methods of shear strength determination. *Prerequisite:* 282. Three hours. Mr. Olson.

284 THEORETICAL SOIL MECHANICS Theories of soil mechanics, failure conditions, mechanical interaction between solids and water; and problems in elasticity and plasticity pertaining to earth masses. *Prerequisite:* 180. Three hours. Mr. Olson.

290 ENGINEERING INVESTIGATION Independent investigation of a special topic under the guidance of a staff member. Preparation of an engineering report is required. Three hours. Staff.

300 ADVANCED MECHANICS OF MATERIALS The theory of elasticity with applications to curved beams, combined stresses, torsion of non-circular sections, and relaxation procedures. *Prerequisites:* 100, Mathematics 271. Three hours. Staff.

301 PHOTOELASTICITY Development of the theories of photoelastic stress analysis; model similitude; correlation with other stress analysis techniques; and laboratory work on two-dimensional applications such as stress concentrations around holes, notches, and fillets. *Prerequisites:* 100, Mathematics 271. Three hours. Staff.

333 ADVANCED REGIONAL PLANNING (See Resource Economics 333).

360 ADVANCED HYDROLOGY Application of statistics to problems in engineering hydrology; the concept and use of the instantaneous unit hydrograph; study of run-off models; flow through porous media; and design techniques for water resources projects. *Prerequisites:* 260, Mathematics 271. Three hours. Offered as occasion warrants. Mr. Downer.

370 ULTIMATE STRENGTH DESIGN Development of ultimate load theory, virtual work, and statistical methods of analysis; design of structural steel and reinforced concrete structures by ultimate load methods; and consideration of shear, axial force, buckling, and rotation capacity. *Prerequisites:* 172, 173. Three hours. Staff. 372 STRUCTURAL DYNAMICS The study of Coriolis acceleration; gyroscopic forces; dynamic measurements; and vibrations, earthquakes, and blast shocks on structures. *Prerequisites:* 172, 173, Mathematics 271. Three hours. Staff.

390 ADVANCED TOPICS IN CIVIL ENGINEERING Special topics to intensify the programs of graduate students in civil engineering. Hours and credits to be arranged. Staff.

391 MASTER'S THESIS RESEARCH Credit as arranged.

### • CLASSICS

Professors Ambrose (Chairman), Bliss, Davison, Gilleland; Associate Professor Schlunk.

Current research interests include Early Greek Literature; the Attic orators; Greek Drama; archaeology; philosophy; Mycenaean and Homeric Greece; Hellenistic economics; political theory; Cicero's rhetorical works; Vergil; Caesar; lyric and elegiac poetry; the Roman conquest of Greece; Roman provincial administration; Etruscology; urban topography; satire; medieval studies.

### **PREREQUISITES FOR ACCEP**TANCE TO CANDIDACY FOR THE **DEGREE OF MASTER OF ARTS**

An undergraduate major or minor or the equivalent; a reading knowledge of French or German.

### MINIMUM DEGREE REQUIREMENTS

Eighteen hours of advanced courses in Greek or Latin, six hours of which must be 381; 6 additional hours in Greek or Latin, History or Philosophy; thesis research (normally 6 hours).

Those who hope for the department's recommendation to go on for a Ph.D. elsewhere must show competence in both German and French by the end of their first year of graduate study. All students must demonstrate an acceptable knowledge of the Greek and Latin languages and of Greek and Roman history.

A program is also offered leading to the degree of Master of Arts in Teaching: Cf. p. 24. Satisfactory scores on the Graduate Record Examination are prerequisite for acceptance to candidacy for this degree.

#### CLASSICS

### **COURSES OFFERED**

### GREEK

201 GREEK ORATORS Selected speeches of Lysias and Demosthenes. Three hours. Alternate years, 1973-74. Mr. Gilleland.

202 GREEK COMEDY Two plays of Aristophanes. Three hours. Alternate years, 1972-73. Mr. Ambrose.

203 GREEK HISTORIANS Thucydides, Books I and II; selections from Herodotus and Xenophon's *Hellenica*. Three hours. Alternate years, 1972-73. Mr. Bliss.

204 GREEK TRAGEDY Sophocles' Antigone and Euripides' Medea, or two equivalent plays. Three hours. Alternate years, 1973-74. Mr. Ambrose.

205 GREEK PHILOSOPHERS Plato, *Republic*, Books I and II; selections from the Pre-Socratics and from Aristotle. Three hours. Alternate years, 1972-73. Mr. Schlunk.

206 GREEK EPIC Readings in the *Iliad* and *Odyssey*. Problems of epic composition and language together with mythological and historical back-ground. Three hours. Alternate years, 1973-74. Miss Davison.

300 PRO-SEMINAR Introduction to philology. Students will normally take this their first semester. Three hours. Staff.

381 SEMINAR Intensive study at the graduate level of Greek authors not read in the candidate's undergraduate program. Credit as arranged. Staff.

391 MASTER'S thesis research credit as arranged. Normally total 6 hours.

#### LATIN

#### **COURSES OFFERED**

203 REPUBLICAN PROSE Extensive reading in Caesar and Sallust, and in the speeches of Cicero. Three hours. Mr. Gilleland.

204 EPIC POETS Extensive reading in Lucretius, Vergil, Ovid, and others. Three hours. Mr. Ambrose.

227 ROMAN LYRIC POETS Selections from the works of Catullus, Horace, Propertius, Tibullus. Three hours. Alternate years, 1972-73. Mr. Schlunk. 251 ROMAN LETTERS Selected letters of Cicero, Pliny and Fronto. Alternate years, 1973-74. Mr. Bliss.

252 COMEDY Two plays of Plautus and Terence. Study of the precursors of this literary form. Three hours. Alternate years, 1973-74. Mr. Bliss.

253 ROMAN ORATORY Selections from Cicero's *De Oratore, Orator, Brutus,* and from his speeches. Historical development of forensic and other rhetorical canons. Three hours. Alternate years, 1973-74. Mr. Gilleland.

### COMMUNICATION AND THEATRE

255 HISTORIANS OF THE EMPIRE Augustus, Res Gestae; Tacitus, Annals, I-IV; selections from Suetonius and Ammianus Marcellinus. Three hours. Alternate years, 1972-73. Miss Davison.

256 SATIRE Selections from Horace and Persius; Juvenal, Petronius. Study of the development of this literary form. Three hours. Alternate years, 1973-74. Mr. Gilleland.

271 SILVER LATIN Extensive reading of post-Augustan authors not included in other advanced courses. Three hours. Alternate years, 1972-73. Mr. Bliss.

300 PRO-SEMINAR Introduction to philology. Students will normally take this their first semester. Three hours. Staff.

381 SEMINAR Intensive study at the graduate level of Latin authors not read in the candidate's undergraduate program. Credit as arranged. Staff.

391 MASTER'S THESIS RESEARCH Credit as arranged. Normally total 6 hours.

### • COMMUNICATION AND THEATRE

Professors Feidner, Huber, Lewis, London (Chairman), Luse, Manchel; Associate Professors Lane, Wilson; Assistant Professors Bryan, Cronin, Haynes, Howell, Schenk, Shields, Toomey, Waite, Williams, Worden, Yadav; Instructors Cover, Dilley, Hayes, Petry; Lecturers Houghton, N. Smith; Coordinator Daruvala.

Current interests and research in the Department of Communication and Theatre include diagnostic-therapeutic programming; the effectiveness of the classroom teacher in improving articulation skills of school-age children; studies of the dialects of the people of Vermont; studies concerning cancer of the larynx and the rehabilitation of such individuals using esophageal speech; seasonal occurrence of cleft lip-cleft palate births in Vermont; using the chewing technique in habilitating persons with cleft palate; operant procedures as applied to stuttering; conceptual language disturbance in children and adults; the role of selected clinician variables on client verbal productivity; content analysis of speech therapy sessions; studies concerning the development of educational radio and television programming and networks; the development of the Champlain Shakespeare Festival; group communication in the classroom; mass media in Britain and Canada; cross-cultural communication; persuasive speaking in Vermont during the Civil War period; the effects of environment on communication.

### COMMUNICATION AND THEATRE

The department offers two master degrees: Master of Arts in Communication and Master of Science in Speech Pathology.

### PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS IN COMMUNICATION

An undergraduate major in communication (speech), or in a related field of the social sciences or humanities with the equivalent of a minor in communication; satisfactory scores on the Graduate Record Examination (aptitude only).

### MINIMUM DEGREE REQUIREMENTS

Thirty hours of graduate level courses including 12 hours in communication, 6 hours in thesis research, 12 hours in communication or in a related field.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE IN SPEECH PATHOLOGY

A minimum of 30 hours in speech pathology-audiology and selected areas to include 101, 281 (or their equivalents); a course in Child Psychology. These courses may be taken after a student is admitted to graduate study, but are prerequisite to degree candidacy, and will not be considered as a part of the 30 hours required for the Master's Degree. Satisfactory scores on the Graduate Record Examination (Aptitude only).

### **MINIMUM DEGREE REQUIREMENTS**

Thirty hours of graduate level courses including 18 hours in speech pathology and audiology, 6 hours in speech pathology or a related field; thesis research (6 hours). Undergraduate plus graduate courses must include 6 hours of audiology.

### **COURSES OFFERED**

201 THEORIES OF HUMAN COMMUNICATION The relationship of language, perception, thinking, and social context to human communication. *Prerequisite:* Nine hours of related courses, including 1. Three hours. Mr. Yadav.

210 CLASSICAL ORIGINS OF COMMUNICATION THEORY The points of view of outstanding writers of the classical period who have influenced human communication theory. *Prerequisite:* Nine hours of related courses. Three hours. Mr. Waite.

212 PERSUASIVE COMMUNICATION The study of recent research contributions to such areas as theories of persuasion, source credibility, and argument and controversy. *Prerequisite:* Nine hours of related courses including 111 or 112 or 113. Three hours. Ms. Williams.
#### COMMUNICATION AND THEATRE

213 THEORIES OF SPEECH ANALYSIS Principles and theories of rhetorical criticism applied to speakers and speech movements. *Prerequisite:* Nine hours of related courses. Three hours. Mr. Waite.

214 ISSUES IN AMERICAN PUBLIC ADDRESS Selected American speakers and speeches studied against the background of their lives and the issues of their times. *Prerequisite:* Nine hours of related speech courses, including 11. Three hours. Mr. Waite and Ms. Williams.

215 GROUP COMMUNICATION Each semester, one of the following topics will be studied in depth: (1) Group Communication Theory, (2) Leadership in Groups, and (3) Communication in Organizations, (4) Communication in the Classroom. *Prerequisite:* Nine hours of related courses, including 14. Three hours. May be repeated up to nine credit hours. Mr. Cronin.

223 INTERPERSONAL COMMUNICATION A study of human communication on the interpersonal level. *Prerequisite:* Nine hours of related courses, including 121. Three hours. Mr. Lewis.

225 CROSS-CULTURAL COMMUNICATION A study of the conceptual perspective and the basic fund of knowledge necessary for viewing those variables which are central to the study of cross-cultural communication. *Prerequisite:* Nine hours of related courses. Three hours. Mr. Yadav.

243 REPERTORY THEATRE OPERATION Lectures, research, observation and practical experience relating to the problems of producing Shakespeare in a repertory theatre. Special emphasis on the productions of the Champlain Shakespeare Festival. *Prerequisite:* consent of the instructor. May be taken up to nine hours. Staff.

245 THE CLASSICAL THEATRE An investigation of the earliest dramatic rituals and the theatres of Greece and Rome as evidenced by historical remains and extant dramas. *Prerequisite:* 39 plus 3 hours. Three hours. Mr. Bryan.

246 THE MEDIEVAL AND RENAISSANCE THEATRE An overview of the medieval and renaissance theatre, accompanied by an evaluation of relevant historical materials and representative dramas. *Prerequisite:* 39 plus 3 hours. Three hours. Mr. Bryan.

247 SEVENTEENTH AND EIGHTEENTH CENTURY THEATRE An intensive view of the dramas and theatrical conditions in Europe and America from the closing of the English theatres to the end of the eighteenth century. *Prerequisite:* 39 plus 3 hours. Three hours. Mr. Bryan.

248 NINETEENTH AND TWENTIETH CENTURY THEATRE An examination of the backgrounds, theatrical conventions, and dramas representative of Romanticism, Realism, and revolts against Realism. *Prerequisite:* 39 plus 3 hours. Three hours. Mr. Bryan.

## COMMUNICATION AND THEATRE

252 LIGHTING Theory and practice in the illumination of stage productions and the creation of aesthetic effects. *Prerequisite:* 151. Three hours. Mr. Schenk.

254 ADVANCED SCENE DESIGN Analysis of the drama from the standpoint of its visual creation upon the stage; audience-stage relationships, styles of production. *Prerequisite:* 154. Three hours. Mr. Schenk.

260, 261 SEMINAR IN MASS MEDIA An intensive examination of selected areas of study related to mass media. *Prerequisite:* Nine hours of related courses, including 63. Three hours, Mr. Howell and staff.

262 WRITING FOR MASS COMMUNICATION A comparative study of the principles of writing for the mass communications media. *Prerequisite:* nine hours of related courses, including 63. Three hours. Mr. Worden.

263 INTERNATIONAL MASS COMMUNICATION Mass media systems of other countries. *Prerequisite:* nine hours of related courses. Three hours. May be repeated up to 9 credit hours. Mr. London.

264 ADVANCED TELEVISON PRODUCTION Emphasis on the following types of programs; educational, news, documentary, dramatic and variety. Laboratory use of the ETV studio. *Prerequisite:* 164. Three hours. Mr. Dilley. 265 CINEMATOGRAPHY Advanced study of film expression and production of student films. *Prerequisite:* 167 or consent of the instructor. Three hours. Mr. Worden.

266 SEMINAR IN FILM A study of various topics, film criticism and research. *Prerequisite:* Nine hours of related courses, including 165 or 166. Three hours. May be repeated up to 9 credit hours. Mr. Manchel.

267 THE CONTEMPORARY CINEMA Lectures, screenings, and reports on modern filmmakers, recent trends and new techniques. *Prerequisite:* 6 hours of related courses, including 165 or 166. Three hours. Mr. Manchel.

268 THE BLACK MAN IN FILM A study of black artists in movies from 1895 to the present, with an emphasis on American films. *Prerequisite:* 6 hours of related courses, including 165 or 166. Three hours. Mr. Manchel.

270 LEARNING AND DEVELOPMENT OF SPEECH AND LANGUAGE Speech and language acquisition in relation to current learning theory and methods of linguistic analysis. *Prerequisite:* Nine hours of related courses. Three hours. Mrs. Wilson.

271 SPEECH PATHOLOGY I Etiology, symptomatology, and principles of habilitation for voice disorders (including the laryngectomized) and cleft palate. *Prerequisite:* Twelve hours of speech (including 281) and psychology. Three hours. Miss Luse.

272 SPEECH PATHOLOGY II The nature of articulation and the etiology, diagnosis, and treatment of disorders of articulation. *Prerequisite:* Twelve hours of speech (including 74, 101) and psychology. Three hours. Mr. Shields.

### COMMUNICATION AND THEATRE

273 PRINCIPLES OF AUDIOLOGY An introduction to clinical audiology including a consideration of hearing disorders, tests of the hearing function, and hearing conservation programs. *Prerequisite:* Twelve hours of speech (including 74) and psychology. Three hours. Mrs. Houghton.

275, 276 CLINICAL STUDY Supervised practicum experiences with children and adults presenting disorders of speech, hearing, and language. *Prerequisite:* Twelve hours in speech and hearing science courses, including 271 or 272; departmental permission. Credit as arranged. Staff.

281 ANATOMY-PHYSIOLOGY OF SPEECH Anatomy and physiology of speech and language processes. *Prerequisite:* nine hours of speech and psychology. Lectures and laboratory. Four hours. Mrs. Wilson.

282 ANATOMY-PHYSIOLOGY OF AUDITION Anatomy and physiology of the normal auditory system. Basic acoustics and subjective correlates of the auditory stimulus. *Prerequisite:* nine hours of speech and psychology. Four hours. Mr. Patterson.

283, 284 SEMINAR Discussion and research in the selected areas of communication and theatre. *Prerequisite:* departmental permission. Three hours. Staff.

294 SEMINAR FOR PROSPECTIVE TEACHERS OF COMMUNICATION A study of the resources, procedures and methods utilized in teaching the different areas of communication at the various instructional levels. *Prerequisite:* 12 hours. Three hours. Mr. London.

300 RESEARCH METHOD AND DESIGN Research method and design, bibliographical resources, and professional writing in the field of communication and theatre. Three hours. Mr. London.

365 ADVANCED CINEMATOGRAPHY An exploration of the limitations and possibilities of the motion picture medium through familiarization with equipment and production techniques. *Prerequisite:* 265. Three hours. Mr. Worden.

377 REHABILITATIVE AUDIOLOGY I: AMPLIFICATION; SELECTION AND USE Principles and rationale underlying clinical procedures in hearing aid selection. *Prerequisite:* 273. Two hours. Mrs. Houghton.

378 REHABILITATIVE AUDIOLOGY II: SPEECH-READING AUDI-TORY TRAINING Theories and methods for the development of speechreading skills and the effective use of residual hearing. *Prerequisite:* 273. Two hours. Mrs. Houghton.

379 REHABILITATIVE AUDIOLOGY III: PSYCHO-SOCIAL ASPECTS OF HEARING LOSS Perceptual, personal, and social problems of the hardof-hearing; theories, research, and management. *Prerequisite:* 273. Two hours. Mrs. Houghton.

381, 382 ADVANCED READINGS Readings, with conferences, intended to contribute to the programs of graduate students in phases of communica-

tion and theatre for which formal courses are not available. Credit as arranged, up to 3 hours each semester. Staff.

383 SEMINAR IN SPEECH PATHOLOGY An intensive study of selected topics in speech pathology. *Prerequisite:* 271, 272. Three hours. Staff.

385 SEMINAR IN VOICE Study of the research in voice production and speech. Application to pathological and non-pathological problems. *Prerequisite*: 271, 272. Three hours. Miss Luse.

386 SEMINAR IN CEREBRAL PALSY Etiology, pathology, diagnosis, and principles of habilitation of cerebral palsy and related conditions. Emphasis on disorders of oral communication and associated disturbances. *Prerequisite:* 271, 272. Three hours. Staff.

387 SEMINAR IN LANGUAGE DISORDERS Identification, evaluation, and rehabilitation procedures for the preschool and school-age child with language disabilities. *Prerequisite:* 270. Three hours. Mrs. Wilson.

388 SEMINAR IN STUTTERING Study of the research in stuttering relative to etiology and rehabilitation. *Prerequisite:* 271, 272. Three hours. Mr. Toomey.

389 SEMINAR IN APHASIA IN ADULTS Study of the symbolic and communicative disturbances in aphasic adults, principles and procedures in diagnosis, and a rationale for rehabilitation. *Prerequisites:* 271, 272. Three hours. Mr. Shields.

391 MASTER'S THESIS RESEARCH Credit as arranged. Staff.

## • ECONOMICS AND BUSINESS ADMINISTRATION\*

\*Economics and Business Administration will be split in two separate departments during 1973-4. At the time of this printing no further changes in prerequisites or course offerings are anticipated.

Professors Greif and Nyquist; Associate Professors Gross, Laber, Michael, Severance (Acting Chairman) and Squire; Assistant Professors Battelle, Gatti, Kuklis and Tashman.

## **BUSINESS ADMINISTRATION**

# **PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION**

Appropriate courses in accounting, marketing, industrial management, micro theory, macro theory, and statistics are required. Transcripts will be evaluated on an individual basis. Satisfactory scores on the Admissions Test for Gradu-

ate Study in Business. (ATGSB scores are acceptable in lieu of graduate record examination scores for financial assistance in this program.)

### **MINIMUM DEGREE REQUIREMENTS**

The above prerequisites for acceptance to candidacy must be supplemented in either of the following two ways:

*Plan A:* Economics 207, 228, 252 and 289; twelve hours chosen in the candidate's field of concentration; thesis research (6 hours).

*Plan B:* Economics 207, 228, 252 and 289; twelve hours chosen in the candidate's field of concentration; nine additional hours of courses approved by the department for a total of thirty-three hours.

Not more than six credit hours of graduate work completed prior to residency as defined on page 18 will be applied toward the degree requirements.

For course listings, see under Economics.

## ECONOMICS<sup>1</sup>

Professors Dellin (Acting Chairman) and Nadworny; Associate Professors Alnasrawi, Campagna and Chase; Assistant Professors Salgo and Wicker.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

Twenty-four hours in Economics, including eighteen hours in courses numbered above 100; twelve hours in a related field, including six hours in courses numbered above 100. Satisfactory scores on the Graduate Record Examination.

#### MINIMUM DEGREE REQUIREMENTS

Twenty-four hours in approved courses in Economics numbered above 200, including 295, 377 and 378; thesis research (6 hours).

#### **COURSES OFFERED**

206 PRINCIPLES OF INVESTMENTS An analysis of the investment process, including an examination of types of financial assets, the markets in which such assets are traded, and factors affecting their values. *Prerequisite:* 12 and 14. Three hours. Staff.

207 CORPORATE FINANCE A study of the sources of financing and the efficient utilization of funds by corporations. Topics include capital budgeting, capital structure, dividend policy, and problems of financing new business ventures, large and small. *Prerequisites:* 11, 12 and 14. Three hours. Mr. Battelle.

<sup>1</sup>Applications to this program are suspended for the present time.

216 ECONOMIC DEVELOPMENT Theories of economic growth applied to underdeveloped areas of the contemporary world, including the political and social determinates of economic progres. *Prerequisites:* 11, 12; 190 recommended. Three hours. Mr. Alnasrawi.

217 REGIONAL ECONOMIC GROWTH An inquiry into the processes of economic growth at the regional level; theoretical models of regional growth will be developed; the relationships among growth theory, international trade theory, and location theory will be analyzed and applied to regional growth. Empirical evidence on interregional factor movements (migration and capital flows) will be examined and related to historical patterns of income growth at the state level in the U.S. Research in areas of student interest. *Prerequisite:* 186, 190. Three hours. Mr. Laber.

228 CURRENT MARKETING DEVELOPMENTS Modern marketing theory and practice. Topics include: the nature of consumer changes; urban and suburban trading centers; the distribution cycle; marketing legislation; functional and institutional changes. *Prerequisite:* 122. Three hours. Mr. Greif.

229 MARKETING MANAGEMENT Formulation of overall policies and planning strategies for marketing programs. Product planning and development; channel selection; market and sales forcasts; advertising and sales campaigns. *Prerequisite:* 122. Three hours. Mr. Greif.

234 MONETARY THEORY Analysis of Classical, Keynesian, and modern macroeconomic models; micro and macro demand for and supply of money; portfolio choice; term structure of interest rates and the influence of financial intermediaries. *Prerequisite:* 190. Three hours. Mr. Severance.

238 ECONOMIC HISTORY OF MODERN EUROPE A comparative historical study of the process of the economic growth as experienced in Britain, France, Germany, and Russia since 1760. For the economic history of preindustrial Europe see History 237. *Prerequisites:* 12 and History 12. Three hours. Staff.

240 WAGE AND EMPLOYMENT THEORY Microeconomic theory dealing with the pricing of labor as an economic resource. Analysis of theoretical economic and behavioral models that attempt to explain the role and the effects of institutions on the wages, allocations, and levels of utilization of labor resources. *Prerequisites:* 186, 190; 141 highly desirable. Three hours. Mr. Chase.

241 MANPOWER IN AN ADVANCED ECONOMY Fundamental, changes in the structure of the American labor force; income, education, occupational distribution, and unemployment factors. Implications and impacts of Manpower Development and Training Act, Economic Opportunity Act, and other programs on manpower training and allocation. Income maintenance and manpower. *Prerequisite:* 141. Messrs. Chase and Nadworny.

251 PERSONNEL ADMINISTRATION Selecting and training employees; job analysis and evaluation; evaluating employees; wage and wage administration; problems of morale; human relations in the supervision of personnel. *Prerequisite:* 141. Three hours. Mr. Nadworny.

252 EXECUTIVE DECISION-MAKING Synthesis of the management and operation of a firm in terms of production, marketing, personnel, and finance; the process of decision-making; the planning and execution of policies. *Prerequisites:* 121, 143 and 207; a course in finance, or consent of instructor. Three hours. Messrs. Nadworny and Squire.

254 SCIENTIFIC MANAGEMENT AND LABOR Development of scientific management, and the reactions and relationship of organized labor to it; long range effects of scientific management on the structure and policies of industry and organized labor. *Prerequisite:* 143. Three hours. Mr. Nadworny.

256 AMERICAN BUSINESS HISTORY Evolution of firms and industries from relatively small and undifferentiated establishments to large, highly complex institutions of the present day. The roles of Federal and state governments and of legislation. Developments in American management. *Prerequisite:* 143 or consent of the instructor. Three hours. Mr. Nadworny.

258 PROBLEMS OF COMMUNISM A comparative study of economic and political problems of applied communism with particular emphasis on current developments in selected Communist countries. *Prerequisites:* 12 hours in history and/or other social sciences. Three hours. Mr. Dellin.

266 ADVANCED ACCOUNTING Accounting for partnerships, ventures, consignments, installment sales, insurance, statement of affairs, receivers, realization and liquidation, estates, trusts, home offices and branches, and parent and subsidiary accounting. *Prerequisite:* 162. Three hours. Mr. Nyquist.

267 INTRODUCTION TO ECONOMETRICS Classical least squares regression model; tests of significance; problems of the linear model—collinearity, identification, auto-correlation; introduction to FORTRAN programming and computer usage in econometric research; applied econometric research in areas of student interest, matrix algebra introduced as needed. *Prerequisites:* 188, 193, 186. Three hours. Mr. Laber.

271 AUDITING The theory and practice of auditing applicable to the work of the internal and external auditor, including auditor's responsibility, types of audits, and audit programs. *Prerequisite:* 162. Three hours. Mr. Nyquist.

272, 273 COST ACCOUNTING The nature of manufacturing costs and conventional methods of accumulating, summarizing, and interpreting them. Special problems in job order, process and standard costs. Second semester, joint and by-product costs; problems of waste and spoilage; inventory plan-

ning, capital budgeting; accounting systems including EDP; statistical methods and operations research. *Prerequisite:* 14, 272 for 273. Three hours. Mr. Nyquist.

276 C.P.A. PROBLEMS Review of questions and problems from past C.P.A. examinations, including partnerships, corporations, financial statements, auditing, cost accounting, insolvencies, receiverships, liquidations, consolidations, estates, trusts, governmental and institutional accounting methods. *Prerequisite:* 162. Three hours. Mr. Nyquist.

277 INTRODUCTION TO OPERATIONS RESEARCH Application of quantitative techniques to the formulation and solution of economic and business problems. Topics include forecasting methods, linear programming, inventory and queuing theory. *Prerequisite:* 188. Three hours. Mr. Gross.

285 COMPARATIVE ECONOMIC SYSTEMS Major economic systems, their theoretical models, basic institutions and practical varieties, from a comparative point of view. *Prerequisites:* 11, 12 and six hours in another social science. Three hours. Mr. Dellin.

289 QUANTITATIVE METHODS IN BUSINESS The application of statistical tools to industrial problems. Topics covered include control charts, sampling plans, index numbers and measurement of trends. *Prerequisites:* 188; Mathematics 8 or 11. Three hours. Mr. Gross.

290 THE SOVIET ECONOMY An analysis of the economic development of the USSR, its structure, performance, and direction. *Prerequisites:* 11, 12; twelve additional hours in economics, political science or European history. Three hours. Mr. Dellin.

291 ECONOMIC PATTERNS AND POLICIES OF EASTERN EUROPE An area approach to the resources, organization, and domestic and foreign economic policies of the Communist countries of Eastern Europe, with special emphasis on recent changes. *Prerequisites:* 11, 12; twelve additional hours in economics, political science or European history. Three hours. Mr. Dellin.

292 INTERNATIONAL ECONOMIC PROBLEMS AND POLICIES Changing patterns of the international economy; important aspects of international cooperation and conflict in the economic sphere; growth and stability on global basis; regional and interregional developments. *Prerequisite:* 12. Three hours. Mr. Alnasrawi.

293 WEST EUROPEAN ECONOMIES A study of the evolution of the economic systems of West European countries, with particular emphasis on the Common Market and its foreign Economic relations. *Prerequisite:* 12 and six hours in another social science. Three hours. Mr. Dellin.

295 DEVELOPMENT OF ECONOMIC THOUGHT Development of economic ideas. The pre-Classical, Classical, Socialist, Neo-classical, Keynesian Schools and individual theoreticians. *Prerequisite:* 186 and 190 or concurrent enrollment. 190 recommended. Three hours. Messers. Chase and Dellin.

## ECONOMICS OF NATURAL RESOURCE PLANNING

297, 298 SEMINAR Review of recent books and periodical literature; discussions and reports on topics of contemporary interest. *Prerequisite:* permission of the department. Three hours. Staff.

300, 301 INDEPENDENT READING AND RESEARCH Designed to meet the special research problems of graduate students. *Prerequisite:* twelve graduate credits. Credit as arranged. Staff.

303 ADVANCED PUBLIC FINANCE Economic analysis of the public sector. Emphasis is on the application of economic theory to the problems of public finance; incidence theory, optimal allocation of resources, debt management, the effect of various tax considerations upon investment theory, and fiscal policy as a component of full-employment theory. *Prerequisites:* 190 and 186, or the equivalent. Three hours. Mr. Tashman.

341 MANAGERIAL ECONOMICS AND OPERATIONS RESEARCH Techniques used in management decision making and forward planning. Operations research techniques and advanced quantitative methods applied to operating problems in business. *Prerequisites:* Economics 186 and 289. Three hours. Staff.

367 ADVANCED ECONOMIC STATISTICS AND ECONOMETRICS Theories and techniques of statistical analysis; probability, sampling, design of experiments, tests of statistical hypotheses, statistical estimation, regression, correlation, statistical demand and cost functions, econometric methods and models as tools of structural analysis, and economic projections. *Prerequisites:* Math 11-12 and Economics 267. Three hours. Staff.

377 ADVANCED MICROECONOMIC THEORY Advanced microeconomic models presented and analyzed. Advanced market structure theories, theory of games, general equilibrium, and dynamic methods. *Prerequisite:* 186. Three hours. Mr. Laber.

378 ADVANCED MACROECONOMIC THEORY Advanced macro models presented and analyzed. Models of economic growth, general equilibrium and economic dynamics; theory and empirical results. *Prerequisites:* 186, 190. Three hours. Mr. Campagna.

391 MASTER'S THESIS RESEARCH Credit as arranged.

The ECONOMICS RESEARCH CENTER is an agency for conducting fundamental and practical research in the area of economic development and a clearing house for the compilation, analysis, and dissemination of economic information. Studies such as measurement of prices, industrial output, transportation, and other trends in the State, as well as of marketing trends, labor force, employment changes, industrial development, business location, economic growth, and allied areas in the State or region or the nation will be undertaken. The Economics Research Center is intended as a resource organization for the disciplined conduct of research as well as an established source of information for University personnel, governmental, and private groups.

#### EDUCATION

## • ECONOMICS OF NATURAL RESOURCE PLANNING

See Resource Economics

## EDUCATION

Professors Boller, Corrigan, Fishell, Gobin, Hunt, Leggett and Rippa; Associate Professors Carlson, Case, Fox, Hanley, Lang, Larson, McKenzie, Nash, Nichols, Peterson, Petrusich, Stocker, Wheeler; Assistant Professors Abruscato, Agne, Bright, Burrell, Christensen, Clements, Conrad, Dunkley, Erb, Greig, Lange, Marchant, McEntee, Moore, Nedde, Ponzo, Rathbone, Shiman, Soderverg, Tong; Instructors Burdett, Christie, Egner, Greenberg, Knight, Kusiak, Lates, Paolucci, Perelman, Royce, Schneider, Slack, Smith, Szabo, and Watson.

The College of Education offers numerous opportunities for graduate study in preparation for special competencies in a variety of fields which include practicums, research problems, and in-service relationships with cooperating school systems. The programs in various areas of specialization are described below.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF EDUCATION

Eighteen hours of Education and related areas or appropriate professional certification and satisfactory score on the Graduate Record Examination. (Aptitude only). The Education course prerequisites do not apply to the Student Personnel Services in Higher Education Program.

## MINIMUM DEGREE REQUIREMENTS

Eighteen hours in courses in Education numbered above 200, including a minimum of six graduate hours in the foundations of education, 12 additional hours in approved courses or 6 additional hours and thesis research; a year of successful experience in teaching or in a related educational activity.

## AREAS OF SPECIALIZATION

The College of Education is in the process of reorganization in order to facilitate new options and opportunities for graduate students. The Organizational and Human Resource Development Program area is a result of merging Administration and Planning, Counseling, and Student Personnel Services in Higher Education Programs. In addition to the areas of specializations listed below, students desiring to design an interdisciplinary major that draws from each of the specializations may do so in consultation with hir/her advisor. Inquiries regarding this program and the specializations should be addressed to Associate Professor, Robert V. Carlson.

#### Administration and Planning

This program area is designed to prepare educational administrators and planners for public schools, educational agencies, administrative positions in higher education and social agencies. The M.Ed. Program usually requires 30-36 credit hours of courses, seminars, practicums, and research to complete. The C.A.S. Program usually requires 30-36 credit hours of intensive study beyond the M.Ed. requirements.

Courses in administration include 295, 332, 335, 337, 352, 353, 354, 355, 356, 357, 358, 391, and 397.

#### Counseling

This degree program provides preparation for the individual who intends to become a school counselor, a director of pupil personnel services, or a counselor in another setting. The program covers three broad areas including courses to assist the candidate to understand the foundations and dynamics of human behavior within the social context, courses to aid the candidate in understanding the foundations of education and the organizational structures of institutions of learning, and courses which provide understanding of the professional aspects of the work of the counselor and which assist the candidate in the refinement of skills necessary for competence in helping relationships, whether individual or group. There is emphasis upon the implementation of theory in practice with opportunities provided for student-counselors to work in real-life settings with supervision.

Courses in the Counseling program include: 220, 221, 295, 350, 351, 370, 374, 381, 383, 384, 386 and 388.

In addition to the general admissions procedures, a personal interview is required for this program.

#### Student Personnel Services in Higher Education

This program area is aimed at providing a general background for the individual who is preparing himself to work within the broad area of student personnel services. The focus of the program covers three broad areas; 1) the foundations and dynamics of human behavior and of the individual in his culture; 2) the foundations of education, and 3) professional studies in student personnel work and higher education. The program allows flexibility for the student to choose courses which would strengthen his major area of interest, i.e., admissions, housing, student activities, financial aid, counseling, placement and others. Pre-requisites for this program are individualized dependent upon the student's goal.

Courses in the student personnel services program include: 220, 295, 319, 360, 362, 374, 383, 385, 387 and 397.

#### **EDUCATION**

In addition to the general admissons procedures, a personal interview is required for this program.

#### Foundations of Education

This degree program area is designed to meet the personal-professional needs of the following students: (1) research scholars who wish to undertake protracted and intensive study of education as a disciplined, systematic field of inquiry; (2) in-service teachers and community college educators who are interested in the broad theoretical foundations of education, beyond specific specialization; (3) administrators, school-board members, and community leaders who wish a broad background in the theoretical-practical underpinnings of education; (4) laymen who wish to study broadly the field of education in order to make reasoned and critical judgments about the many educational proposals to which they are constantly exposed; (5) professionals outside the field of education (for example, journalists, writers, clergymen, businessmen) who want a general, multi-disciplinary understanding of education in all of its components; and (6) innovators who are interested in critical, in-depth studies of alternative educational structures (for example, inner-city and rural community schools), and (7) individuals concerned with international education and service to developing countries.

Courses in foundations of education include 202, 204, 205, 206, 252, 254, 255, and 277.

Inquiries regarding this program should be addressed to Professor S. Alexander Rippa.

#### Reading and Language Arts

The purpose of this program area is to prepare teachers and specialists in the field of reading. Classroom teachers, reading specialists or consultants, supervisors and administrators are responsible for developing programs which will enable every student to attain his maximum proficiency in the use of reading and language. To meet this end several courses have been devised with focus on both classroom reading instruction and reading difficulties. Through the Reading Center program students also have opportunities for laboratory experiences as well as for research and study in reading, literature, and language arts.

Courses in reading and language arts include: 222, 223, 234, 275, 276, 378, and 379.

Inquiries regarding this program should be addressed to Professor Lyman Hunt.

#### Special Education

This program area is designed to prepare consulting teachers in special education. Only those applicants who intend to be full-time graduate students

will be accepted. Although the minimum requirements for this degree are 30 credit hours, including six hours of foundations of education, candidates will generally complete 60 credit hours of course work, laboratory experience, and internship. Thus, each candidate should expect to spend one summer and two additional academic years in full-time study.

Courses in special education include: 216, 224, 295-298, 310, 312, 316 and 319.

Inquiries regarding this program should be addressed to Associate Professor Hugh McKenzie.

#### **Teacher** Education

This program area is designed to develop leadership in such educational fields as teaching, curriculum and research for elementary and secondary school teachers.

Programs are developed to provide a comprehensive background in the fields basic to teaching, as well as an application of that knowledge to a special field. They include courses aimed at the improvement of instruction in subjects taught in the elementary and secondary schools, an understanding of the principles and problems involved in curriculum development, and opportunities for independent research in the fields represented by the course offerings of the College of Education.

As in the education of teachers enrolled for pre-service degrees, work at the graduate level also draws upon other divisions of the University, thus enabling the College of Education to develop strong programs of professional education which include academic offerings in the various teaching fields in elementary and secondary education.

Courses in teacher education include: 211, 217, 218, 225, 227, 228, 241, 242, 244, 248, 256, 257, 259, 270, and 271.

Inquiries regarding these programs should be addressed to Associate Professor Edward Ducharme.

Occupational and Practical Arts Education

See Vocational Education and Technology.

## **COURSES OFFERED**

202 PHILOSOPHY OF EDUCATION Educational theory and philosophy past and present; contributions of leading educational philosophers; the interrelationships of education, society, and philosophy. *Prerequisite:* 12 hours in education and related areas. Three hours. Miss Boller, Mr. Nash, or Mr. Rippa. 204 SEMINAR IN EDUCATIONAL HISTORY: THE STRUGGLE FOR EQUALITY OF OPPORTUNITY A study of selected topics in the history of education from the "Golden Age" of Greece to the present. Special attention to the nature of education in democratic and authoritarian social orders. Discussions and research will revolve around such topics as the education of

#### EDUCATION

women, the plight of American Indians, and the quest of the black people throughout the world for equality and freedom. *Prerequisites:* 12 hours in education and related areas. Three hours. Miss Boller, Mr. Conrad, Mr. Nash, or Mr. Rippa.

205 HISTORY OF AMERICAN EDUCATION History of principles and practices in American education as they relate to social, economic, political, and cultural developments. *Prerequisite:* 12 hours in education and related areas, or permission of instructor. Three hours. Mr. Rippa.

206 COMPARATIVE EDUCATION Underlying principles, general organization, and typical practices of education in leading countries of the world. Special emphasis on modern education and on areas of particular interest to class members. Constant reference will be made to American education. *Prerequisite:* 12 hours in education and related areas. Three hours. Miss Boller, Mr. Rippa, Mr. Shiman, or Mr. Wheeler.

211 EDUCATIONAL MEASUREMENTS The essential principles of measurement in education. Topics include measures of achievement, analysis of standard tests, construction of objective tests and inventories. *Prerequisite:* 12 hours in education and related areas. Three hours. Staff.

212 CHILD AND ADOLESCENT DEVELOPMENT A study of the growth and development of the individual from infancy to adulthood with special emphasis upon implications for teaching and learning. *Prerequisite:* 12 hours in education and related areas. Three hours. Staff.

216 INTRODUCTION TO INDIVIDUALIZED INSTRUCTION FOR CLASSROOM TEACHERS Introduction to the individualization of instruction for language behaviors. Each student is required to complete a classroom project with an elementary school child. *Prerequisite:* 12 hours in Education and related areas and permission of the instructor. Three hours. Special Education staff.

217 SECONDARY SCHOOL CURRICULUM Principles and problems in curriculum development. An analysis of recent curricular innovations in American secondary schools. *Prerequisite:* 12 hours in education and related areas. Three hours. Mr. Abruscato.

220 PERSONALITY DEVELOPMENT Approaches to understanding human behavior in applied settings. With emphasis on behavior development as an interpersonal process. *Prerequisite:* 12 hours in education and psychology. 221 COUNSELOR-TEACHER-PARENT CONSULTATION The consultive relationship in educational settings. *Prerequisites:* Education 220 and permission of instructor.

222 IMPROVEMENT OF READING INSTRUCTION IN THE ELEMEN-TARY SCHOOL Analysis of philosophies, programs and instructional practices for teaching reading in the elementary school. Examination and evaluation of basal textbook, individual and specialized reading programs. *Prerequisite:* twelve hours in education and/or related areas including an introductory course in reading or consent of instructor. Three hours. Staff.

223 READING PROGRAMS IN SECONDARY SCHOOLS AND COLLEGES Relationship of reading to learning; study of organization, instructional procedures, and materials for developing reading improvement for secondary and college students: programs reading in content areas. Prerequisite: twelve hours in education and/or related areas or consent of instructor. Three hours. Staff.

224 INTRODUCTION TO BEHAVIORAL PRINCIPLES OF EDUCATION Emphasis will be on the application of basic behavioral principles in the regular class setting that will improve student's academic and social behaviors. *Prerequisite:* 12 hours in Education and related areas and permission of the instructor. Three hours. Special Education staff.

225 TEACHING SOCIAL STUDIES IN SECONDARY SCHOOLS Emphasizes teaching modes of inquiry through such concepts as discovery, selecting key relationships, using original source material, and setting up independent study. *Prerequisite:* 12 hours of education and related areas. Three hours. 227 TEACHING SCIENCE IN SECONDARY SCHOOLS Consideration of modern science curricula for grades 7-12. Course will deal with articulation and implementation of science programs, course development, and science teaching techniques. *Prerequisite:* 12 hours in education and related areas and permission of instructor. Three hours. Mr. Agne.

234 LITERATURE AND LANGUAGE FOR CHILDREN AND YOUTH Characteristics, interests, and reading habits of children and young people; criteria for selection and evaluation of literature; organizing book units for teaching literature and for content areas; books for children and youth. *Prerequisite:* twelve hours in education and related areas or consent of instructor. Three hours. Mrs. Lang.

240 MUSICAL CREATIVITY IN THE GENERAL MUSIC CLASS Designing a course of study for the general music class. Developing musical concepts and perception through individual differences. Aural approach through class performance on recorders, guitars, and mallet instruments. *Prerequisites:* An undergraduate major in Music Education or consent of instructor. Three hours. Mr. Wigness.

241 SCIENCE FOR THE ELEMENTARY SCHOOL Emphasis in this course will be on the methods and materials relating to the construction of science units for the elementary pupil, grades 1-6. Opportunity will be provided for teachers to build units applicable to their teaching needs. *Prerequisite:* 12 hours in education and related areas and permission of instructor. Three hours. Mr. Agne.

#### EDUCATION

242 MODERN TRENDS IN ELEMENTARY EDUCATION Study of school programs, materials, experiences in all areas of the school curriculum, both separately and as they relate in an integrated program. *Prerequisite:* 12 hours in education and related areas. Three hours. Staff.

243 RECENT TRENDS IN MUSIC EDUCATION Study of recent thought and practices in music education. Examination of current trends in the Contemporary Music Project, Comprehensive Musicianship, The Tanglewood Symposium, recreational music, music in the inner city, and other topics of concern. *Prerequisite:* an undergraduate major in music education or consent of instructor. Credit variable, one to four hours. Mr. Lidral.

244 SOCIAL STUDIES IN THE ELEMENTARY SCHOOL Study of literature, research, and problems in teaching social studies in the elementary school. *Prerequisite:* 12 hours in education and related areas. Three hours. Miss Petrusich.

248 EDUCATIONAL MEDIA Modern instructional aids, theory and practice; educational media related to psychology of teaching and learning. *Prerequisite:* twelve hours in education and related areas. Three hours. Staff.

252 SEMINAR IN AESTHETIC EDUCATION Consideration of ways to expand aesthetic awareness among children, youth and adults. The aesthetic quality of natural and man-created environments with implications for educational practice will be given special attention. *Prerequisite:* 12 hours in education and related areas. Three hours. Mr. Conrad.

253 PRACTICUM IN MUSIC EDUCATION Current methodology in music education for music specialist and classroom teacher. Students will study and learn to present courses in music in the public schools including Orff and Kedaly approaches general music, comprehensive musicianship, and other recently introduced and promising methods. Each year the emphasis will be in a different area of concentration. *Prerequisite:* an undergraduate major in music education or elementary education and teaching experience or consent of instructor. Credit variable. Course may be taken for 1-4 hours each semester and may be repeated for a maximum of 8 hours of credit. Staff.

254 ANTHROPOLOGY OF EDUCATION Introductory examination of theories and research of cultural anthropology and education. An anthropological perspective on education grounded in the cultural realities of life in the American school. Study of the interrelationship of culture and man—his educational values, beliefs, and practices. *Prerequisite:* 12 hours in education and related areas. Three hours. Mr. Nash.

255 THE SCHOOL AS A SOCIAL INSTITUTION Professional role of the modern educator and the values underlying educational policy will focus on such contemporary issues as political pressures on public schools, problems of integration, place of religion in education, and impact of the culturally different child on school and community. *Prerequisite:* 12 hours in education and related areas. Three hours. Miss Boller, Mr. Conrad, Mr. Nash, or Mr. Rippa. 256 METHODS AND MATERIALS IN ELEMENTARY SCHOOL MATH-EMATICS Topics include the evolution of mathematical concepts and notations, the meaning of numbers and number systems, the theory underlying fundamental operations, and an analysis of the modern approach to mathematics in the elementary school. *Prerequisite:* 12 hours in education and related areas. Three hours. Miss Boller, Mr. Erb.

270 KINDERGARTEN METHODS AND ORGANIZATION Objectives, organization, curriculum, methods and materials, and relationships of kindergarten to Head Start and other pre-school experiences. *Prerequisite:* 12 hours in education and related areas. Three hours. Mr. Rathbone.

271 KINDERGARTEN EDUCATION WITH LABORATORY EXPERI-ENCES A course designed to acquaint the prospective kindergarten teacher with educational research conducted by Piaget, Bruner, Montessori, and others with experiences provided for working with children of kindergarten age. *Prerequisite:* 12 hours in education and related areas. Three hours. Mr. Rathbone.

275 ANALYSIS OF READING AND RELATED LANGUAGE DIFFICULT-IES Analysis and evaluation of learning difficulties with emphasis on reading and writing: nature of difficulties; procedures and materials for assessing reading performance. Involvement with children is required. *Prerequisite:* twelve hours in education and related areas, including an introductory course in reading or consent of instructor. Three hours. Mr. Clements.

276 LABORATORY EXPERIENCES IN READING AND RELATED LAN-GUAGE INSTRUCTION Approaches to be used for the prevention and correction of reading and written language difficulties. Supervised teaching of individuals and/or small groups experiencing reading and language problems. Apprenticeships in reading instructional programs. *Prerequisite:* Ed. 275 *Analysis of Reading and Related Language Difficulties* or consent of instructor. Three-six hours. Mr. Clements.

277 SEMINAR IN EDUCATIONAL PSYCHOLOGY Examination of personal values, attitudes, and beliefs related to learning, psychological research of the teaching-learning process, use of such research in analyzing the process of education, and the creation of applications for educational settings of all kinds. *Prerequisite:* 12 hours in education and related areas. Three hours. Staff.

290 BASIC CONCEPTS IN MUSIC EDUCATION Disciplinary backgrounds; historical and philosophical foundations; fundamental considerations of the functions of music in the schools; development of a personal philosophy. Three hours. Staff.

291 PSYCHOLOGY OF MUSIC Psychological dimensions of tone and

## EDUCATION

rhythm; the learning process in music; emotional and aesthetic response; musical ability; musical behavior and its measurement; American and European viewpoints and contributions. *Prerequisite:* 145-146 or Psychology 1 and 205. Three hours.

292 ISSUES IN CONTEMPORARY EDUCATION Designed so that its content and structure may accommodate special issues in education not especially appropriate within the boundaries of an existing course. *Prerequisite:* 12 hours in Education and related areas. Two to six hours. Staff.

295, 296, 297, 298 LABORATORY EXPERIENCE IN EDUCATION Supervised field work designed to give student experience in specialized areas for their professional development. *Prerequisite:* permission of instructor in the appropriate program area. Credit ás arranged. Staff.

303-304 PROBLEMS AND RESEARCH IN TEACHING SECONDARY SCHOOL ENGLISH This course is identical with English 303-304.

310 METHODS FOR DERIVING AND ACHIEVING SPECIAL EDUCA-TION OBJECTIVES Development and application of procedures for deriving educational objectives, selecting and sequencing instructional materials, managing classroom behaviors, and achieving individualized instruction. Each student will be required to conduct a supervised classroom project. *Prerequisite:* 12 hours in education and related areas, and permission of the instructor. Three hours. Special Education staff.

312 ANALYSIS OF CLASSROOM BEHAVIOR: THE HANDICAPPED LEARNER This course is a survey of basic behavioral principles and procedures involved in the analysis of behavior as they apply to the problem of the handicapped learners in the classroom setting. *Prerequisite:* Education 310. Three hours. Special Education staff.

313 STATISTICAL METHODS IN EDUCATION Application of descriptive and inferential statistics to educational and psychological data. Three hours. Staff.

316 SEMINAR IN RESEARCH IN THE EDUCATION OF HANDI-CAPPED LEARNERS A broad survey of research undertaken to evaluate teaching/learning procedures, methodology, and materials employed in the education of the handicapped learner. *Prerequisite:* Education 312. Three hours. Mr. McKenzie.

319 INTERNSHIP FOR SPECIALIZED PERSONNEL IN EDUCATION Students will undertake an approved internship in an institution which reflects the particular area of interest and needs of the student. *Prerequisite:* permission of the instructor. Credit as arranged. Staff.

332 SEMINAR AND SIMULATION TRAINING IN EDUCATIONAL AD-MINISTRATION AND PLANNING Provides an opportunity for the student to experience and apply selected administrative and planning concepts and skills in a simulated setting. *Prerequisite:* 12 hours in education and related areas. Three hours. Staff.

335 INSTRUCTIONAL ASSESSMENT AND STAFF DEVELOPMENT Organizational behavior, group and interpersonal relations, staffing and staff development concepts and practices, supervisory and coordinative roles, program and instructional assessment. *Prerequisite:* 12 hours in education and related areas. Three hours. Staff.

337 POLITICAL PROCESSES IN EDUCATION Political and operational relationships of educational organizations to multiple publics and governmental bodies at the local, state, and national levels. *Prerequisite:* 12 hours in education and related areas. Three hours. Staff.

350 GUIDANCE IN EDUCATION Introduction to guidance as an organized function of education with special emphasis upon the foundations of guidance, including such areas as counseling, testing, information, organization and administration, vocational development, referrals, ethics. *Prerequisite:* 12 semester hours in education and psychology. Three hours. Staff.

351 UNDERSTANDING INDIVIDUAL DIFFERENCES Tests of achievement, aptitude, interests, personality, and other assessment techniques will be studied. Experience provided in selection, administration, and interpretation of tests and in the integration of data with the helping relationship. Staff.

352 ANALYSIS OF EDUCATIONAL ORGANIZATIONS Organizational concepts, structures, and methods of analysis, relationships between organizational variables, diagnosing causes of organizational problems, strategies for planning and effecting change. *Prerequisite:* 12 hours in education and related areas. Three hours. Staff.

353 INQUIRY SEMINAR IN EDUCATIONAL ADMINISTRATION AND PLANNING A culminating experience to assist students in Administration and Planning and related areas to integrate their course, module, independent study, and research learnings. *Prerequisite:* Permission of instructor. Three hours. Staff.

354, 355 SYSTEMS THEORY AND TECHNIQUES Systems theory analyzed in terms of its utility for research theory development, interdisciplinary dialogue, and administrative practice. Particular emphasis given to the integrative power of systems analysis techniques for the administrative processes of planning, programming and evaluation. *Prerequisite:* 12 hours in education and related areas. Six hours (three hours per semester). Staff.

356, 357 SEMINAR IN FUTURE COGNITION AND PLANNING Selected futures forecasting techniques and processes will be applied to education. Study will include an examination of the knowledge, values, and attitudes implicit in planning alternative futures. *Prerequisite:* 12 hours in education and related areas. Six hours (three hours per semester). Staff.

358 SEMINAR IN COMMUNITY EDUCATION The seminar participants will analyze the Community Education process, relate the process to com-

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munity development, and develop strategies for the planning and implementation of Community-Education. Three hours. Staff.

360 HIGHER EDUCATION IN AMERICA An introductory study of institutions of higher education in the United States with emphasis upon contemporary nature and function. Analysis from the sociological, philosophical, historical, economic and political perspectives. Three credits. Staff.

362 THE AMERICAN COLLEGE STUDENT Study of the American college student within his living-learning environment. Emphasis upon sociological and psychological aspects in relation to student personnel work and counseling. *Prerequisite:* 12 credit hours in education, psychology, and sociology or related areas. Three hours. Staff.

370 ELEMENTARY SCHOOL GUIDANCE The guidance movement in the elementary school: needs and prospects; appropriate methods; role of counselor; program development; vocational development; appraisal techniques; evaluation of effectiveness. *Prerequisites:* Education 220 and Education 350. Three hours. Staff.

374 COUNSELING THEORY AND PRACTICE A theoretical and practical approach to understanding the dynamics of the counseling process. Emphasis placed upon the refinement of a personal philosophy and theory of counseling and the implementation of it in practice. *Prerequisite:* graduate standing, 12 hours in education and/or psychology, and permission of instructor. Three hours. Staff.

378 ADVANCED STUDY AND RESEARCH IN READING AND RELAT-ED LANGUAGE ARTS Survey of research, comparison and evaluation of emerging programs, design and development of projects in reading. *Prerequisites:* 15 hours in education including 9 hours in the field of reading and language education, or consent of the instructor. Three hours. Mr. Hunt.

379 SEMINAR IN READING INSTRUCTION Study of reading relative to total curriculum. Significant trends and concepts related to specific problems and programs in reading and language arts instruction; role of the supervisor and the reading consultant. *Prerequisites:* 15 hours in education including 9 hours in the field of reading and language education or consent of the instructor. Three hours. Mr. Hunt.

381 PERSONALIZING INFORMATION PROCESSES IN GUIDANCE The role of information in the growth and development of the individual within the current cultural context. Practical application of the uses of information in individual and group counseling as well as in group guidance. *Prerequisite:* 12 hours in education and/or psychology. Three hours. Staff.

382 TEACHING INTERNSHIP Supervised teaching experiences on a full-

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time basis, with related seminars in teaching subject. *Prerequisite:* Permission of the coordinator of Professional Laboratory Experiences, College of Education. Three to eight hours. Staff.

383 GROUP DYNAMICS: THEORY AND EXPERIENCE Encounter group experience for prospective counselors geared to provide them with increased awareness of self and of their modes of relating to others. Study of theory and practice of group dynamics. *Prerequisites:* Twelve hours in education and psychology and permission of the instructor. Three credits. Staff.

384 PRACTICUM IN COUNSELING Supervised experiences in individual and small-group counseling situations. A minimum of 30 hours in actual counseling relationships, with analysis and evaluation of verbatim samplings. For students nearing completion of Master's in Guidance. *Prerequisite:* 374 and permission of the instructor. Three hours. Staff.

385 STUDENT PERSONNEL SERVICES IN HIGHER EDUCATION Purposes, organization, and administration of student personnel services in higher education. Functional areas within student personnel work are examined in terms of the student culture, current research, and basic principles of administration. *Prerequisite:* Permission of instructor. Three hours. Staff.

386 ORGANIZATION AND COORDINATION OF GUIDANCE PRO-GRAMS Planning, initiating, organizing, coordinating, and evaluating guidance services. Emphasis on roles and relationships in a K through 12 developmental guidance program in which total staff participation is encouraged. *Prerequisite:* introductory courses in guidance and 12 hours in education and psychology. Three hours. Staff.

387 SEMINAR IN HIGHER EDUCATION Designed for graduate students concentrating in Student Personnel Services in Higher Education. Analysis and discussion of current issues and problems in higher education. *Prerequisite:* Candidacy in graduate program in Student Personnel Services in Higher Education. One to three credits. Staff.

388 PROCEDURES IN FAMILY COUNSELING Theory and process of counseling with families. Live demonstrations of family counseling with opportunities for student involvement. *Prerequisites:* Education 220, Education 374, and permission of instructor. Three hours. Staff.

390 ORGANIZATION AND ADMINISTRATION OF MUSIC EDUCA-TION Study of the organization and administration of vocal and instrumental music in the public schools. *Prerequisite:* graduate standing in music education and teaching experience or consent of instructor. Three hours. Staff. 391 MASTER'S THESIS RESEARCH Thesis topic must be approved by a faculty committee. Credit as arranged. Staff.

#### **EDUCATION**

397 PROBLEMS IN EDUCATION Individual work on a research problem selected by the student in consultation with a staff member. *Prerequisite:* 12 hours in education and related areas; endorsement by a sponsoring faculty member. Credit as arranged. Staff.

399 RESEARCH METHODS IN EDUCATION Seminars and research projects will introduce the students to the methods of historical, descriptive, experimental, quasi-experimental, field studies, and survey research. Three hours. Ms. Miller, Mr. Fishell.

366 SOCIAL WELFARE AND SOCIAL WORK AS SOCIAL INSTITU-TIONS Critical survey of the philosophy and purpose of social welfare and systems of service delivery in welfare agencies. Investigation of basic concepts of social work practice. Three hours. Miss Whittlesey.

## • PHYSICAL EDUCATION

201 ADMINISTRATION OF ATHLETIC PROGRAMS Designed to provide the athletic director, school administrator, and teacher-coach with a background for effective administration of the athletic program of schools. *Prerequisite:* 12 hours education and related areas. Three hours. Mr. Leggett.

203 PRINCIPLES OF PHYSICAL EDUCATION Principles basic to sound philosophy of physical education for the space age; appraisal of historical development; relationship to health education, recreation and other areas. *Prerequisite:* 12 hours in education and related areas. Three hours. Mr. Gobin or Mr. Greig, or Mr. Christensen.

208 SCHOOL HEALTH PROGRAMS Organization of the total school health program. Problems and administration in the areas of school environment, health services, health education, and school-community relationships. *Prerequisite:* P.E. 116 or equivalent. Three hours. Mr. Gobin.

## • ADDITIONAL GRADUATE COURSES

The following courses are also offered by the College of Education, usually in the Summer Session and in the Evening Division.

214	THE SLOW LEARNER (EXCEPTIONAL CHILD WITH LEARN	l-
	ING DISABILITY)	3
215	THE GIFTED CHILD	3
218	WORKSHOP IN CURRICULUM credit varia	ble 1-4
219	WORKSHOP IN ECONOMIC EDUCATION	4
228	LITERATURE IN THE JUNIOR-SENIOR HIGH SCHOOL CUR	-
	RICULUM (Literary Criticism for Teachers)	3

229	COMMUNICATIVE ARTS IN SECONDARY SCHOOLS (Teaching	
	English in Secondary Schools)	3
257	TEACHING MATHEMATICS IN SECONDARY SCHOOLS	3
259	TEACHING FOREIGN LANGUAGE IN THE ELEMENTARY	
	(Secondary) SCHOOL	3
260	IMPROVEMENT IN TEACHING BOOKKEEPING AND BUSINESS	
	SUBJECTS	3
261	SEMINAR IN BUSINESS EDUCATION	3
262	PRINCIPLES, PROBLEMS, AND TRENDS IN BUSINESS EDUCA-	
	TION	3
<b>2</b> 63	IMPROVEMENT IN TEACHING SECRETARIAL SUBJECTS	3
264	BUSINESS EDUCATION CURRICULUM	3
373	INDIVIDUAL TESTING	3
380	PROFESSIONAL PROBLEMS IN EDUCATION	3

## • ELECTRICAL BIOPHYSICS

A cooperative program offered by the Department of Physiology and Biophysics (N.R. Alpert, Chairman) and the Department of Electrical Engineering (W. Roth, Chairman).

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An accredited Bachelor's degree in Electrical Engineering; a year course in Biology; a year course in Physical Chemistry.

## **MINIMUM DEGREE REQUIREMENTS**

Physiology and Biophysics 301; twelve hours in physical sciences; additional approved courses; thesis research (10 hours) in the Department of Physiology and Biophysics.

## • ELECTRICAL ENGINEERING

Professors Handelsman, Lai, Lambert, Roth (Chairman) and Rush; Associate Professors Evering, and Taylor; Assistant Professors Absher, Mirchandani, and Williams.

Master of Science and Doctor of Philosophy programs are offered. Candidates

normally have obtained the Bachelor of Science Degree in Electrical Engineering prior to application for admission but other applicants are encouraged to consider the program if they have extensive background in mathematics and the basic sciences. In such cases, it may be necessary for a student to complete his entrance qualifications without receiving credit toward his graduate studies. The general requirements for admission as outlined under the "Regulations of the Graduate College" must be met. Areas of research interests are control systems, biomedical engineering, electromagnetic fields, instrumentation, solid state physical electronics, information processing and communication theory.

# PREREQUISTES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An accredited Bachelor's degree in Electrical Engineering.

## MINIMUM DEGREE REQUIREMENTS

Advanced courses in Electrical Engineering, Physics, and Mathematics (18-24 hours); thesis research (6-12 hours).

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Successful completion of Ph.D. comprehensive examinations. The majority of students will have completed the core program—comprising graduate courses in Controls, Fields, Solid State Circuits, Communications, Mathematics and Physics—before taking the comprehensive examination.

## MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

At least 48 credit hours in courses and seminars and 35 credit hours in thesis. Normally, 18 additional credit hours in an area of specialization are found necessary. A reading knowledge of two approved languages or fluency (able to read, write and converse) in one. The language requirement for the Electrical Engineering Ph.D. program comprises the following: a. Satisfactory passing of a reading proficiency examination in two foreign languages. The selection shall be made from French, German or Russian; or, b. Satisfactory completion of the reading proficiency examination in one of the languages in (a) plus a verbal proficiency examination in the same language. The requirements specified under the Regulations of the Graduate College must also be met.

## **COURSES OFFERED**

201 LINEAR SYSTEM THEORY Introduction to linear system theory and

application to the processing and control of information. Mathematical models and classification of systems. Lagrangian and Hamiltonian formulation. Timeinvariant and time-varying differential systems. Characterization by impulse response and integral transforms. Methods of analysis. Adjoint system and implications. Characterization and analysis of linear discrete-time systems. *Prerequisite:* Math 124 or equivalent background. Three hours. Staff.

202 NETWORK ANALYSIS Introduction to modern network analysis through a topological study of networks with emphasis on electrical networks. Graph theory. Fundamental principles and theorems. State variable characterization of linear, nonlinear and time-varying networks. Other methods of characterization. Analysis using linear algebra concepts. Computational problems. *Prerequisite:* EE 171 and Math 124 or equivalent background. Three hours. Mr. Mirchandani.

205, 206 NETWORK SYNTHESIS Design of linear and nonlinear networks using the digital computer. Review of classical realizability theory of passive networks. Computer oriented topics including: Linear algebraic computational and numerical integration problems. Concepts of modelling. Optimization methods. Worst case design. Use of analysis programs. Discussion of recent methods and developments. *Prerequisite:* 202. Knowledge of programming helpful but not necessary. Three hours. Mr. Mirchandani.

230 DIGITAL COMPUTER LOGIC, CIRCUITS & SYSTEMS The logical design of digital computers. Boolean algebra as an aid to circuit design. Circuits and components for the transmission, storage and modification of information and their combination into arithmetic units, memory devices, program controls and other major mechanisms. *Prerequisites:* 123 or Physics 117. Three hours. Staff.

232, 233 HYBRID COMPUTERS System design concepts and use of interconnected analog and digital computers as an engineering tool are stressed. Selected problems from mathematics, biological and physical sciences are solved on a hybrid computer. The use of logic and decision as well as analog/ digital and digital/analog conversion are stressed. *Prerequisite:* 123 or departmental permission. Three hours. Mr. Taylor.

235 ELECTRONIC INSTRUMENTATION FOR SCIENTISTS Introduction to electrical components and circuit theory, electrical measurements, oscilloscopes, power supplies, amplification by vacuum tubes and transistors, oscillators, comparison measurements, servo systems, operational amplifiers for measurement and control, electronic switching circuits, timing and digital counting systems. This course may not be taken for credit by students in Electrical Engineering. *Prerequisite:* College Physics and Calculus or permission of the instructor. Four hours. Mr. Evering.

236, 237 FUNDAMENTALS OF DIGITAL COMPUTER DESIGN (3-0), (3-0)

Fundamentals of logic design. Design of combinational and sequential logic circuits. Implementation of arithmetic operations. Memory systems. Instruction codes. Dynamic storage allocation. No graduate credit for electrical engineering majors. *Prerequisite:* Math 116 or E.E. 32 or equivalent, 236 for 237. Three hours. Staff.

239 TRANSIENT PHENOMENA Study of complex variable basis of Laplace and Fourier Transforms; applications to transient behavior of lumped and distributed parameter systems, root locus, Nyquist criterion and two dimensional field problems. *Prerequisite:* 4. Three hours. Mr. Rush.

240 BOUNDARY VALUE PROBLEMS IN ELECTROMAGNETISM Solution of classical problems of Electromagnetism using images, conformal mapping and separation of variables methods. *Prerequisite:* 144. Three hours. Mr. Rush.

242 THEORY AND APPLICATIONS OF TIME-VARYING FIELDS Maxwell's equations and boundary conditions for time varying systems. Propagation and reflection of electromagnetic waves, guided electromagnetic waves, resonant cavities, and microwave networks. *Prerequisite:* 240 or departmental permission. Three hours. Staff.

244 RADAR SYSTEMS ENGINEERING Radar theory including antennas, propagation, signal detection and parameter estimation. Applications including search and track radars, aircraft landing, radio/radar astronomy, and phased array radars. *Prerequisite:* EE 174. Three hours. Mr. Handelsman.

251 APPLICATIONS OF LINEAR ALGEBRA Introduction of basic definitions and concepts of linear algebra; formulation and solution of engineering problems. Application to problems of state variable analysis, field theory, mechanics, quantum mechanics and signal theory. *Prerequisite:* Graduate standing in E.E. or Physics, or departmental permission. Three hours. Mr. Rush.

261 TRANSISTOR ENGINEERING Analysis of the properties of PN junctions. Theory of transistors as developed from drift and diffusion properties of carriers. Charge control model of transistor switch. *Prerequisite:* Mathematics 123. Three hours. Staff.

262 TRANSISTORS Circuit analysis of transistor operation in terms of hybrid parameters. Equivalent circuits for high frequency operation; oscillators and pulse switching circuits. *Prerequisite:* 261. Three hours. Staff.

272 INFORMATION THEORY Introduction to probability concepts of information theory; entropy of probability models; theoretical derivations of channel capacity; coding methods and theorems, sampling theorems. *Prerequisite:* Mathematics 191. Three hours. Mr. Absher.

281 SEMINAR Presentation and discussion of advanced electrical engineering problems and current developments. *Prerequisite:* graduate engineering enrollment. One hour. Staff.

285 CREATIVE ENGINEERING Creative techniques applied to problems in 96

process control, biomedical engineering, communications, circuit design. *Prerequisites:* Graduate standing in EE or departmental permission. Three hours. Mr. Roth.

287 SPECIAL TOPICS Formulation and solution of theoretical and practical problems dealing with electrical circuits, apparatus, machines or systems. *Prerequisite:* 4. Three hours. Staff.

311, 312 INTRODUCTION TO OPTIMUM CONTROL SYSTEMS Review of conventional s-plane design of linear systems. Introduction to the optimal control problem, parameter optimization, and least-square optimization in the frequency domain. Optimization using the calculus of variations, Pontryagin's maximum principle, Hamilton Jacobi theory, and Dynamic programming. Computational methods for finding optimal controls and trajectories. Examples of optimum systems control. Introduction to stochastic control problems. *Prerequisites:* 111, 311 for 312. Three hours. Mr. Absher or Mr. Taylor.

314, 315 NONLINEAR SYSTEM THEORY Analysis and synthesis of piece-wise linear networks. Topological study of second order autonomous systems. Nonlinear conservative and Lagrangian systems. Existence of periodic solutions and associated theorems. Graphical methods of analysis. Concepts of stability. Lyapunov stability. Perturbation theory; existence and convergence of periodic solutions. Parametrically excited systems. Mathieu-Hill theory. *Prerequisite:* 201 or Mathematics 230. Three hours. Staff.

317, 318 THEORY OF OPTIMUM CONTROL SYSTEMS Optimum zdomain design of sampled-data systems. Discrete variational calculus and a discrete maximum principle. Formulation of distributed system problems and a distributed maximum principle. Optimum state estimation in linear stationary systems. Optimum filtering for nonstationary continuous systems. Leastsquares curve fitting and state estimation in discrete linear systems. Sensitivity in optimal control. *Prerequisite:* 312, 370, 317 for 318. Mr. Absher or Mr. Taylor.

319, 320 SPECIAL TOPICS IN CONTROL SYSTEM THEORY Topics selected from special interests of staff with lectures and readings from current literature. *Prerequisite:* 318. Mr. Absher or Mr. Taylor.

340, 341 SPECIAL TOPICS IN ELECTROMAGNETIC FIELD THEORY For advanced students in the field of electromagnetism. Topics selected from special interests of staff with lectures and readings from current literature. Three hours. Staff.

345 ELECTROMAGNETIC ANTENNAS AND PROPAGATION Fundamentals of radiating systems and antennas. Antenna gain, directivity, receiving area, linear antennas, aperture antennas and phased arrays, transmission line systems and propagation through the atmosphere and ionosphere. *Prerequisite:* EE 242 or equivalent. Three hours. Mr. Handelsman.

363, 364 INTRODUCTION TO SOLID STATE THEORY Crystal structures in terms of the Bravais lattice. Band theory and the concept of Brillouin zone.

Vibrational, transport, and other fundamental problems associated with ordered solids. *Prerequisites:* Atomic or Modern Physics; 363 for 364. Three hours. Equivalent to and alternates with Physics 341, 342. Mr. Lambert.

365 LASERS AND MASERS Conditions for operation and photon flux amplification. Modes of operation and measurement of power and beam characteristics. CW and pulsed lasers. Light modulation and detection. *Pre-requisite:* Bachelor's Degree in Engineering or physics or departmental permission. Three hours. Mr. Lambert.

366, 367 SOLID STATE THEORY Quantum mechanical free electron theory of metals. Quasi-free electron theory for periodic structures. Calculation of energy bands for the most common crystal structures employing the tight binding approximation. Introduction to the Boltzmann transport equation, Onsager Relations, and transport coefficients. *Prerequisites:* 364, 366 for 367. Three hours. Mr. Lambert.

370, 371 SIGNAL THEORY Analysis and representation of nonrandom and random signals. Discrete signals. Signal-space concepts. Random processes. Correlation function and power density spectrum. Measurement techniques. Applications. *Prerequisite:* Graduate standing in Electrical Engineering or con-current enrollment in 174, 370 for 371. Three hours. Mr. Lai.

372 ADVANCED COMMUNICATION ENGINEERING Principles of optimum receiver: Design and implementation. Implementation of coded communication systems. Models of communication channels: Bandpass channels and fading channels. Modulation systems: AM, FM, PAM, PPM, PWM and PCM. *Prerequisite:* Graduate standing in EE. Three hours. Mr. Lai.

374 THEORY OF SIGNAL DETECTION Testing of hypothesis. Detection of known and unknown signal. Detection by multiple observations. The estimation of signal parameters. Detection of signals of unknown arrival time. Signal resolution. *Prerequisite:* Graduate standing in EE. Three hours. Mr. Lai.

376 CODING AND SIGNALING The coding problem. Linear codes and nonlinear.codes. Error-correction capabilities of linear codes. Important linear codes. Cyclic codes. Bose-Chaudhuri codes. Burst-error-correcting codes. Recurrent codes. Parity-check codes. Decoding methods. Efficient signaling for message sequences. *Prerequisite:* Graduate standing in EE. Three hours. Staff.

378 SPECIAL TOPICS IN STATISTICAL COMMUNICATION AND RE-LATED FIELDS Coding for communication or computer systems, pattern recognition and learning machines, artificial intelligence, etc., selected from special interests of staff with lectures and readings from current literature. *Prerequisite:* Graduate standing in Electrical Engineering. Three hours. Mr. Lai.

# 391 MASTER'S THESIS RESEARCH Credit as arranged.491 DOCTORAL THESIS RESEARCH Credit as arranged.

## • ENGLISH

Professors Bandel, Bogorad, Cochran, Jones, Long, Orth and Rothwell (Chairman); Associate Professors Broughton, Clark, Hall, Poger and Shepherd; Assistant Professors Biddle, Bradley, Dickerson, Edwards, Eschholz, Gutman, Howe, Huddle, Rosa, Seid, Simone, Stanton, and Stephany; Instructor Thompson.

The research interests of the faculty of the Department of English and library resources permit graduate students to undertake thesis subjects in virtually all the fields represented by the course offerings of the Department.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

An undergraduate major in English or its equivalent; satisfactory scores on the Aptitude and Advanced Graduate Record Examinations; demonstration of proficiency in writing by a detailed statement concerning the purpose in pursuing graduate study in English.

## **MINIMUM DEGREE REQUIREMENTS**

Eighteen hours in English; including 212, 301, 302 for MA and MAT and 371 for MA; 6 additional hours in English or a related field; thesis research (6 hours); reading knowledge of a foreign language, normally French or German.

The department also offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 24. Satisfactory scores on the Graduate Record Examinations are prerequisite for acceptance to candidacy for this degree.

*Note:* The written comprehensive examination for the degrees of Master of Arts and Master of Arts in Teaching covers both English and American literature.

## **COURSES OFFERED**

200 OLD ENGLISH The sounds, words, and structure of Old English; simple prose texts and selections from *Beowulf*. Three hours. Alternate years, 1973-74. Mr. Dickerson.

202 MEDIEVAL LITERATURE The forms (in translation) of medieval literature, with emphasis on Arthurian materials. Three hours. Mr. Stephany.

204 MIDDLE ENGLISH Literary, historical, and linguistic considerations

#### ENGLISH

of Middle English texts, excluding Chaucer. Three hours. Alternate years, 1972-73. Mr. Dickerson.

205, 206 ENGLISH DRAMA TO THE CLOSING OF THE THEATRES First Semester: From the drama in the Middle Ages to Marlowe and Jonson. Second Semester: Jacobean Drama (exclusive of Shakespeare), to include Webster, Tourneur, and Ford, to the closing of the Theatres in 1642. Mr. Howe, Mr. Rothwell.

209, 210 ELIZABETHAN PROSE AND POETRY The major writers of the Tudor and Stuart periods; Three hours. Alternate years, 1973-74. Mr. Long.

212 MILTON Paradise Lost, Paradise Regained, Samson Agonistes, some of the minor poems, and selected prose works. Three hours. Mr. Bogorad.

217 RESTORATION AND EIGHTEENTH-CENTURY DRAMA Development of English drama from Dryden to Sheridan. Three hours. Alternate years, 1972-73. Mr. Howe, Mr. Seid.

218 RESTORATION AND EIGHTEENTH-CENTURY PROSE AND PO-ETRY Significant writers from Dryden to Johnson. Three hours. Alternate years, 1972-73. Mr. Bogorad.

227, 228 ENGLISH NOVEL English fiction from its origins through the nineteenth century. Three hours. Mrs. Hall, Mr. Stanton.

231, 232 VICTORIAN LITERATURE Significant writers from 1832 to 1900. Three hours. Alternate years, 1972-73. Mr. Long.

235 MODERN BRITISH DRAMA British and continental plays of the late 19th and 20th centuries. Three hours. Staff.

236 MODERN AMERICAN DRAMA Recent and contemporary. Three hours. Mr. Orth.

239 MODERN BRITISH POETRY Three hours. Mr. Poger.

242 LITERATURE OF THE SOUTHERN RENAISSANCE Selected short stories, novels, and poetry by Glasgow, Faulkner, Warren, Tate, Styron, and others. Three hours. Alternate years, 1973-74. Mr. Shepherd.

244 MODERN IRISH LITERATURE Irish literature from 1890 to the present. Three hours. Mr. Bradley.

251, 252 AMERICAN NOVEL OF THE NINETEENTH CENTURY First semester: Hawthorne, Melville, and others; second semester: Twain, Howells, James, and others. Three hours. Mr. Biddle, Mr. Eschholz, Mr. Shepherd.

253 AMERICAN COLONIAL LITERATURE Intellectual and literary origins, in the seventeenth and eighteenth centuries, of American culture. Mather, Taylor, Edwards, Franklin, Jefferson, Freneau and Brown. Three hours. Mr. Rosa.

254 EMERSON, THOREAU, AND THEIR CIRCLE Three hours. Alternate years, 1973-74. Mr. Orth.

256 REGIONAL WRITING IN AMERICA Selected works by Cooper, Twain, Faulkner, and others, including units on local color and Southwest humor. Three hours. Alternate years, 1974-75. Mr. Cochran.

257 AMERICAN POETRY TO WORLD WAR I Major American poets to 1917, including Poe, Whitman, Dickinson, and others. Three hours. Mr. Cochran.

258 MODERN AMERICAN POETRY Major American poets from World War I to 1950. Three hours. Ms. Edwards, Mr. Poger.

261 STRUCTURE OF THE ENGLISH LANGUAGE Descriptive study of Modern American English. Three hours. Mrs. Clark.

262 HISTORY OF THE ENGLISH LANGUAGE The principles of historical linguistics and their application to English. Three hours. Alternate years, 1972-73. Mrs. Clark.

264 ENGLISH STYLISTICS Introduction to English stylistics through consideration of changing conceptions of style, evaluation of selected methods of stylistic analysis, and comparison of various literary styles. Three hours. Alternate years, 1973-74. Mrs. Clark.

266 AMERICAN ENGLISH DIALECTS The emergence of American English with special attention to dialectology. *Prerequisites:* English 13, Linguistics 101 or by permission of the Instructor. Mr. Eschholz.

273 TECHNIQUE AND CRITICISM OF POETRY Intensive analysis of various kinds of poetry to develop appropriate critical methods and standards. Three hours. Mr. Bogorad.

275 HISTORY OF CRITICISM Principles and theories of criticism from Aristotle to the twentieth century. Three hours. Alternate years, 1973-74. Mrs. Hall, Mr. Stanton.

276 CONTEMPORARY CRITICISM Three hours. Mr. Poger.

278 MODERN TRADITION Special topics necessary for the understanding of the critical, intellectual and literary works of the modern period: Symbolism, Realism, Self-consciousness, Nature, the Unconscious, Myth and others. Mr. Poger.

301 CHAUCER Study of the principal works of Chaucer, with emphasis on Chaucer's literary scope, talents, and position in medieval literature. Three hours. Mr. Dickerson.

302 GRADUATE SEMINAR A seminar for graduate students only. The topic varies from semester to semester, depending on the faculty member assigned to the course. One seminar is required of all graduate students in English. Three hours.

303-304 PROBLEMS AND RESEARCH IN TEACHING SECONDARY

## EXTRA-DEPARTMENTAL COURSES

SCHOOL ENGLISH Consideration of problems, curricular materials, teaching procedures and research methods in secondary school language, literature, and composition. *Prerequisites:* 12 hours of Education; acceptance as qualified to earn graduate credit in English. Three hours. Mr. Biddle.

371 PRINCIPLES OF LITERARY RESEARCH Methods of literary study, research, and scholarship. Required of all first-year M.A. candidates in English. Three hours. Mr. Orth.

391 MASTER'S THESIS RESEARCH Credit as arranged.

397, 398 SPECIAL READINGS AND RESEARCH Directed individual study of areas not appropriately covered by existing courses. Not to exceed three hours per semester.

## • EXTRA-DEPARTMENTAL COURSES

AREA STUDIES 297, 298. Seminar for area studies majors and other qualified students conducted by a team of area specialists and covering selected topics through interdisciplinary and comparative approaches. *Prerequisite:* Permission by the executive committee and Dr. J. Felt of Area Studies. Three hours. Staff.

GENERAL LITERATURE 251, 252. STUDY OF MOVEMENT, GENRE, OR TOPIC. Precise content of the course to be announced before the registration period, chosen from the following (or similar) topics: 1. Medieval Epic (French, Germanic, Spanish); 2. Comedy (Classics, English, French); 3. Enlightenment (French, English, German); 4. European Romanticism (English, French, German); 5. Political Literature in the Nineteenth Century (English, French, German); 6. Existentialism in Literature (French, German, Spanish); 7. Avant-Garde Theater (French, German, American); 8. Tragedy (Classics, French, German). Prerequisite: Any 100-level literature course in any of the cooperating departments. Three hours. Staff.

## FORESTRY

Professors Christensen (Chairman), Reidel, Whitmore and Wilm; Associate Professors Hannah, and McCormack; Assistant Professors Armstrong, Donnelly, Hoekstra, and Lindsay; Adjunct Professor Foulds; Adjunct Assistant Professors Fuller and Harold; Lecturer Turner.

Research in the Department of Forestry includes investigations on the effects of site and cultural practices upon the growth of quality spruce and balsam fir Christmas trees; development of computer techniques for forest pest survey; seasonal carrying capacity of Vermont forests for white-tailed deer; and the application of operations research procedures to youth conservation programs. Other investigations include research on outdoor recreation user group conflicts on Vermont forest lands; habitat management and population dynamics of wood ducks; recreation impacts on Vermont forest environments; present and potential wood residue utilization at wood processing firms in Vermont; and cooperative input to a Northeastern Regional Research project on genetic and environmental adaptability of forest trees.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Successful completion of a four-year Forestry curriculum or a strong Forestry undergraduate major.

## **MINIMUM DEGREE REQUIREMENTS**

Advanced Forestry and related courses (15-24 hours); Thesis research (6-15 hours).

## **COURSES OFFERED**

205 MINERAL NUTRITION OF PLANTS This course is identical with Plant and Soil Science 205.

207 WATER RELATIONS OF PLANTS Soil-plant water relations. Absorption, transport, and transpiration by plants. Effects of water excesses and deficits. *Prerequisite:* permission. Three hours. Mr. Donnelly and botany and plant and soil science staff. Alternate years, 1974-75.

221 SITE RELATIONS AND PRODUCTION DYNAMICS IN FORESTS Theory of site relations, methods of study, discussion of current research and its application; total site concepts; dynamics of dry matter production. *Prerequisite:* Permission. Three hours. Mr. Hannah. Alternate years, 1973-74.

222 ADVANCED SILVICULTURE Scientific bases for silvicultural practices for specific forest types. *Prerequisite:* Permission of instructor. Three hours. Mr. McCormack.

242 ADVANCED FOREST BIOMETRY Advanced principles of electronic data processing and biometry for forest land management. Current developments in the science of forest biometry. *Prerequisite:* 144 or permission. Three hours. Staff.

252 FOREST VALUATION Principles of valuation of forest land, growing stock, and other forest resources. *Prerequisites:* 136 and 151 or concurrent enrollment. Two hours. Mr. Armstrong.

253 FOREST MANAGEMENT DECISION THEORY Operations research procedures in forest management including wildlife, fire control, insect control, construction projects, and management of conservation programs. *Prerequisite:* Calculus. Three hours. Mr. Armstrong.

### FRENCH

271 WILDLIFE MANAGEMENT Integration of principles and techniques of wildlife management with contemporary land use; emphasis on development and maintenance of habitat requirements; population regulation. Field trips. *Prerequisites:* Forestry 123, 170. Four hours. Mr. Fuller and Mr. Hoekstra.

282 SEMINAR Review and discussion of current problems and controversies in natural-resource management. Required of forestry and wildlife seniors and graduate students. One hour. Mr. Wilm.

381 SELECTED PROBLEMS IN FORESTRY OR WILDLIFE SCIENCES Advanced readings, or a special investigation dealing with a topic beyond the scope of existing formal courses. *Prerequisite:* Undergraduate major in forestry or wildlife. Credit arranged. Staff.

391 MASTER'S THESIS RESEARCH Credit as arranged.

## • FRENCH

Associate Professors Julow (Chairman), and Kohler; Assistant Professors Crichfield, T. Geno, Rivard, Whatley, Whitebook, and Wiley; Instructor Carrard.

Opportunities for thesis research in French literature are offered in all areas from the medieval through the 20th century, as well as French-Canadian literature.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

An undergraduate major in French or equivalent. Satisfactory scores on the Aptitude and Advanced Graduate Record Examinations.

### **MINIMUM DEGREE REQUIREMENTS**

Twenty-four hours in French, which may include six hours in a related field; thesis research, six hours.

A program is also offered leading to the degree of Master of Arts in Teaching. Satisfactory scores on the Graduate Record Examinations (Aptitude and Advanced) are prerequisite for acceptance to candidacy for this degree. Cf. p. 24.

#### **COURSES OFFERED**

The following courses are available for graduate credit. They are divided into courses concerned primarily with advanced language study and those which treat literature. In literature, the two-hundred level courses, open to both

undergraduates and graduates, cover the history of French literature from its origins to the present time by means of division into centuries and genres. Emphasis is placed on major figures and works, with a view to studying them for their intrinsic value as well as in their historical context. The two courses offered specifically for graduate students are regularly supplemented by special topics given under the rubric of the Graduate Seminar; content may vary from year to year, depending on student and staff interests. For more detailed information on specific courses, consult with department chairman and the course instructor.

## FRENCH LANGUAGE

223, 224 ADVANCED COMPOSITION AND CONVERSATION 3 hours (each course). Mr. Crichfield and Staff.

233 EXPLICATION DE TEXTES 3 hours. Mr. Carrard.

234 STYLISTICS 3 hours. Mr. Carrard.

## FRENCH LITERATURE

251 MEDIEVAL 3 hours. Mrs. Whitebook. Alternate years, 1974-75.

256 16th CENTURY 3 hours. Miss Wiley. Alternate years, 1974-75.

261 THE BAROQUE AGE 3 hours. Staff. Alternate years, 1974-75.

262 17th CENTURY 3 hours. Mr. Julow. Alternate years, 1974-75.

267, 268 18th CENTURY 3 hours (each course). Mrs. Whatley. Alternate years, 1973-74.

271, 272 19th CENTURY POETRY 3 hours (each course). Mr. Crichfield. Alternate years (not offered 1973-74).

273, 274 19th CENTURY NOVEL 3 hours (each course). Mr. Julow and Mr. Crichfield. Alternate years, 1973-74.

275 19th CENTURY THEATER 3 hours. Staff. Alternate years, 1973-74.

281 20th CENTURY POETRY 3 hours. Mr. Carrard. Alternate years, 1974-75.

283, 284 20th CENTURY NOVEL 3 hours (each course). Mr. Rivard. Alternate years, 1973-74.

285, 286 20th CENTURY THEATER 3 hours (each course). Mr. Geno and Staff. Alternate years, 1974-75.

287, 288 FRENCH CANADIAN LITERATURE 3 hours (each course). Mr. Rivard. Alternate years, 1974-75.

301 MARCEL PROUST A la Recherche du Temps Perdu 3 hours. Mr. Rivard. Alternate years, 1973-74.

302 EMILE ZOLA'S Rougon-Macquart 3 hours. Mr. Julow. Alternate years, 1974-75.

381, 382 GRADUATE SEMINAR 3 hours. Staff.

## GEOGRAPHY

391 MASTER'S THESIS RESEARCH Credit as arranged. Staff. For undergraduate courses see the undergraduate catalog.

## • GEOGRAPHY

Professor Miles, Vander Meer (Chairman); Associate Professors Barnum, Gade, Lind and Meeks; Assistant Professor Leinbach; Instructor Ring.

Faculty research interests include most systematic aspects of geography, especially from an historical perspective. Technique interests are in cartography, remote sensing, and quantitative methods. The regional interests and field experience are almost world-wide in scope, but normally a Master's thesis would be a project on Vermont or adjacent areas.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

Twelve semester hours or its equivalent in geography and supporting courses in related fields or demonstrated proficiency in geography which would be assurance of success in graduate study. Satisfactory scores on the Graduate Record Examination.

## **MINIMUM DEGREE REQUIREMENTS**

Twenty-four hours of approved courses in geography including six in thesis research, and six additional hours in geography or a related field.

The department also offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 24.

### **COURSES OFFERED**

Admission to the following courses for graduate study requires the approval of the department.

201 HISTORICAL GEOGRAPHY OF THE UNITED STATES (Same as History 201) The physical setting of the American historical development, emphasizing the sequence of peoples and cultures which have occupied the land and their varied appreciation of its resource base. *Prerequisites:* a course in U.S. History plus six additional hours in geography, history, or other social sciences. Three hours. Mr. Miles.

202, 203 HISTORICAL GEOGRAPHY OF EUROPE (Geography 202 same as History 202) European geography within a framework of past times, the historical development and distribution of settlement, economic and political patterns. *Prerequisite:* History 12 plus six additional hours in geography or history. Three hours. Mr. Barnum.
211 GEOGRAPHIC ANALYSIS OF VERMONT A course emphasizing field studies, using the state and local area as an outdoor laboratory to indicate lines of geographic inquiry and to demonstrate methods and techniques of investigation into the human use of the earth. *Prerequisites:* 6 hours in geography. Three hours. Staff.

216 BIOGEOGRAPHY Processes and patterns of distribution, domestication and human utility of plant and animal species and communities in varying environmental and historical contexts. *Prerequisites:* nine hours in geography or biology. Three hours. Mr. Gade.

220 SEMINAR IN ENVIRONMENTAL GEOLOGY See Geology 220.

221 SPECIAL TOPICS IN REGIONAL GEOGRAPHY Specialized study of a particular region or parts thereof. *Prerequisite:* 12 hours in the social sciences including three in geography and departmental permission. Three hours. Staff.

231 PHYSICAL AND RESOURCE GEOGRAPHY OF THE UNITED STATES Identification and analysis of natural regions of the U.S. as they reflect the elements of the physical environment. Emphasis on distributional patterns and resources significance. *Prerequisite:* 6 hours in geography including Geography 12. Three hours. Mr. Meeks.

233 REGIONAL PLANNING This course is identical with Resource Economics 233.

241 ADVANCED PHYSICAL GEOGRAPHY Analysis of the patterns of distribution and the characteristics of the earth's physical landscapes. Survey of changing climatic and physical patterns during prehistoric times. *Prerequisite:* Geography 12 or 51. Three hours, Mr. Lind.

243 SPATIAL ANALYSIS (identical with Resource Economics 243) The Analysis of spatial structure and interaction in geography through quantitative and statistical models. An introduction to measurement, scaling, sampling, classification and geographic covariation within a spatial framework. *Prerequisite:* six hours in geography (preferably including Geography 14) or permission of instructor. Three hours. Mr. Leinbach.

244 ADVANCED ECONOMIC GEOGRAPHY Locational analysis of economic activity, transportation and spatial interaction. *Prerequisite:* Geography 14 and six additional hours in geography, economics, or other social sciences. Three hours. Mr. Leinbach.

246 URBAN GEOGRAPHY An analysis of the morphology and function of cities. Consideration of urban growth and development, methods of classification, distribution, and theories of location. *Prerequisite:* Geography 11 and 6 additional hours in the social sciences. Three hours. Mr. Barnum.

### GEOGRAPHY

251 ADVANCED CLIMATOLOGY Analysis of regional and local climatic data with special reference to climatic controls: special laboratory projects. *Prerequisite:* Geography 151 and permission. Three hours. Mr. Lind.

257 POLITICAL GEOGRAPHY (Same as Political Science 257) The political unit as a geographic area. Location, resources, and the distributional relationships of the variety of cultural or human factors as they have a bearing on the structure and functioning of the modern political unit. The relationship between geopolitics and political geography. *Prerequisites:* 12 hours in geography and political science. Three hours. Mr. Miles.

258 SELECTED TOPICS IN POLITICAL GEOGRAPHY Advanced studies in political geography focusing primarily on contemporary world politics from a geographical and geopolitical viewpoint. *Prerequisite:* Geography/ Political Science 257 and permission. Three hours. Mr. Miles.

261 SPECIAL TOPICS IN REMOTE SENSING OF ENVIRONMENT (same as Geology 219) Advanced research projects in remote sensing involving use and application of multi-spectral data for environmental studies. *Prerequisite:* Geography 161, or permission of the instructor. Three hours. Mr. Lind.

262 CULTURAL GEOGRAPHY (same as Anthropology 262). Concepts and theories of cultural ecology, culture area, culture history and the cultural landscape. *Prerequisites:* Geography 11 and six additional hours in geography, anthropology or other social sciences. Three hours. Mr. Gade.

263 MAN IN NATURE An inquiry into the changing conceptions of the earth as the home of man, and the conservative and destructive uses of the physical environment that have resulted from these attitudes. *Prerequisite:* 3 hours of geography. Three hours. Mr. Gade.

271 ADVANCED CARTOGRAPHY The history and importance of cartography; contemporary developments; special laboratory projects. *Prequisite:* Geography 71 and permission. Three hours. Mr. Barnum.

281 THE NATURE OF GEOGRAPHY The history, philosophy and structure of modern geography. *Prerequisite:* 12 hours in geography. Three hours. Staff.

301-305 Each seminar will count for three credits; at least one will be offered each year.

301 SEMINAR IN HUMAN GEOGRAPHY

303 SEMINAR IN PHYSICAL GEOGRAPHY

305 SEMINAR IN REGIONAL GEOGRAPHY

381 ADVANCED READINGS AND RESEARCH Readings on research topics, with conferences and reports, to provide graduate students with background and specialized knowledge in an area not appropriately covered by an existing course. Credit as arranged. Staff.

391 MASTER'S THESIS RESEARCH Credit as arranged.

### • GEOLOGY

Professor Stanley (Chairman); Associate Professors Hunt and Wagner; Assistant Professors Bucke, Drake and Doolan.

Research programs are oriented in the following areas: Selected problems in minerology; selected problems in igneous and metamorphic petrology; sedimentary and metamorphic stratigraphy of New England and nearby areas; structural geology of sedimentary, metamorphic, and igneous terrains, including structural analysis of strain features of various sizes; petrofabric studies of strain features in selected minerals; geologic history and recent sedimentation of Lake Champlain; evolution, ecology and ontogeny of invertebrate fossils; glacial geology of Green Mountains and Champlain Lowland; ground water and geomorphic problems in Northern Vermont; problems in environmental geology; field and laboratory cold room ice studies. Interdisciplinary studies are available.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major in Geology, year courses in Chemistry, Physics or Biology, and Mathematics. Open to undergraduate majors in physics, chemistry, biology, engineering or mathematics who have accumulated 12 semester hours in geology.

# MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

Thesis and advanced courses in Geology must total at least thirty semester hours. Advanced courses in related sciences are encouraged and may be substituted for some selected Geology courses on approval by the departmental advisor.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE IN TEACHING (GEOLOGY).

- 1. A bachelor's degree from an accredited institution;
- 2. Certification as a teacher of a physical or natural science;
- 3. Satisfactory scores on the Graduate Record Examination (Aptitude portion).

### MINIMUM REQUIREMENTS FOR THE DEGREE OF MASTER OF SCI-ENCE IN TEACHING (GEOLOGY).

Thirty hours of course work that will strengthen the students background in earth science. Up to 12 hours of 100-level courses may be chosen if applicable. Course work may be chosen from supporting subject areas as well as from geology. Each student, in conference with his adviser, will develop a program

#### GEOLOGY

suited to his needs and background. No thesis is required, however, each degree recipient must complete a general written or oral examination.

A program is also offered leading to the degree of Master of Arts in Teaching: Cf. p. 24.

### **COURSES OFFERED**

215 GEOMORPHOLOGY Examination of stream, wind, glacier, and wave mechanics and the resultant land forms. Emphasis is given to recent field and laboratory studies. *Prerequiste:* 51 or permission of instructor. Three hours. Mr. Wagner.

216 GLACIAL GEOLOGY Quaternary history of the world with emphasis on the origin, mechanics and effects of past and present glaciations. *Prerequisite:* 51 or permission of instructor. Three hours. Alternate years. Mr. Wagner.

218 HYDROGEOLOGY The origin, occurrence, movement, and character of ground water in various geologic environments; principles and practices of development, utilization, and management of ground water supplies. *Prerequisite:* 51, 216, or permission of instructor. Three hours. Alternate years. Mr. Wagner.

219 SPECIAL TOPICS IN REMOTE SENSING OF THE ENVIRONMENT (See Geography 261) Three hours. Mr. Lind.

220 SEMINAR IN ENVIRONMENTAL GEOLOGY Consideration of environmental problems in Vermont, New England, and elsewhere with emphasis on the geological role in the solution of these problems. *Prerequisite:* 51, 132, or permission of instructor. Three hours. Staff.

221 SOIL CLASSIFICATION AND LAND USE (See Plant and Soil Science 261) Three hours. Mr. Bartlett.

223 ENVIRONMENTAL GEOLOGY ACTION STUDIES Study of environmental problems. Emphasis is given to project selection, investigation methods, actual investigation, and constructive implementation of findings for maximum social benefit. *Prerequisite:* permission of instructor. Three hours. Mr. Wagner.

235 ADVANCED STRUCTURAL GEOLOGY Dynamic and kinematic origin of earth structures with emphasis on field studies, rock mechanics and other laboratory experiments. *Prerequisite:* 166. Three hours. Mr. Stanley.

237 STRUCTURAL PETROLOGY Origin of strain features in common rockforming minerals with emphasis on their dynamic and kinematic interpretations as based on laboratory and field studies. Laboratory includes orientation and universal stage procedures, use of computers in the rotation of data, and methods of interpretation. *Prerequisite:* 166 and 145. Three hours. Mr. Stanley.

238 FIELD GEOLOGY Geologic mapping of nearby areas. Methods of analysis of field data, structural features in sedimentary, metamorphic, and igneous rocks, and stratigraphic principles. Held in late May and early June. *Prerequisite:* 166 or departmental permission. Four hours. Mr. Stanley. 242 REGIONAL GEOLOGY An examination and comparison of the geology of selected portions of the world. *Prerequisites:* 155 or 156, 166. Three hours. Mr. Stanley, Mr. Doolan.

245 NEW ENGLAND GEOLOGY Comprehensive study of the geology of New England with emphasis on the spatial and temporal relationships to the eastern part of the North American continent. *Prerequisite:* 166, 156, or 224. Three hours. Mr. Stanley.

250 ADVANCED MINERALOGY Selected topics in mineralogy including crystal chemistry, experimental mineralogy, and current problems in mineralogy. *Prerequisite:* permission of instructor. Three hours. Alternate years. Mr. Drake.

252 CLAY MINERALOGY The structure, composition, properties, occurrence, origin, distribution, environmental significance of the various clay minerals. Laboratory techniques in identification of clay minerals and measurement of their physical and chemical parameters. *Prerequisite:* permission of instructor. Three hours. Mr. Bucke.

253 PHASE EQUILIBRIUM The application of thermodynamics and graphical methods to the analysis of multicomponent, polyphase systems of mineralogical interest. *Prerequisite:* 111 or permission of instructor. Three hours. Mr. Drake.

254 GEOCHEMISTRY The application of basic concepts in chemistry to geological problems, including solution geochemistry, weathering, mineral paragenesis, and the effects of pressure and temperature. *Prerequisites:* 155 or 156 or permission of instructor. Three hours. Mr. Drake.

261 IGNEOUS GEOLOGY Paragenesis of igneous rocks; laboratory work on selected suites of specimens. *Prerequisite:* 145, 156. Three hours. Alternate years. Mr. Doolan.

264 METAMORPHIC GEOLOGY The origin of metamorphic rocks with emphasis on the concepts of metamorphic facies, analysis and interpretation of mineral assemblages, and the spacial relationship of metamorphism to tectogenesis. *Prerequisites:* 145, 156. Three hours. Alternate years. Mr. Doolan, Mr. Drake.

270 INVERTEBRATE PALEONTOLOGY Classification, geological distribution, evolution, and morphology of major invertebrate fossil groups. Consideration given to correlation and environmental interpretation. Laboratory includes methods of collecting, preparing, and identifying fossils. *Prerequisite:* 121, or equivalent. Three hours. Mr. Hunt.

272 RECENT SEDIMENTATION Investigation of recent sedimentary environments using geolimnological and oceanographic techniques. Group and individual projects. Field oriented with use of the University research boats. *Prerequisite:* 155 or 42 and permission of instructor. Three hours. Mr. Hunt.

277 STRATIGRAPHY The sequential development and distribution of the sedimentary rocks. *Prerequisite:* 156 or permission of instructor. Three hours. Alternate years. Mr. Bucke.

#### GERMAN

278 SEDIMENTARY PETROLOGY Origin and interpretation of sedimentary rocks. Topics include mechanics of transportation and deposition, recent depositional environments, interpretation of surface textures, methods of statistical analysis, theoretical aspects of rock classification, and sedimentary tectonics. This section study and individual projects. *Prerequisite:* 155. Three hours. Mr. Hunt.

291 SEMINAR IN GEOLOGY Selected topics of current interest. *Prerequisite:* senior or graduate standing. One to three hours. Staff.

371 ADVANCED READINGS Readings and research problems intended to contribute to the program of graduate students in phases of geology for which formal courses are not available. *Prerequisite:* graduate standing in geology. One to three hours. Staff.

391 MASTER'S THESIS RESEARCH Credit as arranged.

## • GERMAN

**Professor Webster (Chairman); Associate Professors Kahn and Paucker;** Assistant Professors Allen, Mieder and Richel.

Current research interest concerns the linguistic structure of German; history of the German language; medieval German literature; literature of the eighteenth, nineteenth and twentieth centuries; the modern novel; exile literature; culture; folklore; and stylistics.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

An undergraduate major in German, including a year course in literature and a year course in advanced composition and conversation or the equivalent, satisfactory scores on the Graduate Record Examinations.

#### **MINIMUM DEGREE REQUIREMENTS**

German 381; additional courses in German; advanced courses in a related field (6 hours); thesis research (6-12 hours).

The department also offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 24. Satisfactory scores on the Graduate Record Examination are prerequisite to acceptance to candidacy for this degree.

#### **COURSES OFFERED**

201 PROSEMINAR: METHODS OF RESEARCH AND BIBLIOGRAPHY An introduction to tools and methods of research. *Prerequisite:* 101, 102 or the equivalent. Three hours. Mr. Mieder.

203 DEVELOPMENT OF GERMAN INTELLECTUAL MOVEMENTS A comprehensive survey of the history of ideas as a framework for the study of German literature. *Prerequisite:* 101, 102 or the equivalent. Three hours. Mr. Paucker.

204 COURTLY EPIC AND MINNESANG Cultural background and major works of medieval classicism. *Prerequisite:* 101, 102 or the equivalent. Three hours. Mr. Paucker.

205, 206 GOETHE AND SCHILLER AND THEIR TIME Origin, development, characteristics and criticism of German Classicism. *Prerequisite:* 101, 102 or the equivalent. Three hours. Mr. Webster and Staff.

207 NINETEENTH CENTURY PROSE Masterpieces of narrative prose by representative authors such as Mörike, Keller, O. Ludwig, C.F. Meyer, Stifter, Raabe and the early Thomas Mann will be read. *Prerequisite:* 101, 102 or the equivalent. Three hours. Staff. Alternate years, 1974-75.

208 NINETEENTH CENTURY DRAMA Works by Kleist, Büchner, Grillparzer, Hebbel, O. Ludwig, Wagner and the early Hauptmann will be read. *Prerequisite:* 101, 102 or the equivalent. Three hours. Staff. Alternate years, 1974-75.

209, 210 THE TWENTIETH CENTURY Selected works in poetry, prose and drama by Brecht, George, Hauptmann, Hofmannsthal, Kafka, Thomas Mann, Rilke, and others will be read. *Prerequisite:* 101, 102 or the equivalent. Three hours. Mr. Allen. Alternate years, 1973-74.

221, 222 ADVANCED COMPOSITION AND CONVERSATION Guided conversation, discussion and advanced oral and written drill in German. Study of modes of expression and stylistic devices of modern German based on analysis of selected texts. Problems in translating literary and technical English prose into German. *Prerequisite:* 121, 122 or equivalent. Three hours. Mr. Kahn.

232 HISTORY OF THE GERMAN LANGUAGE Introduction to Germanic linguistics, the comparative method, and linguistic reconstruction. The linguistic development of German from Indo-European to the present. No knowledge of older stages of the language is presupposed or required. *Prerequisite:* 121, 122 or the equivalent. Three hours. Mr. Mieder.

235 THE STRUCTURE OF GERMAN Linguistic analysis of the phonological, morphological, and syntactic structure of modern German with special attention to problems useful for teachers. *Prerequisite:* 121, 122 or the equivalent. Three hours. Staff.

281 SEMINAR Special readings and research. Three hours. Staff.

322 BRECHT AND THE MODERN DRAMA Brecht's major dramas, as well as selected theoretical writings. Analysis of his concept of modern theater and its influence on contemporary German playwrights. Readings to include Dürrenmatt, Weiss and others. Three hours. Miss Richel.

### HISTORY

381 GRADUATE SEMINAR Readings, conferences, and reports in connection with the work of candidates for the Master's degree. Credit as arranged. Staff.

391 MASTER'S THESIS RESEARCH Credit as arranged.

## HISTORY

Professors Bliss, Daniels, Davison, Evans (Emeritus), Felt (Chairman), Hand, Rollins, Schmokel (Director of Graduate Studies), Schultz and Stout; Associate Professors Hutton, Metcalfe, Muller, Overfield, Seybolt, Spinner and Steffens; Assistant Professors Andrea, Fackler, Stoler, True and Young.

Research interests include American history of the colonial, early federal, Civil War, and twentieth-century periods; American social and legal history; American foreign relations; Vermont history; history of the American black; American military history; Medieval Europe; the Renaissance and the Reformation; French history; English History (Tudor-Stuart and recent); twentiethcentury German, Russian and Chinese history; the Communist movement and Soviet foreign policy; Canadian history (including French Canada); Latin American history; African history; music history; history of science. For ancient history, see Latin and Greek.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS AND MASTER OF ARTS IN TEACHING

An undergraduate major in history, or in a related field of the social sciences or humanities with the equivalent of a minor in history. Competency in a foreign language as appropriate to the student's intended program.

Applicants must take the Graduate Record Examination (aptitude and advanced history), and submit a sample independent research paper or term paper written in the course of undergraduate study.

# MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS

Twenty-four hours in History, including thesis research (six hours), and History 301; six additional hours in History or a related field.

The Department also offers a program leading to the degree of Master of Arts in Teaching (Cf. p. 24). Satisfactory scores on the Graduate Record Examination are prerequisite for acceptance to candidacy for this degree.

#### **COURSES OFFERED**

200 PHILOSOPHY OF HISTORY An investigation of the theories of his-

tory from the perspectives of both historians and philosophers. Three hours. Mr. Steffens.

201 HISTORICAL GEOGRAPHY OF THE UNITED STATES This course is identical with Geography 201.

202 HISTORICAL GEOGRAPHY OF EUROPE This course is identical with Geography 202.

203 LATIN AMERICAN HISTORY The Spanish Empire in America including the Indian heritage, the conquest, economic, social and political trends within the empire, and the struggles for independence. Reading knowledge of Spanish strongly recommended. Three hours. Mr. True.

205 HISTORY OF MEXICO Reading knowledge of Spanish strongly recommended. Three hours. Mr. True.

207 THE EARLY MIDDLE AGES Western Europe from the late Roman Empire to the death of Otto III (A.D. 1002). Three hours. Mr. Andrea.

208 THE HIGH MIDDLE AGES Western Europe, 1000-1300. Three hours. Mr. Andrea.

211 THE RENAISSANCE Historical change in Italy and northern Europe from the 14th century to the early 16th century, emphasizing the transition from medieval to early modern society. Three hours. Mr. Overfield.

212 THE REFORMATION Political, economic, and cultural developments in Europe in the sixteenth century. Particular attention will be devoted to the religious movements. Three hours. Mr. Overfield.

213, 214 CANADIAN HISTORY Canadian development from the French exploration and settlement to the present; evolution of self-government and relations with the United States; historical foundations of the problems of biculturalism. Three hours. Mr. Muller, Mr. Metcalfe, Mr. Young.

215, 216 FRENCH CANADA A history of the French experience in North America from 1608-1867, and 1867 to the present. Ability to read in French a decided asset. *Prerequisite:* 213, 214, or concurrent enrollment in same. Three hours. Mr. Young.

221 THE AMERICAN COLONIES Three hours. Mr. Carlson, Mr. Stout.

222 THE AMERICAN REVOLUTION Three hours. Mr. Carlson, Mr. Stout.

226 THE MIDDLE PERIOD OF U.S. HISTORY History of the U.S., 1815-1856. Three hours. Mr. Fackler.

231, 232 FRENCH HISTORY First semester: seventeenth century to 1815; second semester: 1815 to the present. Three hours. Mr. Hutton.

233, 234 GERMAN HISTORY First semester, seventeenth century to 1850; second semester, 1850 to the present. Three hours. Mr. Overfield, Mr. Schmokel.

#### HISTORY

235, 236 INTELLECTUAL HISTORY OF MODERN EUROPE Emphasis upon ideas in their relation to major political and social movements. First semester: Humanism, the Scientific Revolution, and the Enlightenment (1500-1800); second semester; the Nineteenth century (1800-1914). Three hours. Mr. Hutton, Mr. Overfield.

240 AMERICAN BIOGRAPHY Investigation and portryal of personalities; the uses of biography in the study of American history. Subjects selected to represent a variety of vocations and aspects of history. Three hours. Mr. Schultz.

243 SOVIET RUSSIA The USSR from the Revolution of 1917 to the present. Three hours. Mr. Daniels.

244 TSARIST RUSSIA History of Russia from the Middle Ages to the Revolution of 1917. Three hours. Staff.

253 TUDOR-STUART ENGLAND England from 1485 to 1660, with particular emphasis on the central period from the 1530's to the 1640's (the Henrician Reformation to the Revolution). Three hours. Mr. Metcalfe. (Offered 1972-73 and alternate years)

254 VICTORIAN ENGLAND Selected topics in 19th century English history with emphasis on "industry and empire," changing class relationships, and the growth and development of political parties. Three hours. Mr. Spinner. (Offered 1972-73 and alternate years)

257, 258 AMERICAN STATESMEN Thought and practical politics of American statesmen. Three hours. Mr. Schultz.

259 THE LINCOLN ERA A history of the United States, 1830-1865, with emphasis on the sectional conflict of the 1850's, the Civil War and the life of Lincoln. Three hours. Mr. Schultz.

261 VERMONT HISTORY A survey of Vermont history from early times to the present. Three hours. Mr. Muller.

263, 264 SOCIAL HISTORY OF THE U.S. Selected topics in the history of American society, including social movements, rural history, or urban history. Three hours. Mr. Fackler.

265, 266 AMERICAN INTELLECTUAL HISTORY Three hours. Mr. Felt. 267, 268 HISTORY OF U.S. FOREIGN RELATIONS First semester 1763-1893; second semester 1893-present. Three hours. Mr. Stoler.

271, 272 HISTORY OF MODERN CHINA History of China in modern times, including the Empire, the Western impact, the Revolutions of the 20th century, and the Communist regime. Three hours. Mr. Seybolt.

277 SOVIET POLITICS (Same as Political Science 277) An intensive historical and institutional study of the Soviet government and Communist Party, mainly treating the period since 1953. Application of sociological and biographical analysis and data-processing techniques. Comparative treatment of other communist systems. *Prerequisite:* 6 hours of appropriate work in history, political science, or economics. Three hours. Mr. Daniels.

278 FOREIGN POLICY OF THE USSR (Same as Political Science 278).

280 SCIENCE AND CULTURE A study of science as an integral part of the culture of our age with emphasis on the published works of leading scientists, mathematicians and "humanists" of the 20th century. Three hours. Mr. Steffens.

281 SCIENTIFIC REVOLUTIONS AND SOCIETY An evaluation of the relationship between scientific activity and conditions of society during the "Scientific Revolution" of the 17th century, the rapid development of science and technology in the 19th century and the "new science" of the 20th century. 289 QUANTITATIVE METHODS IN HISTORICAL RESEARCH Applications of quantitative methods to the selection and analysis of historical source materials; emphasis on political and social data. Use of the University's Computation Center facilities and other data-processing equipment. *Prerequisite:* Math 110 or permission of the instructor. Three hours. Mr. Fackler.

291 GENERATION OF HISTORICAL EVIDENCE Readings, research and field work on the problem of assessing how events generate evidence and how historians judge and correlate such evidence. Discussion of archival practices and of the approaches to evidence used by the social sciences. Emphasis on first-hand experience in the processes which generate primary source material. Three hours. II. Staff.

301 HISTORIOGRAPHY Techniques of historical research and the development of the various philosophies of history. Designed to provide a professional orientation for graduate students. Required for all beginning M.A. candidates. Three hours. Staff.

377 SPECIAL TOPICS Mr. Felt and Staff.

391 MASTER'S THESIS RESEARCH Required of all candidates for the M.A. Normally arranged for two semesters at three hours each.

397 SPECIAL READINGS AND RESEARCH Directed individual study of areas not appropriately covered by existing courses.

## • HOME ECONOMICS

Professors Betsinger (Chairman), Brown, Grams, Morse, Williams; Associate Professors Caldwell, Knowles, Powell, Webster; Assistant Professors Atwood, J. Emanuel, Goldhaber, Jameson, Livak, Osborn, Prior, Shelton, Soule and Whittlesey; Instructors Buller, F. Emanuel, Lord, Marvin, McKay, Reidel and Simon; Teaching Associate Lawler; Technologist Hegyi; Adjunct Professor Spaven; Adjunct Assistant Professors Coffey, Strassburg and Wynne; Affiliated Faculty: Assistant Professor Rathbone.

#### HOME ECONOMICS

The Department offers the Master of Science degree in Human Nutrition and Foods, the Master of Arts in Teaching, and the Master of Extension Education. The degree of Doctor of Philosophy in the field of Nutrition is offered in cooperation with the Department of Animal Sciences.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major in Human Nutrition and Foods or a related field.

#### MINIMUM DEGREE REQUIREMENTS

Twenty-one hours of graduate credit including thesis research (6-15 hours) must be earned in the field of specialization and may include courses in foods, nutrition, and related sciences; nine hours may be selected from minor subjects of which a course in statistics is recommended.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

See Department of Animal Sciences page 43.

# **PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS IN TEACHING**

An undergraduate major in Home Economics or a related field.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF EXTENSION EDUCATION

An undergraduate major in Home Economics or a related field. See Department of Vocational Education and Technology, page 00.

### **COURSES OFFERED**

S217 AMERICAN TEXTILES AND FASHION: TWO CENTURIES—18th CENTURY TO 1910 Study of home production of textiles, needle art and clothing in collections at Shelburne Museum. Lectures, demonstrations and laboratory experience. *Prerequiste:* six hours in design and/or textiles, or permission of instructors. Three hours. Misses Atwood and Caldwell.

219 INTERIOR DESIGN II Interior design; period furnishing, its present use and influence upon modern furnishing. *Prerequisite:* 119. Three hours. Miss Caldwell.

221 COSTUME DESIGN AND DRAPING Draping techniques in creative fashion design. Handling of fabrics in relation to line in dress. Original projects. *Prerequisites:* 15, 122. Three hours. Mrs. Webster.

#### HOME ECONOMICS

229 CLOTHING, TEXTILES AND RELATED ART SEMINAR Theory and research in Clothing, Textiles and Related Art, analysis of current problems; review and discussion of recent publications; individual studies. *Prerequisites:* 117, 219 or 221. Three hours. Staff.

235 RECENT ADVANCES IN FOODS AND NUTRITION Interpretation, application and communication of trends in foods and nutrition as evidenced through literature and research. *Prerequisites:* 12 hours in foods and nutrition and related areas. Three hours. Staff.

236 INTRODUCTION TO FOOD RESEARCH Methods and techniques used in experimental work in foods. Independent laboratory study of problems in food preparation. *Prerequisite:* 135. Three hours. Miss Williams.

237 READINGS IN FOODS Critical survey of the literature on the recent developments in food research. *Prerequisite:* senior standing; 135. Two or three hours. Staff.

238 WORLD DIETARY PROBLEMS A background for understanding the causes of undernutrition, the magnitude of the problem, and the programs seeking workable solutions. *Prerequisites:* 135, 144, or departmental permission. Three hours. Miss Williams.

239 INSTITUTIONAL ORGANIZATION AND MANAGEMENT Institutional organization and management; personnel policies; laws and regulations; promotion and advertising. *Prerequisites:* 138, 139, or equivalent. Three hours. Mr. Emanuel.

240 METHODS IN NUTRITION EDUCATION Problems common to nutrition educators in schools, hospitals, and community. Individual investigations selected to meet special needs. *Prerequisite:* college course in nutrition or departmental permission. Three hours. Staff.

244 DIET THERAPY Adaptations of the normal diet in conditions affected by or affecting the utilization of food. *Prerequisites:* 246, biochemistry, physiology. Four hours. Miss Powell.

246 ADVANCED NUTRITION A study of nutrients and their specific functions in metabolic processes. *Prerequisites:* 43 or equivalent, and a course in biochemistry and physiology. Three hours. Staff.

248 READINGS IN NUTRITION Critical survey of the literature on recent developments in nutrition. *Prerequisites:* 246, or departmental permission. Two or three hours. Staff.

249 NUTRITION SEMINAR A review of recent developments in nutrition with special emphasis on nutritional problems on a worldwide basis. *Prerequiste:* a college course in principles of nutrition. Three hours. Miss Morse and Mr. Welch.

251 ADVANCED HOUSING Investigation of housing data and current

#### HOME ECONOMICS

problems including studies of environmental factors, technological developments and governmental programs. *Prerequisites:* 51, Economics 12 and Sociology 21. Three hours. Miss Knowles.

256 HOME MANAGEMENT PROBLEMS Application of economic and sociological principles to some problems of the home and family. *Prerequisites:* 56; Economics 12; Psychology 1. Three hours. Staff.

258 FAMILY ECONOMICS The American Family as a socio-economic unit: acquiring resources, managing current consumption, planning for future consumption. *Prerequisite:* 56, Economics 3 or 12. Three hours. Staff.

264 CHANGING ROLES OF MEN AND WOMEN Recent literature regarding the changing roles of men and women and the unique tasks they face in the contemporary world. *Prerequisites:* Junior standing, 9 hours in human development or consent of instructor. Three hours. Mr. Shelton.

265 FAMILY LIFE EDUCATION IN SCHOOL AND COMMUNITY Methods, materials, and philosophy of family life and sex education in the schools. *Prerequisites:* 65, Senior standing and consent of instructor. Three hours. Mr. Grams.

266 SEMINAR IN HUMAN DEVELOPMENT Intensive study of specific issues in human development and their application in a wide variety of professional areas. May be taken more than once up to a maximum of 12 credits. *Prerequisites:* Junior standing, 9 hours of human development or equivalent. Three hours. Staff.

272 TEACHING ADULTS Organization and teaching of classes in home economics to meet the needs of adults; supervised experience in teaching adults. *Prerequisite:* 171, or permission of instructor. Two hours. Miss Brown. 273 OCCUPATIONAL EDUCATION Role of the Home Economics teacher in organizing and implementing wage earning educational units at the secondary school level. *Prerequisite:* 171, or experience in secondary home economics education. Three hours. Miss Osborn.

274 HOME ECONOMICS IN ELEMENTARY AND MIDDLE SCHOOLS Home Economics, an integral part of curriculum, grades one through eight. Observations of children in these grades. *Prerequisites:* 63, 71. Three hours. Miss Osborn.

290 INTRODUCTION TO RESEARCH Research procedures with lectures and discussions of problem selection, objectives, bibliographical techniques, and analysis of data. One hour. Miss Morse.

291 SPECIAL PROBLEMS Reading, discussion, and special field and/or laboratory investigations. *Prerequisite:* Departmental permission. Students may enroll more than once for a maximum of twelve hours. 1-6 hours. Staff. 294 HISTORY OF NUTRITION Foremost investigators and methods involved in the development of present day nutritional knowledge. *Prerequisites:* three hours of nutrition. One hour. Miss Morse.

295 SPECIAL TOPICS Lectures, laboratories, readings or projects relating to contemporary areas of study. Enrollment may be more than once; accumulation up to twelve hours. *Prerequisite:* Departmental permission.

296 FIELD EXPERIENCE Professionally oriented field experience under joint supervision by faculty and business or community representative. Credit arranged up to fifteen hours. *Prerequisite:* Departmental permission.

301 READINGS IN FAMILY ECONOMICS Critical survey of the literature and of recent research in Family Economics. *Prerequisites:* 258. Statistical Methods and one other advanced Economics course (may be taken concurrently). Three or four hours. Staff.

307 ADVANCED CONCEPTS IN NUTRITION (See Animal Science 307.) Three hours. Staff.

308 EXPERIMENTAL TECHNIQUES IN NUTRITION (See Animal Science 308.) Two hours. Staff.

370 ADVANCED HOME ECONOMICS EDUCATION A study of recent trends, philosophy and objectives in methods of teaching homemaking at the secondary school level. Opportunity will be provided for individuals to work on problems related to their own situations. *Prerequisites:* 171, degree in Home Economics, teaching experience. Three hours. Miss Brown.

386 GRADUATE SEMINAR Designed for graduate students concentrating in the department. Advanced study in a special field; opportunities for independent work are provided. Three hours. Staff.

391 MASTER'S THESIS RESEARCH Credit as arranged.

397 PROBLEMS IN EDUCATION (see Education 397) Credit to be arranged. Staff.

# • MATHEMATICS

Professors Brock, Chamberlain, Izzo, Lighthall, Meserve, Moser, Riggs and Schoonmaker (Chairman); Associate Professors Bee, Burgmeier, Cooke, Dwork, Sylwester and Wright; Assistant Professors Aggarwal and Lamborn; Instructors Dickson, Hatcher, Kost, Morency, Mosca, Puterbaugh and Williams.

Current research interests include algebra, real and complex analysis, differential equations, probability and statistics, computer science, operations analysis and combinatorics.

For many mathematics courses it will be assumed that the enrolled student knows how to program the University Computer and how to use the University Computer facility. This knowledge can be acquired by attending an informal, six hour session arranged by the director of the Computer Facility.

### MATHEMATICS

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE\*

Thirty semester hours beyond intermediate calculus, including a year of advanced calculus. Satisfactory scores on the aptitude and advanced sections of the Graduate Record Examination.

### MINIMUM DEGREE REQUIREMENTS

- *Plan A:* Twenty-four semester hours of acceptable graduate credits in advanced Mathematics courses; six semester hours in thesis research.
- *Plan B:* Thirty semester hours of acceptable graduate credits in advanced Mathematics courses; no thesis required.

Under both Plan A and Plan B students already have, or must acquire a knowledge of the content of the following courses: Mathematics 231, 233, 251 and 252.

### **STATISTICS**

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE\*

A baccalaureate degree. One semester of advanced calculus and a course in linear algebra. Satisfactory scores on the aptitude and advanced sections of the Graduate Record Examination.

#### MINIMUM DEGREE REQUIREMENTS

- Plan A: Twenty-four semester hours of acceptable graduate credits in statistics, mathematics and allied fields; six semester hours in thesis research.
- *Plan B:* Thirty semester hours of acceptable graduate credits in statistics, mathematics and allied fields; no thesis required.

Under both Plan A and Plan B students must already have, or must acquire, a knowledge of the content of the following courses in statistics: Mathematics 201, 202, 204, 205, 206, 207, 313 and Applied Nonparametric Statistics.

The student is expected to participate in the Statistics Workshop throughout his graduate studies.

\*The degree of Master of Science in Computer Science is currently under consideration. This degree is expected to be offered under the computer science program.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE FOR TEACHERS

A baccalaureate degree; at least 18 semester hours of credit in collegiate mathematics, including Summer Institute courses S45, S46, S47 and S48, or the equivalent; three years of experience teaching secondary school mathematics; certification as a secondary school teacher of mathematics.

### MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE FOR TEACHERS

Required for the M.S.T. degree in Mathematics is thirty hours of course work in Mathematics. Specific courses in Mathematics which must be included in the program are 121, 124, S142, S144, 251, 260, 261 and three other 200 level courses. Although no thesis is required, each degree recipient must successfully complete a written comprehensive examination. A departmental advisory committee will plan a program for each student recognizing his previous experience. Such programs will be subject to the approval of the Dean of the Graduate College upon recommendation of the Chairman of the Mathematics Department.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY\*

The applicant must satisfy the prerequisites of the Graduate College. He must have a Master's degree, or at least one year (30 semester hours) of graduate study, and satisfactory scores on the aptitude and advanced sections of the Graduate Record Examination. His prior studies must include the equivalent of a year of advanced calculus, Mathematics 241, 242, and a semester of modern algebra, Mathematics 251. If specialization in Computer Sciences is desired, the candidate must have had one year of work equivalent to our Mathematics of Computing, Mathematics 115, 116. In addition the student must qualify on Preliminary Examinations in algebra, real analysis and complex analysis and in one area of specialization chosen by the applicant. Qualification includes both understanding of the material and ability to use his knowledge for independent research.

## MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

The student must complete 40 graduate credit hours in formal course work. At least 20 of these credits must be 300 or 400 level courses in Mathematics including two seminars. Total credit hours including thesis must be at least 75. Arrangements will be made for a thesis advisor and thesis committee. All doctoral students are required to participate in the department's undergraduate teaching program.

\*Applications to this program are suspended for the present time.

### **COURSES OFFERED**

200 STATISTICAL METHODOLOGY I Fundamental ideas and techniques of statistics, including randomization, confidence intervals, hypothesis testing, and estimation. Emphasis on applications to current problems of interest to the student requires acquaintance with another discipline to serve as source of data for problems (e.g., education, biology, economics, psychology, agricultural and civil engineering). No graduate credit for mathematics majors. This course is much more demanding than 110. *Prerequisite:* 9. Three hours. Staff.

201 STATISTICAL METHODOLOGY II Techniques of regression, analysis of variance and covariance, multiple comparisons. Heavy emphasis on application requires knowledge of another discipline to serve as source of current problems and data. *Prerequisites:* 200 or 204. Three hours. Staff.

202 SAMPLING METHODS Constructing and analyzing designs for investigations involving sampling techniques. Descriptive surveys including simple random, stratified, and multistage designs. Estimation in finite populations including ratio and regression estimators. *Prerequisite:* 201. Three hours. Staff.

203 ELEMENTS OF PROBABILITY Basic concepts, techniques and applications of probability, random variables, moment generating functions, laws of large numbers and central limit theorems. Techniques and applications include permutations and combinations, binomial and normal distributions, the Poisson process, reliability theory and quality control. No graduate credit for mathematics or electrical engineering majors. *Prerequisite:* 12. Three hours. Staff.

204 MATHEMATICAL STATISTICS I Theory and application of classical statistical methods. Sampling distributions, estimation procedures, tests of hypothesis and confidence intervals. *Prerequisite:* 102, 124, 203. Three hours. Miss Lamborn.

205 MATHEMATICAL STATISTICS II Theory and application of modern statistical procedures. Non-parametric methods, multivariate techniques, decision theory, sequential procedures. *Prerequisite:* 204. Three hours. Miss Lamborn.

206 EXPERIMENTAL DESIGNS Analysis of variance including subsamples and disproportionate subclass numbers, estimation of variance components, incomplete block designs, compounding of factorial effects, fractional replication, multiple comparison techniques, principles of split plots, and pooling of experiments. *Prerequisite:* 201. Three hours. Mr. Bee.

207 PROBABILITY THEORY Basic non-measure-theoretic course in probability theory with some applications. Axioms of probability, random variables, moment generating functions, laws of large numbers and central limit theorems, introduction to stochastic processes. Students will need a strong working knowledge of calculus including infinite series, partial differentiation and multiple integration. *Prerequisites:* 102, 124. Three hours. Mr. Sylwester. 210 APPLIED STOCHASTIC PROCESSES Random walk models, Markov chains, Poisson process, Brownian motion, probability generating functions, discrete branching processes, homogeneous birth and death processes, and diffusion processes. *Prerequisites:* 207. Three hours. Mr. Sylwester.

211 MULTIVARIATE METHODS Multivariate normal theory, tests of hypotheses. Multivariate analysis of variance and covariance, principle components and factor analysis. *Prerequisites:* 201 and 205, or permission of instructor. Three hours. Staff.

215 SOFTWARE FUNDAMENTALS Review of assembly language coding. Batch processing system programs. IOCS buffer pool management, supervisors, loaders, utilities. Parallel processors. Interrupt handling, spooling. Introduction to multi-programming and time sharing. No graduate credit for mathematics majors. *Prerequisite*: 116. Three hours. Staff.

216 SYSTEMS PROGRAMMING Batch processing system programs. Parallel processing of Input — Output. Multiprogramming systems. Timesharing systems. *Prerequisites:* 223, 224, 226. Three hours. Staff.

217 SWITCHING THEORY Lattices and Boolean algebras, Boolean functions, minimization theory, Quine's algorithm, combinational and sequential logic nets, state assignment problems, Hartmanis' theorems, closure operators, Paull-Unger problems. *Prerequisite:* 33. Three hours. Staff.

218 AUTOMATA THEORY Finite state automata, nondeterministic and two-way automata, theorems of Rabin-Scott, Myhill and Kleene. Regular expressions, homomorphisms, the lattice of automata, free automata, isomorphism theorems. *Prerequisite:* 251. Three hours. Staff.

219, 220 MATHEMATICAL LOGIC Truth tables, axiomatic propositional calculus, independence, first order quantification theory, completeness theorems, prenex normal forms, decidability. Formal number theory, recursive functions, Gödel numbers, recursive undecidability, axiomatic set theory, ordinal numbers, the axiom of choice, effective computability, undecidable problems. *Prerequisites:* 102 or consent of instructor; 219 for 220. Three hours. Mr. Cooke.

221 DETERMINISTIC MODELS IN OPERATIONS RESEARCH Techniques of linear and dynamic programming and game theory. Graphs and tree models. Classical problems are discussed, and problem formulation stressed. *Prerequisites:* 124; 121 desirable. Three hours. Mr. Brock.

222 STOCHASTIC MODELS IN OPERATIONS RESEARCH Stochastic processes and their use in analysis of industrial problems. Markov chains, queueing theory, linear and dynamic programming under uncertainty. *Pre-requisites:* 203, or 207; 221. Three hours. Mr. Sylwester.

223 PROGRAMMING LANGUAGES Formal definition of programming languages including specification of syntax and semantics. Global properties of algorithmic languages. List processing, string manipulation and simu-

lation languages. No graduate credit for mathematics majors. *Prerequisite:* 116. Three hours. Staff.

224 DATA STRUCTURES Lists, strings, arrays. Trees and graphs. Storage systems and structures. Storage allocation and garbage collection. Searching and sorting techniques. Generalized data management systems. No graduate credit for mathematics majors. *Prerequisites:* 33, 116, 124. Three hours. Staff. 225 COMPILER CONSTRUCTION Organization of a compiler including compile and run time symbols tables, lexical scan, syntax scan and object code generation. *Prerequisite:* 216. Three hours. Staff.

226 COMPUTER ORGANIZATION Organization, logic design and components of a digital computer. Features needed for multi-programming, multiprocessing time-sharing and real time systems. No graduate credit for mathematics majors. *Prerequisites:* 33, 116, 124. Three hours. Staff.

228 ADVANCED SYSTEMS PROGRAMMING Advanced study and research in a selected area of systems programming. *Prerequisite:* 216. Three hours. Staff.

229 COMPUTER FACILITY MANAGEMENT Non-mathematical content, problems of technical administration, budget considerations, open-closed shop, equipment proliferation, interorganizational relationships. *Prerequi*sites: 116 or permission of instructor. Two hours. Mr. Brock.

230 ORDINARY DIFFERENTIAL EQUATIONS Solutions of linear ordinary differential equations, the Laplace transformation, and series solutions of differential equations. *Prerequisites:* 121, 124. Three hours. Staff.

231, 232 FUNCTION OF A COMPLEX VARIABLE Differentiation and integration of a function of a complex variable, mapping of elementary functions, infinite series, properties of analytic functions, analytical continuation, calculus of residues, contour integration, integral functions, meromorphic functions, Riemann surfaces, and conformal representation. *Prerequisite:* 242; 231 for 232. Three hours. Staff.

233, 234 THEORY OF FUNCTIONS OF REAL VARIABLES Functions of real variables, including: point sets and measure, transfinite numbers, Riemann and Lebesgue integrals, and sequences of functions. Considerable outside reading is assigned. *Prerequisite:* 242; 233 for 234. Three hours. Staff.

235 PARTIAL DIFFERENTIAL EQUATIONS First order equations, classification of second order equations, standard problems of Laplace and Cauchy. *Prerequisites:* 230, 242. Three hours. Staff.

236 CALCULUS OF VARIATIONS Necessary conditions of Euler, Legendre, Weierstrass and Jacoby for minimizing integrals. Sufficiency proofs. Variation and eigenvalue problems. Hamilton-Jacoby equations. *Prerequisite:* 230. Three hours. Staff.

237 NUMERICAL METHODS I Concept of error, polynomial approxima-

tion, summation techniques, solution of equations, linear systems, eigenvalues. *Prerequisites:* 121 and 124. Three hours. Staff.

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238 NUMERICAL METHODS II Finite differences, differentiation and integration, ordinary and partial differential equations, linear programming. *Prerequisite:* 237. Three hours. Staff.

239 INTEGRAL TRANSFORMS The theory of Fourier, Laplace, Hankel and Mellin transforms with applications to fluid dynamics, elasticity, physics. *Prerequisite:* 231. Three hours. Mr. Burgmeier.

240 OPERATIONAL MATHEMATICS Orthogonal functions, transforms and boundary value problems. *Prerequisite:* 230 or 271. Three hours. Mr. Dwork.

241 ADVANCED CALCULUS I Calculus of several variables, Euclidean spaces, open and closed sets, limits, continuity, differentiation (emphasizing the linearity), maxima and minima, Lagrange multipliers and integration of functions of several variables. *Prerequisites:* 121 and 124. Three hours. Staff.

242 ADVANCED CALCULUS II Jacobians, change of variables in a multiple integral, line and surface integrals, Green's, Gauss' and Stokes' Theorems, Fourier Series, Fourier and Laplace transforms. *Prerequisite:* 241. Three hours. Staff.

251 MODERN HIGHER ALGEBRA Fundamental concepts of Abstract Algebra. Sets, mappings, groups, rings, integral domains, fields, homomorphisms and isomorphisms. *Prerequisite:* 12; 102 highly desirable. Three hours. Staff.

252 ADVANCED LINEAR ALGEBRA Linear transformations and vector spaces, including Jordan forms. Symmetric, Hermitian, orthogonal and unitary matrices, and quadratic forms. *Prerequisite:* 124; 251 desirable. Three hours. Staff.

253, 254 TOPOLOGY The elements of point set topology: closed sets and open sets in metric spaces, continuous mappings, connection, Peano curves, separation theorems and homotopy. *Prerequisites:* 102; 253 for 254. Three hours. Staff.

255 ELEMENTARY NUMBER THEORY Divisibility, prime numbers, Diophantine equations, congruence of numbers, and methods of solving congruences. *Prerequisite:* 121. Three hours. Staff.

256 ANALYTIC NUMBER THEORY Prime numbers, prime number theorem, interchange of summations, Euler phi function, Mobius function, Riemann zeta function. *Prerequisite:* 255, 232 desirable. Three hours. Mr. Brock. 257 THEORY OF GROUPS The study of the various kinds and structures of groups. *Prerequisite:* 251. Three hours. Staff.

258 GALOIS THEORY The study of Galois theory leading to the insolvability of general quintic equations by radicals and theorems on constructions

with straightedge and compass. Prerequisite: 257. Three hours. Staff.

260 FOUNDATIONS OF GEOMETRY Geometry as an axiomatic science; various non-Euclidean geometries; relationships existing between Euclidean plane geometry and other geometries; invariant properties. *Prerequisite:* 12. Three hours. Messrs. Izzo, Meserve and Riggs.

261 THE DEVELOPMENT OF MATHEMATICS Besides considering important contributions of outstanding mathematicians of the past, and classical problems of mathematics, the historical development of the concepts of modern mathematics is presented. Three hours. Staff.

262 GEOMETRY FOR ELEMENTARY SCHOOL TEACHERS Informal Euclidean geometry, classical constructions, coordinate geometry, inductive and deductive reasoning, convexity, and an introduction to topology. Not open to mathematics majors. *Prerequisite:* 126. Three hours. Mr. Izzo and Mr. Meserve.

263 PROJECTIVE AND AFFINE GEOMETRIES The principle of duality, perspectivity, projectivity, harmonic sets, cross ratio, the theorems of Pascal and Brianchon, poles and polars. *Prerequisite:* 124. Three hours. Staff.

264 VECTOR ANALYSIS Introduction to general vector methods including the elements of vector algebra and vector calculus with applications to physics and mechanics. *Prerequisite:* 121. Three hours. Staff.

265 DIFFERENTIAL GEOMETRY Analytic metric differential geometry of curves and surfaces in ordinary three dimensional space; curvature, torsion, Frenet formulas, involutes, evolutes, developable and ruled surfaces, geodesic curves. *Prerequisite:* 121. Three hours. Staff.

266 MATHEMATICS OF DIGITAL COMPUTATION FOR TEACHERS Mathematical theory underlying digital computing machines including assigned problems on a university computer, including programming in a computer system language. A portion of the course is devoted to elementary numerical analysis. *Prerequisites:* 121, 124 highly desirable. Three hours. Staff.

271 APPLIED MATHEMATICS FOR ENGINEERS AND SCIENTISTS I Matrix Theory, Vector Analysis, Linear Ordinary Differential Equations. Emphasis on methods of solution, including numerical methods. No credit for mathematics majors. For a mathematics concentration, a sequence beginning with 230 is advised. *Prerequisite:* 123. Three hours. Staff.

272 APPLIED MATHEMATICS FOR ENGINEERS AND SCIENTISTS II Partial Differential Equations of Mathematical Physics, Calculus of Variations, Functions of a Complex Variable, Cauchy's Theorem, integral formula, conformal mapping. *Prerequisite:* 271. Three hours. Staff.

279, 280 SENIOR PROBLEM Investigation of some area or problem, under the direction of an assigned staff member, culminating in a report. This course is available only to candidates for the Bachelor of Science degree in Mathematics. *Prerequisite:* departmental permission. Three hours. Staff.

281, 283, 285, 287, 289, 291, 293 SPECIAL TOPICS For advanced students in the indicated fields. Lectures, reports and directed readings on advanced topics. *Prerequisite:* Consent of instructor. Credit as arranged. Offered as occasion warrants. Staff.

281 Special Topics in Applied Mathematics

283 Special Topics in Computer Science

- 285 Special Topics in Statistics
- 287 Special Topics in Algebra
- 289 Special Topics in Topology

291 Special Topics in Geometry

293 Special Topics in Analysis

301 THEORY OF HYPOTHESIS TESTING AND ESTIMATION Confidence intervals, point estimation, Neyman-Pearson Theory of testing hypotheses, sufficient statistics, decision theory. *Prerequisites:* 205, 208. Three hours. Mr. Sylwester.

303 ADVANCED DESIGN I Theory of factorial arrangements of treatments, general two-way classification, confounding of factorial effects, fractional replication, confounding in mixed series of factorials, randomization tests, transformations of data, split-plot techniques, and analysis of covariance. *Prerequisite:* 313. Three hours. Mr. Bee.

305 MULTIVARIATE ANALYSIS Theory of multivariate normal distribution, simple, partial, and multiple correlation, multivariate sampling distributions. Wishart distribution,  $T^2$  distribution, estimation of parameters, and tests of hypotheses on vector means and covariance matrix. Classification problems, discriminate analysis and applications. *Prerequisites:* 211, 308. Three hours. Mr. Whorton.

306 REGRESSION ANALYSIS Linear, non-linear, and multiple regression. Statistical model building, examination of residuals, application to analysis of variance, and computing algorithms. *Prerequiste:* 201, 205. Three hours. Miss Lamborn.

308 DISTRIBUTION THEORY Continuous, discrete and mixed random variables, Beta, Gamma, and waiting-time distributions, moments, cumulants, characteristic and generating functions. Theory of runs and order statistics, quadratic forms and distribution free statistics. *Prerequisite:* 205. Three hours. Mr. Bee.

309 NON-PARAMETRIC STATISTICAL ANALYSIS Non-parametric procedures including tests based on ranks, permutation tests, asymptotic relative efficiency, and locally most powerful tests. *Prerequisite:* 205. Three hours. Mr. Sylwester.

313 THEORY OF LINEAR STATISTICAL MODELS Non-central chisquare and F distributions, Markoff theorem, general linear hypothesis of full

rank and less than full rank, experimental design models, and variance components. *Prerequisites:* 205, 206. Three hours. Mr. Bee.

314 MEASURE THEORY Sets and classes, inner and outer measure, Lebesgue-Stieltjes measure, measurable functions, absolute continuity, Radon-Nikodym theorem, and applications in theoretical probability. *Prerequisite:* 242. Three hours. Miss Lamborn.

321 RECURSIVE FUNCTION THEORY Recursive functions and effective computability, Turing machines, Church's thesis, unsolvability, Godel numbering, recursive and recursively enumerable sets, Post's correspondence theorem; universality, enumeration, and iteration theorems. *Prerequisite:* 218 or 219. Three hours. Staff.

325 ADVANCED AUTOMATA THEORY Algebraic structure theory of automata, monoids and automata; homomorphisms, simulation and realization. The semigroup of an automata, decomposition theory of Hartmanis-Stearns, Krohn-Rhodes theorem, categories of automata, abstract automata. *Prerequisite:* 218. Three hours. Staff.

326, 327 COMBINATORIAL THEORY Permutations and combinations, Mobius inversion theorem, inclusion-exclusion principle, generating functions, Polya's counting theorem, graphs, Latin square configurations, finite geometries, block designs. *Prerequisites:* 256, 326 for 327. Three hours. Mr. Brock.

331 FOURIER ANALYSIS Trigonometric series, orthogonal polynomials, convergence properties, boundary value problems, applications. *Prerequisite:* 234. Three hours. Mr. Cooke.

332 APPROXIMATION THEORY Interpolation and approximation by interpolation, uniform approximation, approximation in normed linear spaces, spline functions, orthogonal polynomials. Least squares, Chebychev approximations, rational functions. *Prerequisites:* 124, 238. Three hours. Staff.

333, 334 INTEGRAL EQUATIONS Resolvent kernels for Volterra and Fredholm integral equations, elements of Hilbert spaces, the Fredholm alternative, symmetric kernels, eigenvalues and eigenfunctions, Hilbert-Schmidt theory, Mercer's theorem, numerical techniques. *Prerequisites:* 242, 232 and 234 desirable; 333 for 334 or consent of instructor. Three hours. Mr. Burgmeier.

335, 336 FUNCTIONAL ANALYSIS  $L^2$  spaces and  $L^p$  spaces, Hilbert and Banach spaces, linear functionals and linear operators, completely continuous operators, Fredholm alternative, completely continuous symmetric operators, Hilbert-Schmidt theory, unitary operators, Bochner's Theorem, Fourier-Plancherel and Watson transforms. *Prerequisites:* 234, 335 for 336. Three hours. Mr. Dwork.

337, 338 NUMERICAL ANALYSIS Initial value and boundary value problems for systems of non-linear ordinary differential equations, convergence and stability of computational procedures. Analysis of partial differential 130

equations, boundary value problems, iterative methods. Analysis of methods for obtaining eigenvalues and matrix inverses, pseudo inverses. *Prerequisite:* 238, 332 desirable; 337 for 338 or consent of instructor. Three hours. Mr. Brock and Mr. Riggs.

340 ADVANCED OPTIMIZATION TECHNIQUES Modern invariant imbedding techniques are explored. General linear boundary value problems are studied using Riccati transformations. Quasi-linearization and linear functional equations are among advanced modern mathematical topics discussed. Applications and problems formulation are stressed. *Prerequisites:* 230; 237 and 238 desirable. Three hours. Mr. Burgmeier.

351, 352 ABSTRACT ALGEBRA Groups, rings, integral domains, extensions of rings and fields, factorization theory, groups with operators (Jordan-Holder theorem, Krull-Schmidt theorem), modules, chain conditions, Hilbert basis theorem, Noetherian rings, linear spaces, tensor products of modules. *Prerequisites:* 252, 351 for 352. Three hours. Mr. Wright.

391 MASTER'S THESIS RESEARCH Credit as arranged.

437, 438 ADVANCED ORDINARY DIFFERENTIAL EQUATIONS Existence theorems, uniqueness and continuation of solutions, dependence of solutions on a parameter. Linear systems, regular and irregular singular points, Sturm-Liouville systems, asymptotic behavior, Lyapunov stability, periodic solutions, multidimensional systems. *Prerequisite:* 230; 437 for 438, or consent of instructor. Three hours. Mr. Chamberlain and Mr. Wright.

439 ASYMPTOTIC THEORY OF ANALYTIC ORDINARY DIFFEREN-TIAL EQUATIONS I Asymptotic order and equivalence relations, logarithmic monomials and classes of comparison functions, coefficient domains, Bank's algorithm for asymptotic solutions of quasi-logarithmic type, existence and uniqueness theorems for exact solutions of quasi-logarithmic type, approximate and exact factorizations of linear differential equations. *Prerequisites:* 230, 232. Three hours. Mr. Wright.

440 ASYMPTOTIC THEORY OF ANALYTIC ORDINARY DIFFEREN-TIAL EQUATIONS II Quasi-logarithmic coefficient fields, generalized asymptotic expansions, Strodt's structure theorem for asymptotically non singular solutions, quasilinearization procedures. *Prerequisite:* 439. Three hours. Mr. Wright.

445, 446 MATHEMATICAL PHYSICS Investigation of basic equations of mathematical physics, Schroedinger, Maxwell, Poisson. General orthogonal co-ordinate systems, dyads, mathematical structure of Quantum theory. *Pre-requisites:* 232, 235. Three hours. Mr. Dwork.

447, 448 GENERALIZED FUNCTIONS Modern extensions to theory of distributions, delta functionals, countably Hilbert spaces, applications to transform theory and ordinary and partial differential equations. *Prerequisite:* 234, 336 desirable; 447 for 448, or consent of instructor. Three hours. Mr. Dwork. 491 DOCTORAL THESIS RESEARCH Credit as arranged.

## • MECHANICAL ENGINEERING

Professors von Turkovich (Chairman), Berry, Outwater and Tuthill; Associate Professors Carpenter, Duchacek, Hundal, Marshall, Martinek and McLay; Assistant Professor Pope; Adjunct Professors Gardiner, Liu and Zubko.

Master of Science and Doctor of Philosophy programs are offered. Candidates holding degrees other than those in Mechanical Engineering are encouraged to apply. In such cases it may be necessary for the student to complete the entrance qualifications without receiving credit toward his graduate studies. The general requirements for admission, as outlined under the "Regulations of the Graduate College," must be met. Areas of research interest include brittle materials; fracture mechanics of composite materials; two-phase fluid flow; shell structural analysis; non-linear vibrations; biomechanics; stability of fluid jets; radiative heat transfer; matrix methods in structural mechanics; continuum mechanics; physical and mechanical metallurgy; solidification and casting design; mechanical and thermal processing of metals.

# PREREQUISITE FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An accredited Bachelor's Degree in Mechanical Engineering or its equivalent.

# MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

Approved courses in engineering, mathematics and sciences with thesis research; thirty credit hours.

# PREREQUISITE FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Successful completion of the Ph.D. comprehensive written examinations.

### MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy requires of candidates a minimum of seventy-five credit hours to be earned in course and in thesis research. At least 40 credit hours must be earned in courses and seminars and a minimum of 25 credit hours must be earned in thesis research. Each candidate must be able to comprehend the literature of his field in at least one foreign language provided it is required for his thesis work. The requirements specified under Regulations of the Graduate College must also be met.

### **COURSES OFFERED**

202 DYNAMICS II Advanced topics in dynamics of particles and systems

of particles. Space motion in fixed and moving frames of reference. Impulse and momentum. Central force motion. Kinematics and kinetics of rigid bodies. Euler's equations of motion. Gyroscopic effects in mechanical systems. *Prerequisite:* 133. Three hours. Mr. Hundal.

203 MECHANICAL VIBRATIONS Vibration phenomena in single and multi-degree of freedom systems. Response of systems to periodic and transient excitation. Isolation of shock and vibration. Impedance; matrix and numerical methods for vibration problems. Three hours. Mr. Hundal.

204 SYSTEMS ANALYSIS Lumped parameter and distributed-parameter systems analysis of mechanical, thermal, hydraulic, pneumatic, and electromechanical systems; system response to periodic, transient and random excitation. Three hours. Staff.

206 APPLICATION OF COMPUTERS IN ENGINEERING Utilization of analog, digital and hybrid computers as an engineering tool for the solution of complex engineering problems. Four hours. Mr. Hundal.

211 ADVANCED MECHANICAL STRUCTURES I Energy methods; topics in solid mechanics, introduction to elasticity. Three hours. Mr. McLay.

222 ADVANCED MECHANICAL STRUCTURES II Elasticity; matrix methods. Three hours. Mr. McLay.

231 MATERIALS PROCESSING II Fundamental theory of selected mechanical and thermal processing techniques with applications. *Prerequisites:* 113, 131 or equivalents. Three hours. Mr. Berry.

233 STATISTICAL TECHNIQUES IN MANUFACTURING Quality control engineering methods including correlation, variance and time series analysis. Principles of experimental design and operations research in manufacturing. *Prerequisites:* 53 or 131, Math 200. Three hours. Staff.

243 ADVANCED FLUID MECHANICS Foundations of fluid dynamics; thermodynamics and concepts of compressible flow; isentropic flow; normal shock waves; flow in ducts with friction and with heating or cooling; generalized solution of combined effects. *Prerequisite:* 142 and Mathematics 211. Four hours. Mr. Duchacek.

244 COMPRESSIBLE FLOW Introduction to flow in two and three dimensions; steady irrotational flow; small pertubations; the hodograph method; the Karman-Tsien, Prandtl-Glauert, and Gothert's methods; supersonic airfoils; the method of characteristics; oblique shocks; shock waves and boundary layer interaction. *Prerequisite:* 243. Three hours. Mr. Duchacek.

246 AERODYNAMICS Application of the principles of fluid mechanics to the design and performance of aircraft; fluid dynamics; experimental facilities; airfoil characteristics; aspect ratio and plan-form influences; viscosity phenomena as applied to boundary layer; transition and separation on various shapes; compressibility phenomena; the optimum airfoil; performance. Pre-

requisite: 142. Three hours, Mr. Duchacek.

252 ENGINEERING DESIGN II Application of the principles of engineering mechanics, material science, and thermal science to the design of mechanical systems and their components; optimization, fracture mechanics, product design. Group projects from industry. *Prerequisites:* 53 or 131; 135, 142, 171. Four hours. Mr. Carpenter.

262 THERMAL SYSTEMS Application of engineering thermodynamics to the analysis of thermodynamic machines and processes; problems on gas turbine, jet propulsion, nuclear power plants, energy conversion devices and other areas of current interest. *Prerequisites:* 11 or 113, 266. Four hours. Mr. Tuthill.

266 HEAT TRANSFER Fundamental principles of heat transfer; conduction, convection, radiation; steady and unsteady state; the electric analogy; applications to heat transfer equipment. *Prerequisites:* 111 or 113; Mathematics 271. Three hours. Mr. Duchacek.

267 ADVANCED THERMODYNAMICS A rigorous, detailed study of the laws of thermodynamics and of ideal and actual thermodynamic processes. *Prerequisites:* 111 or 113, Mathematics 271. Three hours. Mr. Tuthill.

271 INDUSTRIAL MATERIALS II The composition, structure, mechanics and fabrication of polymeric materials. The mechanism of adhesion. Deformational mechanics of crystalline materials. *Prerequisite:* 171. Three hours. Mr. Outwater.

272 MECHANICAL BEHAVIOR OF MATERIALS Elastic and plastic behavior of single crystals and polycrystals; dislocations; approximate plastic analysis; anisotropic materials; hardness; residual stress; brittle, transitional and ductile fractures; fatigue; damping; creep and surface phenomena. Three hours. Mr. Outwater.

281 SEMINAR Presentation and discussion of advanced mechanical engineering problems and current developments. *Prerequisite:* graduate engineering enrollment. One hour. Staff.

284 ADVANCED HEAT ENGINES Application of engineering science to specific types of heat engines according to the interest of the students. *Pre-requisites:* 111, 142, 266. Three hours. Staff.

294 ENGINEERING DESIGN ANALYSIS AND SYNTHESIS Application of the fundamental concepts and principles of mathematics, physics, mechanics, electricity, thermodynamics, fluid dynamics and heat transfer combined with economic considerations and decision-making processes to the rigorous training in the design analysis and synthesis of engineering systems and their components. Two hours. Staff.

297 NUCLEAR ENGINEERING Fission and fusion chain preactions; criticality; neutron diffusion; fast and breeder reactors; design considerations and accident delineation; high pressure and boiling heat transfer; liquid metals; fuelcoolant interaction; transient phenomena; safety. *Prerequisites:* senior or graduate standing. Four hours. Staff.

301 ADVANCED ENGINEERING DESIGN ANALYSIS AND SYNTHE-SIS Application of the fundamental concepts and principles of advanced mathematics, physics, mechanics, electricity, thermodynamics, fluid dynamics and heat transfer combined with economic considerations and decisionmaking processes to the rigorous training in the design, analysis and synthesis of complex engineering systems and their components. *Prerequisite:* Graduate Standing in ME. Four hours. Staff.

302 ENGINEERING ELASTICITY Tensors, complex variables, variational methods. Four hours. Mr. McLay.

303 STRESS ANALYSIS (THEORY AND EXPERIMENT) Theory and experimental method of measuring static and dynamic stress and strain including the use of piezoelectric materials; wire resistance strain gages; mechanical, optical, inductance and capacitance displacement gages; photoelasticity; brittle coating; x-rays and associated instrumentation and recording systems; theory of plasticity; methods of elastic-plastic analysis, plastic design of structures, plates and shells. *Prerequisite:* Graduate Standing in ME. Three hours. Mr. McLay.

306 CONTINUUM MECHANICS Tensors, conservation laws, field equations for solids and fluids. Three hours. Mr. McLay.

307 ADVANCED FLUID DYNAMICS Stress in continuum; kinematics and dynamics; potential fields; Wing theory; Navier-Stokes equation; hydrodynamic stability; turbulence; laminar and turbulent boundary layer theory; transient flows; free laminar and turbulent flows; mixing. *Prerequisites:* graduate standing in M.E. Four hours. Mr. Martinek.

308 ADVANCED DYNAMICS Application of Lagrange's equation and Hamilton's principle to mechanical systems. Systems with constraints. Matrix formulation of problems in kinematics and dynamics. Stability of linear and nonlinear systems. *Prerequisite:* ME 202. Three hours. Mr. Hundal.

309 ADVANCED ENGINEERING THERMODYNAMICS Microscopic thermodynamics; Maxwell-Boltzmann, Bose-Einstein, Fermi-Dirac statistics; kinetic theory of cases; transport properties, compressed cases, liquids and solid states; chemical systems; irreversible processes; fluctuations. *Prerequisites:* graduate standing in M.E. Three hours. Mr. Martinek.

310 ADVANCED HEAT TRANSFER Generalized equation of heat conduction; classical, integral transforms and approximate solutions; thermal boundary layers; forced and free convection; condensation, boiling and ablative cooling; radiation, statistical theory; mass transfer. *Prerequisites:* graduate standing in M.E. Three hours. Mr. Martinek.

311 ADVANCED GAS DYNAMICS Compressible flow in ducts; friction and heat transfer; shock waves; small perturbation theory; similarity in high speed flows; transonic, supersonic and hypersonic flows; methods of characteristics. Aerodynamic heating; rarified gas flows. *Prerequisite:* graduate standing in M.E. Three hours. Mr. Martinek.

320 SPECIAL PROBLEMS IN ELASTICITY Advanced topics in the theory of elasticity in which there is a particular student and staff interest. *Prerequisite:* Graduate Standing in ME. Three hours. Staff.

321 SPECIAL PROBLEMS IN FLUID MECHANICS Advanced topics in fluid mechanics in which there is a particular student and staff interest. *Pre-requisite:* Graduate Standing in ME. Three hours. Staff.

322 SPECIAL PROBLEMS IN DYNAMICS Advanced topics in dynamics in which there is a particular student and staff interest. *Prerequisite:* Graduate Standing in ME. Three hours. Staff.

323 SPECIAL PROBLEMS IN THERMODYNAMICS Advanced topics in thermodynamics in which there is a particular student and staff interest. *Pre-requisite:* Graduate Standing in ME. Three hours. Staff.

324 SPECIAL PROBLEMS IN HEAT TRANSFER Advanced topics in heat transfer in which there is a particular student and staff interest. *Prerequisite:* Graduate Standing in ME. Three hours. Staff.

325 SPECIAL PROBLEMS IN MATERIALS Advanced topics in behavior of materials in which there is a particular student and staff interest. *Prerequisite:* Graduate Standing in ME. Three hours. Messrs. Berry, Outwater and von Turkovich.

330 MATRIX METHODS IN STRUCTURAL DYNAMICS Matrices, eigenvalve problems, forced vibration, wave propagation. *Prerequisite:* ME 203. Three hours. Mr. McLay.

391 MASTER'S THESIS RESEARCH Credit as arranged. Staff.

491 DOCTORAL THESIS RESEARCH Credit as arranged. Staff.

# • MEDICAL MICROBIOLOGY

Professor Stinebring (Chairman); Associate Professors Boraker, T. Moehring,

#### MEDICAL MICROBIOLOGY

Novotny, Phillips, and Schaeffer; Assistant Professor M. Absher; Instructor Galagher.

Research activities include: host-parasite interactions with emphasis on cellular and molecular aspects of mechanisms of pathogenesis; non-antibody resistance mechanisms especially concerning production, storage, and mode of action of interferon; studies of cellular aging; transplantation immunity and immunogenetics; mechanisms of transmission of bacterial DNA; studies of rubella, respiratory syncytial, and other viruses.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Two years of biological science; mathematics through elementary calculus (Mathematics 12 equivalent); one year course in physics (Physics 5 and 6 equivalent); chemistry including one year of inorganic chemistry, quantitative analysis and one year of organic chemistry (equivalent of Chemistry 1, 2, 123, 131, 132). Chemistry 140 (Physical Chemistry for Biological Science Students) would be helpful but is not required.

### **MINIMUM DEGREE REQUIREMENTS**

Medical Microbiology 302, 381-384, Thesis Research; approved selected course or courses from among Medical Microbiology 203, 211, 322, a course in bio-chemistry from among Microbiology and Biochemistry 201-250, 254, or Biochemistry 301-302, 303-304 with approval of the Department; passage of a comprehensive examination in Medical Microbiology and related subjects.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY\*

\*This program offered jointly with Department of Microbiology and Biochemistry.

Two years of biology; chemistry through physical chemistry (equivalent to Chemistry 1, 2, 123, 131, 132, 141, and 144); mathematics through calculus; additional courses required by the Department depending on the aims of the student.

#### **MINIMUM DEGREE REQUIREMENTS**

Medical Microbiology 302; participation in seminars offered by the Depart-

#### MEDICAL MICROBIOLOGY

ment during residency of students; Biochemistry 301-302, 303; Microbiology and Biochemistry 254; approved selected courses from programs in Medical Microbiology, Biochemistry, Physiology and Biophysics, Botany and Zoology or others at the discretion of the Department.

The student is expected to develop proficiency in the use of computer language and programming. There is no other formal language requirement. Knowledge of a particular language may be required by the candidate's Studies Committee if his research problem warrants this decision.

A maximum of thirty-five hours for thesis research will be allowed for the degree.

### **COURSES OFFERED**

203 THE MAMMALIAN CELL AS A MICROORGANISM Discussion of such current ideas in cell biology as cell immortality, transformation, dedifferentiation, synchronization, cell-macromolecule interaction; laboratory will illustrate current cell culture techniques as a foundation for the lectures. Designed for biology students of varied training. Four hours. T. Moehring, Schaeffer.

205 PATHOGENIC BACTERIOLOGY Studies of major species of pathogenic bacteria with emphasis on mechanisms of disease production, epidemiology, control measures, and diagnosis. Designed for advanced undergraduate or graduate students interested in phenomenon of parasitism. *Prerequisite:* permission of the instructor. Three hours. M. Absher and Stinebring. 211 GENETICS OF MICROORGANISMS Studies of mutation, genetic information transfer, fine structure of the gene, cytoplasmic inheritance, and lysogeny in fungi, bacteria, and viruses. *Prerequisite:* permission of the Instructor. Three hours. Novotny.

223 IMMUNOLOGY Analysis of the immune response with respect to structure and function of immunoglobulins, cytokinetics and immunocompetence, tolerance, ontogeny and phylogeny of adaptive immunity, immunogenetics of transplantation, hypersensitivity states, and theories of antibody formation. *Prerequisites:* Consent of the instructor. Four hours. Boraker.

302 MEDICAL MICROBIOLOGY Fundamentals of pathogenic microbiology with emphasis on mechanisms of disease production and mechanisms of resistance to infection. The ecologic rather than taxonomic approach is stressed. *Prerequisite:* permission of the Department. Four hours. Staff.

303 SPECIAL PROBLEMS IN MEDICAL MICROBIOLOGY Supervised investigations in pathogenic microbiology. Credit as arranged. Staff.

325 VIROLOGY Introduction to the nature of viruses, their physical, chemical, and biological characteristics with special reference to cell-virus interaction, viral replication, pathogenesis, viral inhibitors, and oncogenic viruses.

### MEDICAL TECHNOLOGY

Prerequisites: Consent of instructor. Four hours. Gallagher. Alternate years.
381 SEMINAR Current problems in medical microbiology. One hour. Staff.
391 MASTER'S THESIS RESEARCH Credit as arranged.

491 DOCTORAL THESIS RESEARCH Credit as arranged.

## MEDICAL TECHNOLOGY

Professor Coon, Director of Program (Chairman, Department of Pathology); members of the Pathology staff; Associate Professor Breen; Assistant Professors Jones and Kleiler; Instructors Clark, Monaco, Reed and Sullivan.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Undergraduate major in Medical Technology; certification as MT (ASCP) (or equivalent), minimum of one year's experience as a medical technologist. GRE Aptitude Score required.

#### MINIMUM DEGREE REQUIREMENTS

Seminar; additional approved courses in areas including Biochemistry, Microbiology, Administrative and Educational Aspects of Medical Technology; thesis research.

381 SEMINAR Review and discussion of current areas of importance to students in Medical Technology. The seminar will emphasize Administration, Clinical Pathophysiology, Education, and Instrumentation. Selected topics are presented by the student with occasional supplemental discussions led by faculty members or guests. One hour. Dr. Coon.

391 MASTER'S THESIS RESEARCH Credit as arranged. Staff.

## MICROBIOLOGY AND BIOCHEMISTRY

Professors Little and Racusen (Chairman); Associate Professors Foote, Sjogren and Weller; Instructor Husted.

Research currently involves the identification and metabolism of plant proteins, the isolation and characterization of ribosomes from a variety of cell

#### MICROBIOLOGY AND BIOCHEMISTRY

types, the synthesis and regulation of certain isozymes in the glyoxylate bypass of fungi, and the role of microorganisms in aquatic environments. The latter is in collaboration with the Lake Champlain Studies Center.

#### **BIOCHEMISTRY PROGRAM**

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major in Chemistry or Biology which shall include courses in Organic Chemistry, Quantitative Analysis and Biochemistry. A course in Physical Chemistry is strongly recommended.

### MINIMUM DEGREE REQUIREMENTS

Microbiology and Biochemistry 201, 202, 203, 381-384; thesis research (12-15 hours).

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Chemistry 131-132 and 141-142, Mathematics 21, Physics 14-15 or their equivalents; a year course in a biological science, a reading knowledge of one foreign language, French, German or Russian, and the Ph.D. candidacy requirements of the Graduate College. This program is co-sponsored with Biochemistry (College of Med.)

### **MINIMUM DEGREE REQUIREMENTS**

Biochemistry 301, 302, 303; satisfactory participation in biochemistry seminars during residency; advanced courses in Chemistry (10 hours); 10 hours of courses other than Biochemistry and Chemistry; balance of course work from Microbiology and Biochemistry; and doctoral thesis research (30 hours).

### MICROBIOLOGY PROGRAM

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major in science, including an undergraduate course in Bacteriology and Chemistry 131-132.

#### MINIMUM DEGREE REQUIREMENTS

Medical Microbiology 205, 381-384. Thesis Research (10-15 hours).

For another Master's program in the field of Microbiology, see under Medical Microbiology.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY\*

\*Program offered jointly with Medical Microbiology.

One year of organic chemistry and biology and sufficient mathematics and physics to provide background for the candidate's program, a reading knowledge of one foreign language French, German or Russian, and the Ph.D. candidacy requirements of the Graduate College.

#### **MINIMUM DEGREE REQUIREMENTS**

Medical Microbiology 205; the balance of courses from Medical Microbiology, Microbiology and Biochemistry, Biochemistry, Botany and Zoology according to student's need as determined by a studies committee; participation in microbiology seminars throughout residency; doctoral thesis research twenty to thirty-five hours. This program is co-sponsored with Medical Microbiology.

### **COURSES OFFERED**

201 GENERAL BIOCHEMISTRY Broad coverage of biochemistry including principals of analytical biochemistry. *Prerequisite:* Chemistry 16 or 131. Four hours. Mr. Foote. Also offered each spring by Mr. Little.

202 ADVANCED BIOCHEMISTRY A study of metabolic cycles with emphasis on research methods involving radioisotopes and chromatography. *Prerequisite:* 201 or 203 or permission of the instructor. Four hours. Mr. Racusen.

203 MOLECULAR BIOLOGY The structure and biological function of nucleic acids, proteins, and enzymes. Emphasis is on optical, electrophoretic, and ultracentrifugal methods. *Prerequisite:* Chemistry 140 or 142 or permission of instructor. Four hours. Mr. Weller.

220 ENVIRONMENTAL MICROBIOLOGY The activities of microorganisms, primarily bacteria, in air, soil, and water. *Prerequisite:* a previous course in microbiology. Three hours. Mr. Sjogren. Alternate years, 1973-74.

254 MICROBIAL BIOCHEMISTRY The chemical composition and metabolism of microbial cells. *Prerequisite:* 55, 201, or permission of instructor. Four hours. Mr. Sjogren. Alternate years, 1974-75.

301 SPECIAL PROBLEMS *Prerequisite:* permission of the department. Credit as arranged. Staff.

381 SEMINAR A topical seminar with discussion of assigned and collateral reading. Required of graduate students. One hour.

391 MASTER'S THESIS RESEARCH Credit as arranged.

491 DOCTOR'S THESIS RESEARCH Credit as arranged.

#### MUSIC

### MUSIC\*

Professors Lidral and Pappoutsakis; Associate Professors Chapman, D. Kinsey, W. Metcalfe (Acting Chairman), T. Read and Schultz; Assistant Professors Ambrose, Lawes, Weinrich and Wigness; Instructors Anand, Dahl, Dorsam, Fleming, Hartman, F. Kinsey, Lederer, E. Metcalfe, Peterson, Powell, E. Read, Rhinelander and M. Vogelmann; Lecturer Bemis.

Research traditionally includes stylistic study and analysis of selected works with emphasis on structural organization. Graduate research is also conducted in the areas of historical musicology, music education, development of performance techniques and pedagogy, and Americana.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

An approved undergraduate major in Music or Music Education; satisfactory performing ability on an instrument or voice; satisfactory scores on the aptitude and advanced music sections of the Graduate Record Examination; also required for MAT program.

#### **MINIMUM DEGREE REQUIREMENTS**

Twenty-four hours in Music; participation in musical ensembles throughout the term of residence; thesis research (6 hours); a reading knowledge of French, German, or Italian.

The department also offers a program leading to the degree of Master of Arts in teaching: Cf. p. 24. Satisfactory scores on the Graduate Record Examination are prerequisite for acceptance to candidacy for the MAT degree.

### **COURSES OFFERED**

203, 204 ORCHESTRATION First semester: Characteristics of instruments, arranging for orchestra; second semester: advanced exercises in orchestral scoring. *Prerequisites:* 105-106, 203 for 204. Three hours. Mr. Pappoutsakis. 204 in alternate years, 1974-75.

205, 206 COUNTERPOINT First semester: tonal counterpoint; second semester: canon and fugue. *Prerequisites:* 105-106; 205 for 206. Three hours. Mr. Kinsey. 206 in alternate years, 1973-74.

207 PEDAGOGY OF THEORY Objectives, viewpoints, content, and specific approach to organization and the teaching of theory courses. *Prerequisite*: 18 hours in Theory. Three hours. Mr. Lidral.

208 FORM AND ANALYSIS Creative approach to aural and sight analysis

\*Applications to this program are suspended for the present time.
of musical construction. *Prerequisites:* 105-106; 205 recommended. Three hours. Mr. Kinsey.

211, 212 CONDUCTING First semester: technique of the baton, score reading, laboratory practice; second semester: preparation and performance of selected scores, including score reading at the piano and rehearsal procedures. Selected students may conduct university major ensembles. *Prerequisites:* 5-6; 211 for 212. Three hours. Mr. Pappoutsakis. 212 in alternate years, 1973-74.

215, 216 COMPOSITION Creative work in free composition with instruction according to the needs and capabilities of the individual student. *Pre requisite:* 205 and 208 or consent of instructor. May be repeated for credit Three hours. Mr. Read.

221, 222 HISTORY OF MUSIC Changes in musical structure and style in relation to contemporaneous artistic, literary, religious, and social movements. First semester: Gregorian chant to the Baroque era; second semester: Baroque to Modern. *Prerequisites:* 1, 2 and 5-6. Three hours. Mr. Chapman

223 through 228 MUSIC LITERATURE Advanced studies in the literature of music. *Prerequisites:* 105-106 and 221, 222. Three hours. Mr. Chapman.

245, 246 CHAMBER MUSIC LITERATURE Study through analysis and performance of masterworks for small groups leading to public performance. *Prerequisite:* 12 hours or the equivalent in performance field and consent of instructor. May be repeated for credit. One hour. Staff.

271, 272 PERFORMANCE PEDAGOGY Methods of teaching voice, strings, woodwinds, brass, percussion, or keyboard instruments including repertoire suitable for use at various levels of ability. Significant literature of all historical periods in the major field. *Prerequisite:* Senior standing in performance and consent of instructor. Three hours. Staff.

281 INDEPENDENT STUDY Studies in theory, composition, history, or literature under the direction of an assigned staff member for advanced students and candidates for honors. Credit as arranged.

301 PROSEMINAR IN MUSICOLOGY A study of the tools and methods of musical bibliography, including the critical and effective use of such materials. *Prerequisites:* 205, 208, 221, 222. Three hours. Mr. Chapman.

302 SEMINAR IN MUSICOLOGY Discussion of the bibiographic tools and methods covered in 301 in relation to the major areas of historical musicology; problems in musical research; introduction to musical paleography. *Prerequisite:* 301. Three hours. Mr. Chapman.

351, 352 ADVANCED PERFORMANCE STUDY Individual instruction in keyboard instruments, voice, strings, woodwinds, brass, percussion, and harp leading to public recital performance. *Prerequisite:* Graduate standing in performance field. May be repeated for credit. One to four hours. Staff.

#### MUSIC

## PATHOLOGY

381 SEMINAR Study of special topics appropriate to student needs. Credit as arranged. Mr. Kinsey.

391 MASTER'S THESIS RESEARCH Credit as arranged. Student may substitute 3 hours of 351, 352 with permission. Staff.

## PATHOLOGY

Professors Coon (Chairman), Andrews, Clemmons, Craighead, Korson, Kusserow, Luginbuhl, Stark, and Trainer; Associate Professors Harris Picoff and Taylor; Assistant Professors Howard and Tihen.

Research interests are in the fields of anatomic, clinical, and experimental pathology. Current studies include histochemistry, extracorporeal heart pumps, problems in blood flow, connective tissue pathology and biochemistry, electron microscopy, neoplasia, immunopathology, and virology.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Anatomy 301, 311; Physiology and Biophysics 301; Biochemistry 301, 302. This program is open only to those persons who have or are pursuing an M.D. Degree.

### MINIMUM DEGREE REQUIREMENTS

Pathology 301, 302 (11 hours), Medical Microbiology 302 (4 hours), additional approved courses; thesis research (6-15 hours).

### COURSES OFFERED

201 HISTOCHEMISTRY A survey of techniques used for chemical identification of cellular and tissue components, including discussion of underlying theories. *Prerequisite:* an acceptable course in cell structure (e.g., Anatomy 311, Botany 256); Chemistry 131-132; permission of the department. A course in biochemistry is strongly recommended. Three hours credit. Not offered each year. Dr. Korson.

301 GENERAL PATHOLOGY A study of the processes of injury, repair, neoplasia, degeneration, etc., as they affect cells, tissues, and the human patient. *Prerequisite:* permission of the department. Three hours. Staff.

302 SYSTEMIC PATHOLOGY An introduction to diseases and pathologic processes with particular reference to their effects on various organ systems. Instruction in clinical laboratory medicine is correlated with the work in systemic pathology. *Prerequisites:* 301 and permission of the department. Eight hours. Staff.

#### PHARMACOLOGY

310 ADVANCED PATHOLOGY Supervised practical experience in handling, processing, and diagnosis of pathological materials. Participation in departmental seminars and conferences. *Prerequisite:* 301-302; permission of department. Credit as arranged. Staff.

320 FUNDAMENTAL ASPECTS OF CELL AND TISSUE PATHOLOGY An in-depth survey of the mechanisms of inflammation and tissue repair; disorders of cell metabolism; coagulation phenomena; growth including neoplasia; and immune responses. *Prerequisites:* General Biochemistry (201 or equivalent); Zoology 212 or Anatomy 311 or equivalent; permission of department. Immunology 323 is desirable. Four hours. Course limited to 10 students. Drs. Clemmons, Craighead, Korson, Kusserow and Staff.

391 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged. Staff.

# • PHARMACOLOGY

Professors Gans, Jaffe, Macmillan and Smith (Chairman); Associate Professors Doremus, McCormack, Reit and Robinson; Visiting Professor Maxwell.

Research interests of the staff cover the following areas: biochemical mechanisms involved in the action of anti-protozoal, anti-helminthic and antineoplastic drugs; regulation of cholesterol and steroid metabolism; synthesis, physico-chemical properties and structure-activity relationships of biologically-active nitrogen heterocyclic compounds; synthesis, chemical properties, and pharmacological actions of drugs affecting the cardiovascular and nervous systems; effect of drugs in preventing abnormalities in young rats born of psychologically stressed mothers; functions of neurohumoral substances in synaptic transmission and microcirculatory regulation. A program of clinical pharmacology is operated in cooperation with the Department of Medicine: pharmacotherapy of depressive illness and interactions between warfarin and concurrently administered drugs.

# **PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREES OF MASTER OF SCIENCE AND DOCTOR OF PHILOSOPHY**

Year courses in Biology, Organic Chemistry, Physics, Analytic Geometry and Calculus; Physical Chemistry; a reading knowledge of one, two or no foreign languages, depending on the requirements of the research supervisor; satisfactory scores on verbal, quantitative and advanced sections of the Graduate Record Examination.

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#### PHILOSOPHY AND RELIGION

#### **MINIMUM REQUIREMENTS FOR THE MASTER OF SCIENCE DEGREE**

Pharmacology 301, 381; supporting courses in Biochemistry and Physiology; master's thesis research (6-15 hours).

## MINIMUM REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY DEGREE

Physiology and Biophysics 301; Biochemistry 301, 302. Pharmacology 301, 328, 372, 381; Biometrics and Applied Statistics 308; doctoral thesis research (20-30 hours).

#### **COURSES OFFERED**

272 TOXICOLOGY The biology of environmental intoxicants and of drug abuse. Ecologic and physiologic consequences of the dissemination of agricultural, industrial and medicinal chemicals. *Prerequisites:* Organic chemistry and background in biology. Open to undergraduates. Three hours. Dr. Gans.

301 MEDICAL PHARMACOLOGY The chemical and biological properties of drugs. Lectures, demonstrations and laboratory exercises. *Prerequisite:* permission of the department. Six hours. Staff.

328 INTRODUCTION TO MEDICINAL CHEMISTRY Important classes of drugs are surveyed. Emphasis is placed on relationships between physiochemical properties and pharmacologic activity; synthetic aspects are considered. *Prerequisite:* Chemistry 131-132. Open to undergraduates with permission of the instructor. Two hours. Dr. McCormack.

372 SPECIAL TOPICS Topics of current interest and importance in pharmacology are considered in depth through presentations by staff, students and visiting scientists. *Prerequisite:* Permission of the department. One hour. Staff.

381 SEMINAR Current developments in pharmacology are presented for discussion by students. *Prerequisite:* permission of the department. One hour. Staff.

391 MASTER'S THESIS RESEARCH Credit as arranged.

491 DOCTORAL THESIS RESEARCH Credit as arranged.

# PHILOSOPHY\*

Professors Cahn (Chairman), Hall; Associate Professor Moneta; Assistant Professors Beckett, Miller, Paskow and Rice; Instructors Anderson, Corcoran, Sugarman and Swanson.

\*Applications to this program are suspended for the present time.

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### PHILOSOPHY

Specialties include history of philosophy, with special emphasis on Plato and Kant, Social and Political Philosophy, Value Theory, Existentialism and Phenomenology, Aesthetics, and Philosophy of Religion.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS IN PHILOSOPHY

Twenty-one hours in Philosophy or demonstrated proficiency in philosophy which would give assurance of success in graduate study.

### MINIMUM DEGREE REQUIREMENTS

Eighteen hours of Philosophy; six additional hours in Philosophy or a related field; six hours of thesis research.

### **COURSES OFFERED**

200 PHILOSOPHY OF HISTORY An investigation of theories of history from the perspectives of both historians and philosophers. *Prerequisites:* Either two advanced courses in philosophy or six hours in history. Three hours. Staff.

202 ANALYTIC PHILOSOPHY The significant problems of philosophy from the standpoint of the predominant contemporary philosophic movement in England and the United States. *Prerequisites:* Philosophy 101 and 102 (or permission of instructor). Three hours. Mr. Beckett.

204 THEORY OF KNOWLEDGE A study of basic concepts and problems involved in explaining the possibility of human knowledge. Topics such as sense perception, memory, truth, necessity, knowledge and belief, and the possibility and limit of human knowledge will be considered. *Prerequisites:* Philosophy 101 and 102 (or permission of instructor). Three hours. Mr. Rice.

206 SOCIAL PHILOSOPHY The meaning and values inherent in social life. *Prerequisites:* Philosophy 101 and 102 (or permission of instructor). Three hours. Mr. Anderson.

207 METAPHYSICS Current and traditional metaphysical problems such as the concept of change, the existence of God, the self, and the world. *Prerequisites:* Philosophy 101 and 102 (or permission of instructor). Three hours. Ms. Moneta.

208 THEORY OF VALUE An analysis of the nature of value and the nature of experience of the various realms of value. *Prerequisites:* Philosophy 101 and 102 (or permission of instructor). Three hours. Mr. Corcoran.

209 AMERICAN PHILOSOPHY The thought of such leading American philosophers as Royce, Peirce, James, Santayana, Dewey and Whitehead. *Prerequisites:* Philosophy 101 and 102 (or permission of instructor). Three hours. Mr. Miller.

210 PHENOMENOLOGICAL THINKERS A critical and intensive investiga-

#### PHYSICS

tion of the thought of a major twentieth century phenomenologist, e.g., Husserl, Heidegger, or Merleau-Ponty. *Prerequisites:* Philosophy 155 or 101 and 102 (or permission of instructor). Three hours. Ms. Moneta and Mr. Paskow.

211 NINETEENTH-CENTURY PHILOSOPHY A systematic analysis of the contributions to philosophical thought of such thinkers as Fichte, Schelling, Hegel, Schopenhauer, Nietzsche, Mill, Kierkegaard, Dilthey, and Marx. *Prerequisites:* Philosophy 101 and 102 (or permission of instructor). Three hours. Staff.

212 EXISTENTIALISM Existentialism, its sources and its relation to literature and to the arts. *Prerequisites:* Philosophy 101 and 102 (or permission of instructor). Three hours. Staff.

213 PHILOSOPHY OF MIND An investigation of the mutually exclusive theories of psycho-physical interactionism, logical behaviorism, neural identity materialism, and double aspect theory. *Prerequisites:* Philosophy 101 and 102 (or permission of instructor). Three hours. Mr. Paskow.

214 INTELLECTUAL BACKGROUNDS OF MODERN LIFE Intellectual movements which have influenced the thought and life of today. *Prerequisites:* Philosophy 101 and 102 (or permission of instructor). Three hours. Mr. Rice.

221 TAO TE CHING A systematic study of one of the most important texts of Taoism and of the English translation of the text. *Prerequisites:* Philosophy 23, Philosophy 101 and 102 (or permission of instructor). Three hours. Mr. Swanson.

222 I CHING OR BOOK OF CHANGES A systematic study of one of the most difficult and most important texts in the Oriental tradition. *Prerequisites:* Philosophy 23, Philosophy 101 and 102 (or permission of instructor). Three hours. Mr. Swanson.

281, 282 SEMINAR Selected topics in philosophy, determined according to the interest of students and instructor. *Prerequisites:* Philosophy 101 and 102 (or permission of instructor). Three hours. Staff.

297, 298 READINGS AND RESEARCH Independent study with an instructor on a philosopher or philosophical problem of the student's choice. *Prerequisites:* Philosophy 101 and 102 (and permission of instructor). Three hours. Staff.

391 MASTER'S THESIS RESEARCH Credit as arranged. Staff.

For economic philosophy, see economics 295; and for political philosophy, see political science 211, 212; and for mathematical logic, see mathematics 259, 260

## PHYSICS

Professors Crowell (Chairman), Detenbeck, Juenker, Krizan, Nyborg and Scarfone; Associate Professors Brown and Cohen; Assistant Professors Nagy and Sachs.

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The Department of Physics offers opportunities for both experimental and theoretical research. An active program in acoustics includes studies of the mechanics of nonlinear sound propagation, and of changes (physical, chemical and biological) produced by high amplitude sound on structures and rates of processes. Studies of the liquid state are also being conducted by ultrasonic methods.

Research in the physics of metals includes studies of the interaction of gas molecules with metal surfaces using ultra high vacuum, radiotracer, work function and thin film techniques. In addition investigations of the optical properties of metals and the mechanisms of photoelectric emission are being conducted.

Research in quantum optics concerned with the uses of scattered light from lasers for the study of inhomogeneities in liquids and gases is in progress. A new program in ion-atomic scattering is in progress.

Work has been initiated in low temperature physics concerned with nuclear magnetic interactions between helium atoms.

Opportunities for theoretical research in the statistical mechanics of interacting molecules near solid surfaces are available. Other studies in statistical mechanics include problems in plasma physics and relativistic corrections to statistical mechanics.

There is an active theoretical research program in relativistic and nonrelativistic quantum mechanics emphasizing the study of solvable particle models and scattering theory.

In addition there is a program in theoretical solid state physics emphasizing problems in lattice dynamics and densities of states in metals and alloys.

Opportunities for collaborative research with other departments of the University, such as Chemistry, Physiology and Biophysics, and Electrical Engineering are also available.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major in Science, Engineering or Mathematics; Physics 211, 213 and 272; two additional semester courses in physics above the sophomore level; two semester courses in mathematics above the sophomore level; satisfactory scores in the Graduate Record Examination. (Aptitude and Advanced Section)

### MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

A total of thirty credit hours, at least twelve of which shall be Physics courses numbered above 300 and including thesis research.

The department also offers a program leading to the degree of Master of Arts in Teaching.

#### PHYSICS

## PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE FOR TEACHERS OF PHYSICAL SCIENCES

The requirements for admission to candidacy for the degree of Master of Science for Teachers of Physical Sciences are: (1) Completion of at least one full year of teaching, (2) Successful completion of Physics 128, Chemistry 131 and 141, and Mathematics 121, or their equivalents. (These courses may have been taken at the undergraduate level, as part of this graduate program, or credit may be obtained by transfer or examination.) and (3) Satisfactory scores on the Graduate Record Examination.

## MINIMUM REQUIREMENTS FOR THE DEGREE OF MASTER OF SCI-ENCE FOR TEACHERS OF PHYSICAL SCIENCES

The above prerequisites for admission to candidacy must be supplemented by: (1) Completion of thirty hours of credit, of which at least eighteen must be in Physical Sciences Option (A) or (B) as described below. The remaining twelve credits may be chosen, with the consent of the Joint Advisory Committee, from appropriate courses at any level in science, engineering, mathematics and education. (Credit in education courses is limited to six semester hours.) (2) Successful completion of a comprehensive examination administered by the Joint Advisory Committee.

Physical Sciences Option (A): Nine semester hours of Physics numbered 128 and above, Chemistry 212 and six semester hours of Chemistry chosen from Chemistry 142, 213, 224, 246 and 251. This option is primarily for teachers of chemistry.

Physical Sciences Option (B): Nine semester hours of Chemistry numbered 131 and above and nine hours of Physics in courses numbered above 200. This option is primarily for teachers of Physics.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

In addition to the general prerequisites of the Graduate College and satisfactory scores on the Graduate Record Examination, the following courses must be completed: Physics 301, 311, 314 and 362; at least one year of general chemistry and 4 semesters in mathematics beyond Math 121 or 123. In addition, the student must have passed his Comprehensive Examination for the Ph.D. degree. The student's record shall be such as to convince the department of his ability to cope with graduate courses and to conduct scientific research.

### MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

The courses Physics 301, 311, 313, 314, 361, 362, 375 are required of all students.

In accord with the general policy of the Graduate College, all doctoral students are required to participate in the department's undergraduate teaching program.

## **COURSES OFFERED**

201, 202 EXPERIMENTAL PHYSICS Experiments in classical and modern physics. Each student selects laboratory experiments appropriate to his back-ground and interests. *Prerequisite:* 16 or 25; Mathematics 121 or 123. Three hours per semester, four semesters maximum. Staff.

211 MECHANICS Newtonian dynamics of particles and systems of particles. Extensive use is made of descriptive, analytical, and approximational techniques. *Prerequisites:* 16 or 24; mathematics 121 or 123. Three hours. Mr. Brown.

213 ELECTRICITY AND MAGNETISM Theory of electrostatic fields, and magnetic fields of steady currents. Electrical and magnetic properties of matter and electromagnetic energy relationships. Vector analysis developed as necessary. *Prerequisite:* 16 or 25; mathematics 121 or 123. Three hours. Mr. Nagy.

214 ELECTROMAGNETISM AND RELATIVITY An introduction to time dependent electromagnetic fields. Maxwell's equations in space and matter. Electromagnetism as a relativistic phenomenon. *Prerequisite:* 213. Three hours. Mr. Nyborg.

216 INTRODUCTION TO MATHEMATICAL PHYSICS Introduction to basic mathematical methods of theoretical physics. Particular emphasis on partial differential equations, especially the wave equation. *Prerequisite:* 211 or 213. Three hours. Mr. Sachs.

220 BIOLOGICAL PHYSICS Physical laws, concepts and methods discussed with respect to their reference to biology. Mechanics of solids, liquids and non-ideal media. Transport of dissolved gases and ions. Properties of macromolecules, radiation biophysics. *Prerequisite:* 16; chemistry 2; mathematics 12. Four hours. Mr. Nyborg.

222 ADVANCED BIOLOGICAL PHYSICS Sound and electromagnetic waves, the latter including light, micro-waves and x-rays; ionizing particles and radiation. Interaction of these physical agents with biological systems. *Prerequisites:* Chemistry 2; Mathematics 121 or 123; and experience in applying differential equations. Departmental permission required. Four hours. Mr. Nyborg.

225 SPECIAL TOPICS IN BIOLOGICAL PHYSICS For research students in the field of biological physics. Lectures, reports and directed readings related to the research of the department. *Prerequisite:* Mathematics 121 or 123 and consent of the department. Credit as arranged. Offered as occasion warrants. Mr. Nyborg.

231 SPECIAL TOPICS IN ACOUSTICS For research students in the field

### PHYSICS

of acoustics. Lectures, reports and directed readings on problems of particular interest to the current research of the department. *Prerequisite:* 216 and consent of the department. Credit as arranged. Offered as occasion warrants. Messrs. Sachs and Nyborg.

251 SPECIAL TOPICS IN THE PHYSICS OF SURFACES For research students in the field of surface chemistry and physics. Background of particular interest to the current research of the Department is presented and discussed. *Prerequisites:* 265 or Chemistry 142 and Mathematics 121 and consent of the department. Credit as arranged. Offered as occasion warrants. Messrs. Crowell and Juenker.

265 THERMAL PHYSICS Basic concepts of thermodynamics including equilibrium conditions in homogeneous and heterogeneous systems. Introduction to kinetic theory and statistical mechanics. *Prerequisite:* 128 and \* mathematics 121 or 123. Three hours. Mr. Juenker. Alternate years, 1971-72.

271 ATOMIC AND NUCLEAR PHYSICS Phenomenological study of electronic structure of atoms, including vector model and various coupling modes. Development of quantum theory. Structure of the nucleus and properties of elementary particles. *Prerequisites:* 211. Three hours. Mr. Detenbeck.

272 INTRODUCTORY QUANTUM MECHANICS Introduction to nonrelativistic quantum mechanics. Schroedinger equation and applications to simple systems. Angular momentum and spin. Approximation techniques. *Prerequisite:* 271 and 216. Three hours. Mr. Detenbeck.

301 MATHEMATICAL PHYSICS—Introduction to basic mathematical methods of theoretical physics; vector and tensor analysis, partial differential equations, orthogonal functions, complex variables and variational techniques presented with appropriate physical illustrations. *Prerequisites:* 211, 214 and 216. Three hours. Mr. Krizan.

311, 312 ADVANCED DYNAMICS Classical Mechanics presented as the basis of the concepts and methods of modern physics. Variational, Lagrangian and Hamiltonian formulations, canonical transformations, continuous systems. *Prerequisites:* 211, 216; 311 for 312. Three hours. Mr. Brown.

313 ELECTROMAGNETIC THEORY Development of Maxwell's theory of electromagnetism with emphasis on its physical basis and the modes of mathematical description. *Prerequisites:* 214 and 216. Three hours. Mr. Scarfone.

314 CLASSICAL ELECTRODYNAMICS A continuation of electromagnetic theory. Plane electromagnetic waves, wave guides and resonant cavities, simple radiating systems and diffraction, magnetohydrodynamics and plasma physics, special theory of relativity, multipole fields. *Prerequisite:* Physics 313. Three hours. Mr. Brown.

#### PHYSICS

321 SPECIAL TOPICS IN THEORETICAL PHYSICS For research students interested in pursuing topics of general and departmental research interest in theoretical physics. *Prerequisites:* Consent of instructor. Offered as occasion warrants. Credit as arranged. Theoretical Physics Staff.

341, 342 SOLID STATE PHYSICS Introduction to crystal symmetry and the reciprocal lattice. Crystal binding and lattice vibrations. Thermal, electrical, and magnetic properties of solids, free electron theory of metals, and band theory. *Prerequisites:* 214, 265, and 272 or their equivalents; consent of instructor. Offered alternate years, 1971-72. Equivalent to and alternates with E.E. 363, 364. Three hours. Mr. Juenker.

343, 344 ADVANCED SOLID STATE PHYSICS Introduction to group theory and its use in crystal physics and energy band theory. Introduction to quasi-particles, including phonons, plasmons, and ferromagnetic magnons. *Prerequisite:* 342 (or E.E., 364), 362 and 375. Three hours. Offered as occasion warrants. Mr. Brown.

361, 362 QUANTUM MECHANICS Mathematical and physical foundations of non-relativistic quantum mechanics from the unifying point of view of Dirac which includes the matrix and wave formulations. Symmetry operations and the algebraic structure of quantum mechanics are emphasized. *Prerequisites:* 211, 214, 272; 361 for 362. Three hours. Mr. Scarfone.

363 ADVANCED QUANTUM MECHANICS Introduction to the mathematical and physical concepts of relativistic quantum mechanics. Topics include the Klein-Gordon equation, Dirac's theory of the electron, the relativistic hydrogen atom, Feynman's propagator theory and its applications. *Prerequisite:* 362. Three hours. Mr. Scarfone.

364 ADVANCED QUANTUM THEORY Quantization of free and interacting fields. Symmetry properties of fields and particles. The S-matrix and Feynman graphs. The elements of Dispersion Theory. *Prerequisite:* 363. Three hours. Mr. Scarfone.

366, 367 SOLID STATE THEORY This course is identical with Electrical Engineering 366, 367.

372 NUCLEAR AND PARTICLE PHYSICS Discussion of the conservation principles following from space-time symmetries and their consequences for nuclear and particle physics. *Prerequisites:* 311, 314, 362. Three hours. 375 KINETIC THEORY AND STATISTICAL MECHANICS Review of thermodynamics. Elements of kinetic theory including the Boltzmann equation, H theorem and transport phenomena. Introduction to equilibrium statistical mechanics, both quantum and classical. *Prerequisites:* 265, 272. Three hours. Mr. Krizan.

376 STATISTICAL MECHANICS Applications of fundamentals of statistical mechanics to quantum and classical ideal and imperfect gases. Investiga-

#### PHYSIOLOGY AND BIOPHYSICS

tions of special topics such as the Ising model, relativistic statistical mechanics, physical adsorption and phase transitions. *Prerequisites:* 375 and 361. Three hours. Mr. Krizan.

391 MASTER'S THESIS RESEARCH Credit as arranged. 491 DOCTORAL THESIS RESEARCH Credit as arranged.

# PHYSIOLOGY AND BIOPHYSICS

Professors Alpert (Chairman) Chambers, Kusserow, Nyborg and Tabakin; Associate Professors Hill, Levy, McCrorery, Webb, Hanson, Kelleher, Patterson, and Parsons; Assistant Professors Gibbons, Halpern, Hamrell, Low, Musty, and Whitehorn; Instructors MacDonald.

Current research activities involve both systemic and cellular investigations. Specific areas of interest include comparative electrophysiology of nerve and muscle; pharmacology of neuromuscular blocking agents; molecular physiology of synaptic and conducting membranes; transmission of activity in cardiac muscle; directional excitability in skeletal muscle; excitation-contraction coupling; ultrasonic effects on living cell membranes; cochlear AC and DC potentials; mechanics, thermodynamics and biochemistry of muscle contraction; congestive heart failure; hypertensive heart diseases; exercise and respiratory physiology. Opportunities exist in the department of Physiology and Biophysics for multi-disciplinary studies in Neurobiology, Cardiovascular Biology, Cell Biology, and Biological Motility.

Preference in admission and awarding financial support will be given to Ph.D. applicants.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Year courses in Biology, Organic Chemistry and Physics. These requirements must be completed by the end of the first year of residency. GRE required.

#### MINIMUM DEGREE REQUIREMENTS

Physiology and Biophysics 301; Neuroscience 302; other graduate courses as arranged (3 hours minimum); thesis research (6-15 hours).

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Biology, 1 year; Chemistry, organic and physical; Physics, 1 year; Mathematics, through calculus. A reading knowledge of French or German is recommended. These requirements must be completed by the end of the first

#### PHYSIOLOGY AND BIOPHYSICS

year of residency. A Master's degree is not a prerequisite for the Ph.D. degree. GRE required.

### MINIMUM DEGREE REQUIREMENTS

Physiology and Biophysics 301, Neuroscience 302; additional approved courses amounting to at least 40 hours, 16 of which must be in the Department; thesis research, minimum 20 hours; language requirement is flexible and will be determined for each individual after consultation with the Studies Committee.

#### **COURSES OFFERED**

301 PHYSIOLOGY AND BIOPHYSICS Function in the whole human organism, and at the cellular, tissue, and organ levels, considered biologically and physically. *Prerequisite:* permission of the department chairman. Eight hours. Staff.

302 NEUROSCIENCE A correlated presentation of the neuroanatomy and neurophysiology of mammalian CNS. Same course as Anatomy 302. *Prerequisites:* Permission of the instructor. Four hours. Anatomy and Physiology Staff.

303 SPECIAL PROBLEMS IN PHYSIOLOGY Various problems are covered by means of lectures, reports and directed reading. *Prerequisite:* Physiology and Biophysics 301; permission of the department chairman. Credit as arranged. Staff.

308 BIOMETRICS AND APPLIED STATISTICS This course is designed as an introduction to the rational use and evaluation of statistical methods in the planning of experiments and the interpretation of biological data. The course includes a biometrics laboratory. Course limited to twelve students. *Prerequisite:* Math 110 or equivalent, and permission of instructor. Five hours. Mr. McCrorey.

309 SYNAPTIC AND CONDUCTING MEMBRANES The mechanisms of synaptic transmission and nerve and muscle conduction will be explored, with particular emphasis on molecular structure and function. *Prerequisites:* Physiology and Biophysics 301 and Neuroscience 302, Biochemistry 301, 302, permission of the instructor. Three hours. Alternate years, 1971-72. Mr. Webb.

310 MOLECULAR BASIS OF BIOLOGICAL MOTILITY This is an advanced course dealing with the molecular basis of muscle contraction and biological movement. The problems of energetics, mechanics and chemistry of biological motility will be considered in detail. Special emphasis will be given to the contraction of skeletal muscle. Lectures and conferences. *Prerequisites:* Physiology and Biophysics 301, Neuroscience 302, Biochemistry 301, 302, permission of the instructor. Three hours. Alternate years, 1972-73. Mr. Alpert.

311 SPECIAL SENSE RECEPTORS Function of receptor cells from the standpoint of stimulation and response. Specific receptors will be considered. Assigned reading in the research literature with seminar discussions. *Prerequisite:* 

### PHYSIOLOGY AND BIOPHYSICS

Physiology and Biophysics 301, Neuroscience 302, permission of the instructor. Three hours. Alternate years, 1971-72. Mr. A. Chambers.

313 SEMINAR ON ENDOCRINE PHYSIOLOGY The course will be devoted to a study of current problems in endocrine research with major emphasis on the molecular mechanism of action of hormones. *Prerequisites:* Physiology and Biophysics 301 or Endocrinology 271; Biochemistry 301-302; and permission of the instructor. Three hours. Mr. Low.

314 PHYSIOLOGY AND BIOPHYSICS OF THE CIRCULATION This course will analyze the molecular mechanisms of adaptation of the circulatory system to acute and chronic stress such as exercise, volume overload, pressure overload, temperature, etc. A comparative physiological approach will be emphasized. *Prerequisite:* Physiology and Biophysics 301, Neuroscience 302, permission of the instructor. Three hours. Alternate years, 1972-1973. Mr. Hamrell.

315 PHYSIOLOGY AND PHARMACOLOGY OF SYNAPSES A comparative study of synaptic connections in invertebrate and vertebrate species will be undertaken, with emphasis on their ultrastructure, pharmacology, and physiology. *Prerequisites:* Physiology and Biophysics 301, permission of the instructor. Two hours. Alternate years, 1972-73. Mr. Parsons.

317 PHYSIOLOGY OF THE CENTRAL NERVOUS SYSTEM The course will cover electrophysiological studies of the central nervous systems of mammals and invertebrates with particular emphasis on concepts dealing with information processing. Behavioral, neurochemical and clinical observations will also be used. *Prerequisites:* Physiology and Biophysics 301 or permission of instructor. Three hours. Mr. Whitehorn.

321, 322 CELLULAR PHYSIOLOGY AND BIOPHYSICS Fundamental physical and physiochemical properties of living cells. The reading of original scientific papers in the area covered will be stressed. *Prerequisite:* permission of the department chairman. Hours and credit as arranged. Staff.

323 PRINCIPLES AND ELEMENTS OF BIOMEDICAL INSTRUMENTA-TION This course is designed for the biologically trained researcher to provide a firm understanding of instrument methodology. Topics include basic electrophysics; transducers; the concepts and manipulation of bioelectric and other signals; physiological instrument systems. A laboratory supports these theoretical ideas. *Prerequisites:* permission of the instructor. Five hours. Mr. Halpern and staff.

381 SEMINAR Presentation and discussion by advanced students and staff of current developments and research in the field. *Prerequisite:* permission of the department chairman. One hour per semester.

391 MASTER'S THESIS RESEARCH Credit as arranged.

491 DOCTORAL THESIS RESEARCH Credit as arranged.

#### PLANT AND SOIL SCIENCE

# • PLANT AND SOIL SCIENCE

Professors Wiggans (Chairman), Bartlett, Hopp (Emeritus), and MacCollom; Associate Professors Boyce, Flanagan, McIntosh, Parker, Pellett, and Wood; Assistant Professors Evert, and Magdoff; Adjunct Professor Calahan; Adjunct Associate Professor Benoit; Assistant Bruckel.

Current research projects are concerned with the solution of horticultural and agronomic problems with special emphasis on environmental physiology, soil chemistry and plant nutrition. Areas of research include winter hardiness of fruits and woody ornamentals; chemical and environmental control of plant growth; cultural and environmental interrelationships as they affect plant growth, crop adaptation and variety testing; crop establishment and soil productivity; soil chemistry of the rhizophere; behavior of nitrogen in the soil; nutrient availability to plants; soil physics of drainage; temperature effects on soil water retention and transmission; plant responses to microclimatic variations. A student's thesis research will be an integral part of the on-going research efforts of the department.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Satisfactory completion of one academic year of graduate study in the Department of Plant and Soil Science and of a written comprehensive examination.

### MINIMUM DEGREE REQUIREMENTS

15-20 hours in Plant and Soil Science and closely related fields; satisfactory participation in seminars during residency; thesis research (8-12 hours).

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Satisfactory completion of two academic years of graduate study in the Department of Plant and Soil Science at the University of Vermont. With the approval of the Dean of the Graduate College and the Department of Plant and Soil Science, a Master's degree may be accepted in partial fulfillment of this requirement.

Satisfactory showing in a general qualifying doctoral examination as prescribed by the Department.

A reading knowledge of a modern foreign language appropriate to the student's specialty. Proficiency in other areas appropriate to the student's specialty may be substituted for the language requirement with the approval of the Studies Committee. This proficiency does not count toward course requirements for the degree.

### PLANT AND SOIL SCIENCE

#### MINIMUM DEGREE REQUIREMENTS

The course requirements are as follows: a total of at least 40 credit hours of which a minimum of 30 must be taken in Plant and Soil Science and closely related disciplines (e.g. Botany, Forestry, Microbiology and Biochemistry, Geology). Satisfactory participation in seminars during residency is required. All doctoral students must take part in the Department's undergraduate teaching program.

### **COURSES OFFERED**

201 MICROMETEOROLOGY Theoretical and practical considerations of the micrometeorological factors that affect plant growth and agricultural practices. *Prerequisite:* 11. Three hours. Mr. Benoit. Alternate years, 1973-74.

204 PLANT RESEARCH TECHNIQUES Methods of conducting research with plants including the organizing and planning of experiments. *Prerequisite:* 11. Three hours. Mr. Wiggans. Alternate years, 1973-74.

205 MINERAL NUTRITION OF PLANTS Role of essential elements for plant growth including classical and modern approaches to the study of ion availability and transport. *Prerequisite:* botany 104. Three hours. Mr. Bartlett and botany, forestry, and plant and soil science staff. Alternate years, 1973-74.

207 WATER RELATIONS OF PLANTS This course is identical with Forestry 207.

222 ADVANCED TREE FRUIT CULTURE Theory and practice of modern commercial fruit science. Nutrition and cultural responses to various management practices. *Prerequisite:* 11. Three hours. Mr. Calahan. Alternate years, 1972-73.

261 SOIL CLASSIFICATION AND LAND USE Classification of soils throughout the world as they relate to soil development and land use. Three Saturday field trips. *Prerequisite:* 61 or a total of six hours in ecology, geography, or geology. Three hours. Mr. Bartlett, Mr. Watson. Alternate years, 1974-75.

264 SOIL CHEMISTRY Chemistry and biology of soils affecting plant growth including the properties of clays and organic matter. *Prerequisite:* 61, chemistry 1-2 or 11-12. Three hours. Mr. Bartlett. Alternate years, 1973-74.

266 SOIL PHYSICS Mathematical and physical principles of the soilwater-plant interaction and its relationship to production and management. *Prerequisite:* 61, physics 5-6 or chemistry 1-2. Three hours. Mr. Benoit. Alternate years, 1974-75.

281 SEMINAR Presentation and discussion of papers on selected topics of current interest by students and staff. *Prerequisite:* senior standing. One hour. Staff.

381 GRADUATE SPECIAL TOPICS Advanced readings and discussion of horticulture, crops, or soils research literature. Three hours. Staff.
391 MASTER'S THESIS RESEARCH Credit as arranged. Staff.
491 DOCTORAL THESIS RESEARCH Credit as arranged. Staff.

# • POLITICAL SCIENCE

Professors Dellin, Gould, Haugen, Hilberg (Chairman), G.T. Little and Staron; Associate Professors Pacy, Simon, Warner and Wertheimer; Assistant Professors Flannery, Kinnard, Nelson and Rosenbloom; Adjunct Assistant Professor Eastman; Instructors Brewer and Diamond.

Research interests of the Department of Political Science and the various library and data processing resources available enable graduate students to undertake research in American political institutions; public law; public policy; political behavior; comparative political systems; international relations; political philosophy and empirical political theory.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

Twelve hours of Political Science at the junior-senior level; supporting courses in other social sciences; satisfactory scores on the Graduate Record examination, including the advanced examination in political science.

### **MINIMUM DEGREE REQUIREMENTS**

An approved program of 24 hours in course work, including Political Science 283 and not more than 6 hours in related fields; thesis research (6 hours).

### **COURSES OFFERED**

Admission to the following courses for graduate credit requires the approval of the Department.

211, 212 HISTORY OF POLITICAL THOUGHT First semester: political thought from Plato to Burke. Second semester: recent political ideologies. *Pre-requisite:* six hours in political science. Three hours. Mr. Staron.

213 CONTEMPORARY POLITICAL THOUGHT Writings of several twentieth-century political thinkers, including works in related fields such as psychology and economics. *Prerequisite:* six hours in political science. Three hours. Mr. Wertheimer.

216 AMERICAN POLITICAL THOUGHT American political thought from the colonial period to recent times. *Prerequisite:* six hours in political science. Three hours. Mr. Simon.

#### POLITICAL SCIENCE

221, 222 CONSTITUTIONAL LAW First semester: judicial review, federalism, citizenship and suffrage, taxing power, commerce power. Second semester: Bill of Rights, Due Process, Equal Protection. *Prerequisite:* six hours in political science. Three hours. Mr. Gould.

227, 228 INTERNATIONAL LAW Principles and applications of public international law. *Prerequisite:* six hours in political science. Three hours. Mr. Little. Not offered 1973-74.

231 THE LEGISLATIVE PROCESS Congressional and parliamentary organization and procedure. *Prerequisite:* six hours in political science. Three hours. Mr. Haugen.

232 LAWMAKING AND PUBLIC POLICY Influence of the executive and problems of congressional and parliamentary control. *Prerequisite:* six hours in political science. Three hours. Mr. Haugen.

233 THE NATIONAL EXECUTIVE Functions and organization of the Presidency and the bureaucracy in American national government. *Prerequisite:* six hours in political science. Three hours. Mr. Warner.

235 DEFENSE POLICY Constitutional and historical framework; intelligence, R & D, procurement, manpower and deployment: U.S.-Soviet discrepancies, developments, and dilemmas. *Prerequisite:* six hours in political science. Three hours. Mr. Kinnard.

239 AMERICAN POLITICS The politics of decision-making in the American political system. *Prerequisite:* six hours in political science. Three hours. Mr. Simon.

242 PROBLEMS OF PUBLIC MANAGEMENT Policy and administrative issues of current domestic programs. *Prerequisite:* six hours in political science. Three hours. Mr. Warner.

250 THE CRAFT OF DIPLOMACY Emphasis on experiences and reflections of diplomatic personalities, supplemented by studies of specialists. *Prerequisite:* six hours in political science. Three hours. Mr. Pacy. Not offered 1973-74.

251, 252 AMERICAN FOREIGN POLICY First semester: constitutional principles, institutional factors, and historic traditions in the formation of foreign policy. Second semester: contemporary policies toward specified countries. *Prerequisite:* six hours of political science. Three hours. Mr. Kinnard and Mr. Hilberg.

256 INTERNATIONAL ORGANIZATION Theory and practice in supranational institutions. *Prerequisite:* six hours in political science. Three hours. Mr. Pacy. Not offered 1973-74.

257 POLITICAL GEOGRAPHY See Geography 257. Three hours. Mr. Miles.

258 PROBLEMS OF COMMUNISM See Economics 258. Three hours. Mr. Dellin.

261 URBAN GOVERNMENT AND POLITICS An analysis of metropolitan areas in terms of their governments, problems and roles. *Prerequisite:* six hours of political science. Three hours. Ms. Diamond.

264 STATE ADMINISTRATION Problems in planning, policy development, and program coordination. *Prerequisite:* six hours in political science. Three hours. Mr. Haugen.

265 INTERGOVERNMENTAL RELATIONS Problems of the Federal system. National-state-local cooperative administration of selected public functions. *Prerequisite:* six hours in political science. Three hours. Mr. Haugen.

273 COMPARATIVE POLITICAL ANALYSIS An intensive examination of selected topics in comparative politics. *Prerequisite:* a semester course in Comparative Government. Three hours. Staff.

277 SOVIET POLITICS See History 277. Three hours. Mr. Daniels.

278 FOREIGN POLICY OF THE U.S.S.R. Three hours. Mr. Flannery.

281 POLITICAL PARTIES Political parties with emphasis upon voting behavior and campaign techniques. *Prerequisite:* six hours in political science. Three hours. Mr. Nelson.

283 SCOPE AND METHODS OF POLITICAL SCIENCE Approaches, sources of information, research methods and systematization in the study of political phenomena. Open to senior majors and graduate students only. Three hours. Mr. Wertheimer.

291 through 293 READING AND RESEARCH For advanced undergraduates and graduate students. Three hours. Staff.

295 SEMINAR The Federal Bureaucracy. *Prerequisite:* six hours in political science. Three hours. Mr. Rosenbloom.

391 through 393 MASTER'S THESIS RESEARCH Credit as arranged.

## PSYCHOLOGY

Professors Albee, Ansbacher, Forgays, Leitenberg and Perrine; Associate Professors Burchard (Acting Chairman), S. Goldstein, Joffe, Lawson, and Patterson; Assistant Professors Gordon, Hasazi, Howell, Kapp, Kent, Kessler, Leff, Musty and Rolf; Instructor Rodd; Adjunct Professor Grams; Adjunct Associate Professor McKenzie; Adjunct Assistant Professors Conquest, Dietzel, Does, J. Goldstein, McDowell and Thomson.

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The Ph.D. program in Experimental Psychology began in 1964, and now includes ongoing research in the following areas: Learning, e.g. utility of reinforcing competing behaviors to extinction and/or punishment procedures; effects of attentional and motivational variables on simple learning in retarded and normal children; Motivation, e.g. mediating effects of the endocrine system on parental stress; Perception, e.g. human stereoscopic depth and contour perception, geometrical-optical illusions; influence of alcohol on perceptual-cognitive behaviors; Physiological, e.g. psychochemical and CNS mechanisms determining innate behaviors; Social, e.g. variables influencing interpersonal conflict, bargaining, and interpersonal set; Neuropsychology, e.g. effects of sensory deprivation on human behavior and physiology; biorhythms and behavior; effects of focalized brain insults upon adaptive abilities and perceptual deficits; Cognitive Processes, e.g. decision making; subjective probability; gambling behavior; computor simulation of psychological processes; acquisition of language and syntax. Students in this program are involved early in independent research projects.

The Ph.D. program in Clinical Psychology began in 1969. It stresses early placement in a variety of clinical facilities and emphasizes the development of research and service techniques relevant to clinical problems encountered in those settings. Clinical research includes: the analysis and modification of antisocial behavior and the development of training programs for police, teachers, and youth workers; development and analysis of social skills in young children using operant procedures; analysis of communication disorders; effects of various therapeutic interventions on alcoholic, sexual, neurotic, and psychotic disorders; descriptive analysis of community mental health programs; etiology of schizophrenia and mental retardation.

An interdisciplinary program of study in neuroscience is available; it consists of a number of courses in physiological psychology, sensory and central processes as well as courses listed in the Physiology and Anatomy departments. Coordinator of this program is Dr. Musty who should be consulted for further information.

While requirements for both the Master of Arts degree and the Doctor of Philosophy degree are described below, this does not imply that it is necessary to take the first degree before one can study for the second. Most students in the clinical program and many in the experimental program are encouraged to study directly for the Ph.D. degree and the training program reflects this, accordingly.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

Undergraduate courses in Statistics, Systematic Psychology and Experimental Psychology; satisfactory scores on the Graduate Record Examination and the Miller Analogies Test.

# MINIMUM DEGREE REQUIREMENTS FOR MASTER OF ARTS DEGREE

Twenty-four hours of Psychology courses and seminars, including Psychology 301, 302, 340, 341; thesis research for 6 credits. The requirement of the specific courses (301, 302, 340, 341) may be exempted by examination. There is no foreign language requirement.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Satisfactory completion of minimum degree requirements for Master of Arts degree, except for thesis; satisfactory performance on the departmental Ph.D. comprehensive examination.

## MINIMUM DEGREE REQUIREMENTS FOR THE DOCTOR OF PHIL-OSOPHY DEGREE

In addition to the 30 credit hours required for the master's degree, 45 credit hours mainly in courses numbered in the 300 or 400 sequences of the psychology curriculum including thesis, or acceptable courses at the 200 or 300 level from other curricula. Satisfactory performance on the departmental final oral examination. There is no foreign language requirement.

### **COURSES OFFERED**

200 BEHAVIOR MODIFICATION A survey of techniques for the manipulation and control of human behavior, and evaluation of their effectiveness. *Prerequisite:* 1, 152. Three hours. Messrs. Lietenberg and Burchard.

205 LEARNING Study of the basic laws of the learning process as revealed by controlled experiments; emphasis will be placed upon specific phenomena and the variables which govern them. *Prerequisite:* 112, 119. Three hours. Mr. Howell.

206 MOTIVATION AND EMOTION The nature and development of motives, emotions and their relation to other psychological processes. *Prerequisite:* 112, 119. Three hours. Mr. Joffe.

210 SENSORY PERCEPTION An introduction to the sensory and perceptual bases of human visual perception, including the perception of size, distance, shape, and color, perceptual constancies, and visual illusions. *Prerequisite:* 112, 119, or permission of instructor. Three hours. Mr. Lawson.

220 COMPARATIVE PSYCHOLOGY Behavior of anumals at various levels of the phyletic scale from lower forms to man under controlled experimental conditions and in their natural environments. *Prerequisite:* 112, 119. Three hours. Staff.

230 EXPERIMENTAL SOCIAL PSYCHOLOGY (2-2) A laboratory course in the experimental methods and techniques typically used in social psychological research. *Prerequisite*: 112, 119. Three hours. Mr. Ferguson.

231 SOCIAL PERCEPTION Experimental and theoretical and theoretical study of the phenomena of the human perceptual process; with emphasis on the role of social, motivational, and learning factors. *Prerequisite:* 112, 119. Three hours. Mr. Perrine.

236 THINKING A critical review of the experimental investigation of thought processes, including concept formation, rule learning, plans and strategies, and decision making. *Prerequisite:* 112, 119. Three hours. Messrs. Gordon & Howell.

239 THE SOCIAL USE AND ABUSE OF ALCOHOL an intensive and critical analysis of the research literature concerning both the normative and deviant use of alcohol. Emphasis will be placed upon methodological aspects of original studies and upon psychological-biographical correlates of drinking patterns, injury on and off the highway, alcoholism, and feasible counter-measures. *Prerequisite:* 112, 119, or permission of instructor. Three hours. Mr. Perrine.

251 BEHAVIOR DISORDERS OF CHILDHOOD Covers a wide range of topics from brain damage to childhood psychoses and nightmare. Each problem behavior will be considered in the context of normal child development with emphasis on the psychological factors responsible for their occurrence and remission. *Prerequisite:* 1 and 151 or 122. Three hours. Mr. Rolf.

252 INTRODUCTION TO CLINICAL PSYCHOLOGY Examination of some of the critical issues in clinical psychology; its scientific status, problems of research; and probable future trends. *Prerequisite:* 112, 119, 152. Three hours. Mr. Kessler.

The prerequisite for all of the courses listed below is acceptance to the graduate psychology program which involves the satisfactory completion of undergraduate courses in experimental psychology, systematic psychology, and statistics. In special cases, these prerequisites may be waived by permission of the instructor.

301, 302 PROSEMINAR This course serves as an overview of the field. It will emphasize empirical findings from the frontiers of the field and relate them to the body of psychology as it is developing today. Three hours. Mr. Forgays and Staff.

305 SEMINAR IN LEARNING THEORY An examination of selected contemporary theoretical approaches and recent research contributions to such problem areas as social learning, emotional learning, the physiology of learning, etc. Three hours. Mr. Howell.

306 SEMINAR IN VERBAL LEARNING Selected problems in verbal learning and memory will be studied by means of a detailed critical examination of the relevant literature, including topics such as short and long term memory, organizational structure of free recall, and pre-experimental associations. Three hours. Staff.

308 SEMINAR IN OPERANT CONDITIONING A review of current de-

velopments in this area of research. Topics such as extinction, punishment, avoidance, schedules of reinforcement, secondary reinforcement, generalization, discrimination training will be considered. Three hours. Mr. Leitenberg.

310 SEMINAR IN PERCEPTION A review of the history and contemporary problems of human perceptual processes. Emphasis will be on perceptual mechanisms responsible for the coding and organization of visual sensory information. Three hours. Mr. Lawson.

315 SEMINAR IN ALCOHOL AND BEHAVIOR A study of the influences of alcohol upon selected aspects of psychological processes including perception, attention, cognition, learning, motivation, and emotion. Three hours. Mr. Perrine.

320 COMPARATIVE PSYCHOLOGY OF BEHAVIORAL DEVELOP-MENT An examination of the general principles underlying the development of behavior from prenatal to adult responding. Three hours. Mr. Joffe.

321 SENSORY PROCESS: VISION A study of the psychological and physiological parameters of the visual receptor system. Emphasis will be placed upon the integration of recent advances in the area of visual perception, neurophysiology, and photochemistry. Three hours. Messrs. Lawson and Musty.

322 SENSORY PROCESSES: MECHANICAL AND CHEMICAL SENSES A study of selected topics from mechanical senses (somesthesis and kinesthesis) and the chemical senses (olfaction and gustation). Emphasis will be placed upon recent advances in perceptual theory, neurophysiology and ultrastructure, as they are related to these senses. Three hours. Staff.

323 SENSORY PROCESSES: AUDITION A study of the psychological and physiological parameters of the auditory system. Emphasis will be placed upon the integration of recent advances in the areas of auditory perception, physiological acoustics, and sensory coding. Three hours. Mr. Patterson.

324 CENTRAL PROCESSES: BRAIN STEM MECHANISMS Advanced studies of spinal, rhombencephalic, and mesencephalic mechanisms of the nervous system, in the control of elementary anamative activity, including reviews of historical and current literature. Three hours. Mr. Musty.

325 CENTRAL PROCESSES: PALEOCORTICAL MECHANISMS Advanced studies of paleocephalic mechanisms of the nervous system with special emphasis on central integrative function of the thalamus, hypothalamus, and rhinencephalon, in the control of vegetative and affective activity. Three hours. Mr. Musty.

326 CENTRAL PROCESSES: CORTICAL MECHANISMS Advanced studies of the prosencephalic systems in cognitive behavior, with reference to cortical function and its relationship to input and output systems. Three hours. Mr. Musty.

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330 ADVANCED SOCIAL PSYCHOLOGY A critical evaluation of such major concepts and methods as: attitude formation, change, and measurement; prejudice; social perception; group dynamics. Three hours. Staff.

331 INTERPERSONAL PROCESSES: MODES OF INTERACTING Examination of interpersonal conflict, cooperation, power relations, information transfer, and persuasion. *Prerequisite:* permission of the instructor. Three hours. Mr. Leff.

332 INTERPERSONAL PROCESSES: COGNITION IN SOCIAL BEHAV-IOR Examination of social attribution, interpersonal set, problems of reciprocal perspectives in social encounter and the formulation of interpersonal strategies. *Prerequisite:* permission of the instructor. Three hours. Mr. Ferguson and Mr. Leff.

333 INTERPERSONAL PROCESSES: MOTIVATION IN HUMAN IN-TERACTION Examination of current and historical theories of social motivation, the interrelations of cognition and affect as determinants of motivation in social contexts, and the operation of selected motives of social significance (such as aggression, altruism, and achievement). *Prerequisite:* permission of the instructor. Three hours. Mr. Leff.

334 SEMINAR IN EXCHANGE THEORY Survey of the various approaches to exchange theory in human interaction. Theories will be set in the context of historical philosophical backgrounds of Mill and Bentham. Current positions of Homans, Blau and Scott, Adams, and Thibaut and Kelley will be surveyed. *Prerequisite:* permission of the instructor. Three hours. Mr. Ferguson.

335 SEMINAR IN SOCIAL JUDGMENT Traditional areas suggested by the work of Asch, Allport and Bruner will be examined with the eye toward target and perceiver variables. Attention will be to recent work by Kelley, Jones, de Charms and others in attribution theory. A section devoted to experimental work in stimulus judgment with applications to aesthetics. *Prerequisite:* permission of instructor. Three hours. Mr. Ferguson.

336 SEMINAR IN ATTITUDE CHANGE Coverage of historical and contemporary attitude change theorists. The literature will be examined in the light of more recent conceptualization of attitudinal dimensions and structural models. Methodological problems of assessing attitudes and attitude change will be discussed. *Prerequisite:* permission of the instructor. Three hours. Mr. Leff and Mr. Ferguson.

337 SEMINAR IN SOCIAL PERCEPTION Examination of the process through which impressions and judgments of man and other social objects are reached. Three hours. Mr. Perrine.

340 ADVANCED STATISTICAL METHODS I Study of Statistical methods as aids for understanding and evaluating psychological data. Critical study of such topics as sampling theory, statistical estimation, analysis of variance, and correlational techniques. Three hours. Mr. Howell.

341 ADVANCED STATISTICAL METHODS II A continuation of 340 with in depth study of regression and nonparametric theory and method. Further study of problems in the analysis and interpretation of data from the behavioral sciences. *Prerequisite:* 40. Three hours. Mr. Howell.

342 CORRELATION AND REGRESSION In depth treatment of correlational techniques commonly used with data found in the behavioral sciences. Special emphasis will be given to continuous and discrete data and their distributions, covering special methods for measuring degree of association. Least square methods for the solution of linear regression problems and associated topics such as matrix algebra. *Prerequisite:* 340. Three hours. Messrs. Goldstein and Howell.

344 EXPERIMENTAL DESIGN Extended coverage of problems in the design and analysis of behavioral experiments to include repeated and nonrepeated measures, interactions, confounding, individual comparisons, missing data, model building, Latin and higher order squares, lattice and block designs. Problems of covariate designs and their interpretations will be considered. *Prerequisite:* 340. Three hours. Messrs. Goldstein and Howell.

345 MATHEMATICAL MODELS IN PSYCHOLOGY The use of probabilistic models in contemporary psychology stressing basic probability theory. Markov chains, information theory, signal detection theory and Bayesian statistics. Three hours. Mr. Gordon.

347 MEASUREMENT AND SCALING Treatment of the philosophy of measurement and scaling including traditional psychophysical techniques. Thurstonian judgmental methods and recent topics in unidimensional scaling. Survey of techniques and applications in metric and non-metric multidimensional scaling. Examination of the relation of these techniques to related areas such as mental test theory, including concepts of reliability and validity, factor analysis, and cluster analysis. *Prerequisite:* 340 and 342. Three hours. Mr. Gordon.

349 SPECIAL TOPICS IN APPLIED STATISTICS A course for advanced graduate students. Topics might include factor analysis, discriminate function analysis, multivariate analysis of variance, advanced experimental design, introduction to Bayesian statistics, computer application in data collection and analysis. *Prerequisite:* permission of the instructor. Three hours. Messrs. Goldstein, Gordon, and Howell.

351 BEHAVIOR THERAPY A review of the literature relating to theory, practice, and research. Emphasis will be placed on the applications of conditioning theory and the experimental analysis of behavior to psychotherapy. *Prerequisite:* consent of the instructor. Three hours. Mr. Leitenberg.

352 INTRODUCTION TO CLINICAL HUMAN NEUROPSYCHOLOGY A clinical seminar dealing with the effects on human behavior of neocortical dysfunction. Review of the early theoretical and clinical approaches to brain function with major emphasis on recent developments in diagnostic techniques and the changes in theory that have occurred subsequently. *Prerequisite:* 221, 222 or equivalent. Three hours. Mr. Goldstein.

353 RESEARCH IN THE EDUCATION OF HANDICAPPED LEARNERS A broad survey of research undertaken to evaluate teaching/learning procedures, methodology, and materials employed in the education of the handicapped learner. *Prerequisite:* Education 312. Three hours. Mr. McKenzie.

356 MENTAL RETARDATION Study of abnormal behavioral development in the intellectual area. Etiology, assessment, and modification of mental retardation. *Prerequisite:* Permission of instructor. Three hours. Mr. Hasazi.

357 RESEARCH IN SCHIZOPHRENIA An advanced seminar intended to investigate the adequacies of past and current research methodologies with respect to environmental, genetic, and biochemical theories of the etiology of schizophrenia. *Prerequisite:* Permission of the instructor. Three hours. Mr. Rolf.

358 ANTISOCIAL BEHAVIOR A review of the literature related to the development and modification of anti-social behavior. Evaluation of previous research and the preparation of practical research proposals which will extend existing knowledge in the field. *Prerequisite:* Permission of instructor. Three hours. Mr. Burchard.

360 METHODS AND MODELS OF CLINICAL PREDICTION An in depth study of the clinical vs. actuarial problems in applied psychology. Consideration is given to historical precedents to the problem followed by treatment of models of intelligence and personality as classic examples of problems in prediction and description including reliability, validity and utility. Following a discussion of quantitative solutions, modern day positions in this controversy are covered. *Prerequisite:* 340 or permission of instructor. Three hours. Mr. Goldstein.

361 ADVANCED PERSONALITY THEORY A survey of present-day personality theories according to issues involved and explanatory demands made on a theory. With emphasis on usefulness to psychotherapy, an organismoperational-Adlerian type theory is favored. *Prerequisite:* Permission of instructor. Three hours. Mr. Ansbacher.

362 COMMUNITY CLINICAL PSYCHOLOGY A seminar in a current philosophy and approach to mental health problems. Topics will include: 1. History and development of community mental health and of community clinical psychology. 2. Consultation methodology in community clinical psychology and community mental health. 3. Research problems in community psychology. *Prerequisite:* Permission of instructor. Three hours. Mr. Kessler. 370, 371 INTRODUCTORY PRACTICUM: ASSESSMENT AND THERA-PY I & II Introductory overview of clinical evaluation and therapy. Psychology 370 emphasizes psychodiagnostic testing, interviewing, and psychotherapy for the young adult, whereas Psychology 371 focuses on children's disorders, family psychodiagnosis and therapy. The facilities of the University of Vermont Counseling and Testing Center and the Psychology Service of the Medical Center Hospital of Vermont will be utilized as part of the training. *Prerequisite:* graduate standing and permission of the instructors. Three hours. Mr. Albee and Staff.

372 through 377 ADVANCED CLINICAL PRACTICUM Supervised experience in a variety of clinical settings including the Medical Center Hospital; the State Hospital; Community Mental Health Facilities; Youth Service Center; and the public schools. *Prerequisite:* Graduate standing in Psychology and permission of the instructor. Three hours. Mr. Leitenberg and Staff.

380 CONTERMPORARY TOPICS Designed to cover selected topics in depth. The major emphasis will be on intensive and critical analysis of original literature in a given area. Suitable topics include: Accident Research, Memory, Fear and Frustration, Adlerian Theory, Behavioral Pharmacology, Information Theory, Instinct, Propaganda and Attitude Formation, Psycholinguistics. Three hours. Staff.

385 ADVANCED READINGS AND RESEARCH Readings, with conferences, to provide graduate students with backgrounds and specialized knowledge relating to an area in which an appropriate course is not offered. One to three hours. Staff.

391 MASTER's THESIS RESEARCH Credit as arranged. Staff.

# • RELIGION

Assistant Professors Andrews, Gussner, Martin, Paden (Acting Chairman) and Yarian.

#### No Master's Degree Program Offered

201 THEORY AND METHOD Critical examination of some of the major theories and methods used in studying and interpreting religion. *Prerequisite:* nine hours in religion; junior standing. Three hours. Mr. Paden.

281 PROBLEMS IN THE HISTORY AND PHENOMENOLOGY OF RE-LIGION Topics of special concern to historians of religions. *Prerequisite:* nine hours in religion; junior standing. Three hours. Staff.

#### **RESOURCE ECONOMICS**

# • **RESOURCE ECONOMICS**

Professors Sargent, Sinclair (Chairman), Tremblay and Webster; Assistant Professors Fife, Gilbert and Schmidt; Adjunct Professor Houghaboom; Adjunct Associate Professor Eddy; Adjunct Assistant Professor Bevins.

The Department conducts research in the economics of recreation, regional planning and development, and environmental quality and control. It also has an active research program in agricultural production and marketing and business management.

Master of Science degrees are offered with concentrations in agricultural economics, resource economics, and economics of natural resource planning.

### AGRICULTURAL ECONOMICS

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Undergraduate degree in economics, agriculture or related field. Satisfactory scores on the Graduate Record Examination. Transcripts are evaluated on an individual basis.

## **MINIMUM DEGREE REQUIREMENTS**

Advanced courses in Agricultural Economics or Resource Economics, and related fields, 15-24 hours; thesis research, 6-15 hours; for a total of 30 hours.

### ECONOMICS OF NATURAL RESOURCE PLANNING

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Undergraduate degree and satisfactory scores on the Graduate Record Examination. Transcripts are evaluated on an individual basis.

### **MINIMUM DEGREE REQUIREMENTS**

At least 24 hours in courses numbered above the 200 level of which at least 6 hours in courses numbered above 300. Thesis research, at least 6 hours for a total of 30 hours.

#### COURSES OFFERED

201 FARM BUSINESS MANAGEMENT Organization and operation of successful farm businesses with emphasis on resource allocation, production efficiency, and marginal analysis. Field trips required. *Prerequisite:* economics 11, 12, or resource economics 61. Three hours. Mr. Tremblay.

205 RURAL COMMUNITIES IN MODERN SOCIETY See Sociology 205. Three hours. Mr. Schmidt.

207 MARKETS, FOOD, AND CONSUMERS Market structure, prices, and economic forces involved in the movement of farm products from producers to 170 consumers. *Prerequisite:* economics 11-12, or resource economics 61. Three hours. Mr. Webster.

208 AGRICULTURAL POLICY History and institutional development of agricultural policy. Price and income problems of American agriculture and alternative solutions. *Prerequisite:* economics 11-12, or resource economics 61. Alternate years, 1972-73. Three hours. Mr. Sinclair.

218 COMMUNITY ORGANIZATION AND DEVELOPMENT See Sociology 207. Three hours. Mr. Schmidt.

222 NATURAL RESOURCE EVALUATION An analysis of economic procedures used in the evaluation of public natural resource developments, with emphasis on benefit-cost analysis. *Prerequisite:* resource economics 121. Three hours. Staff.

225 ECONOMICS OF OUTDOOR RECREATION An economic analysis of demand and supply of natural resources for outdoor recreation. Emphasis on current policy issues and management of recreational business firms. *Prerequisite:* economics 11, 12 or resource economics 61. Three hours. Mr. Bevins.

232 COMMUNITY DESIGN See Civil Engineering 232. Messrs. Oppenlander and Sargent.

233 REGIONAL PLANNING Delineation of regional boundaries, determination of public goals, tools of planning, quality environment planning, and the political process of planning. *Prerequisite:* senior standing and economics 11, 12, or equivalent. Three hours. Messrs. Sargent and Oppenlander.

235 LEGAL ASPECTS OF PLANNING AND ZONING An examination of Vermont planning and zoning law with comparisons with other states. Cases in planning and zoning and land use controls. *Prerequisite:* senior standing or consent of instructor. Three hours. Messrs. Ewing and Sargent.

243 SPATIAL ANALYSIS See Geography 243. Mr. Leinbach.

254 ADVANCED AGRICULTURAL ECONOMICS Theories of supply and demand analysis, price determination, market structure, and income distribution in competitive and imperfectly competitive markets. *Prerequisite:* twelve hours in resource economics and/or economics, and permission of instructor. Three hours. Mr. Sinclair.

255, 256 SPECIAL TOPICS IN RESOURCE ECONOMICS Readings and discussion of selected topics in economics at an advanced level. *Prerequisite:* departmental permission. Credit as arranged. Staff.

266 ECONOMICS OF MANAGERIAL DECISIONS Applying economic concepts to problems of capital budgeting, tax planning, pricing, demand analysis, and discounting cash flows. Cases. *Prerequisite:* economics 11, 12, or equivalent. Three hours. Mr. Fife.

322 ADVANCED RESOURCE ECONOMICS A critical evaluation of contemporary natural resource allocation procedures in the public sector. *Prerequi* 

#### SOCIOLOGY

site: resource economics 222 or equivalent. Three hours. Mr. Gilbert.

333 ADVANCED REGIONAL PLANNING Study of concepts of ecological planning with special emphasis on economic base analysis, resource base analysis, and economic impact studies. Each student will participate in a municipal or regional planning project. *Prerequisite:* resource economics 233 or consent of instructor. Three hours. Messrs. Sargent and Oppenlander.

351 RESEARCH METHODS The scientific method, statistical methods, sampling methods, use of electronic computers, linear programming, reporting research results. *Prerequisite:* three hours of statistics. Three hours. I or II. Mr. Fife.

381 RESOURCE ECONOMICS SEMINAR Discussion of problems and research in resource economics, and regional planning. One hour. Staff.
 391 MASTER'S THESIS RESEARCH Credit as arranged. Staff.

## • SOCIOLOGY

Professors Lewis, Mabry (Community Medicine), Sampson (Chairman); Associate Professors Finney, Folta, Stanfield, Steffenhagen; Assistant Professors Deck (Nursing), Nixon, Schmidt; Instructors Bradshaw, Fishman, Godfrey, Polich.

Research activities include the impact of socio-cultural change on the division of labor in American society; complex organizations; the medical profession; the sociology of illness; correctional institutions; and studies of community, family and political structure. No graduate program offered.

#### **COURSES OFFERED**

Courses numbered 200 to 299 generally require graduate standing or six hours of sociology. Sociology 100 or its equivalent will be required as a prerequisite for 200 level courses effective in the spring semester of 1975.

202 POPULATION DYNAMICS Analysis of the factors affecting human population growth and distribution, migration patterns, and the relationship between economic activity and population trends. *Prerequisite:* six hours of sociology or 10 and an introductory course in biology, economics, geography or zoology. Three hours. Mr. Godfrey.

203 HUMAN ECOLOGY Analysis of the relationships between forms of social organization and their environments. Special attention will be given to the causes and consequences of the differential location of socio-economic, racial and cultural groups and the major institutional facilities of society in contemporary urban communities. Three hours. Mr. Godfrey and Mr. Mabry.

172

205 RURAL COMMUNITIES IN MODERN SOCIETY The changing structure and dynamics of rural social organization in the context of modernization, and urbanization. Emphasis on rural communities in America. Three hours. Mr. Finney and Mr. Schmidt.

206 URBAN COMMUNITIES IN MODERN SOCIETY The changing structure and dynamics of urban social organization in the context of modernization and urbanization. Emphasis upon cities and metropolitan areas in America. Three hours. Mr. Godfrey and Mr. Lewis.

207 COMMUNITY ORGANIZATION AND DEVELOPMENT Community as a changing complex of organization within modern society. Special attention will be given to problems of the formulation and implementation of alternative change strategies. Three hours. Mr. Schmidt.

209 SMALL GROUPS An examination of the structure and dynamics of interpersonal relations and informal interactions in small groups. Three hours. Ms. Deck, Mr. Nixon and Mr. Steffenhagen.

210 COLLECTIVE BEHAVIOR Analysis of the nature and types of emergent, noninstitutional behavior, especially responses to shared stressful or crisis situations. Includes the examination, social origins, development and consequences of crowd, riot, disaster and craze behavior. Three hours. Mr. Finney and Mr. Stanfield. Alternate years, 1974-75.

211 SOCIAL MOVEMENTS Analysis of the nature and types of relatively organized collective action to promote social or cultural change. Special attention will be given to the genesis, structure and social consequences of political and religious movements. Three hours. Mr. Finney, Ms. Folta and Mr. Stanfield.

212 CULTURE AND PERSONALITY The cross-cultural comparison of personality development; the problem of delineating modal personality types. *Prerequisite:* 10, Anthropology 21 and one 100 level course in sociology or anthropology. Three hours. Mr. Mabry, Mr. Magnarella (Anthropology), and Mr. Steffenhagen. (Cross-listed in anthropology).

214 DELINQUENCY Analysis of the nature and types of juvenile behavior that violates law, the mechanisms for defining such behavior as delinquent, and the relationships between delinquency and the social situations of juvenile offenders. Three hours. Ms. Fishman.

215 CRIME Analysis of the nature and types of adult behavior that violates law, the mechanism for defining such behavior as criminal, and the relationships between crime and the social situation of adult offenders. Three hours. Ms. Fishman, Ms. Folta and Mr. Stanfield.

216 CRIMINAL JUSTICE Analysis of the social structures and processes involved in the specification of behavior as being legally deviant and the labeling of individuals as delinquent or criminal offenders. Criminal law, its enforcement and the courts. Three hours. Ms. Folta and Mr. Stanfield.

#### SOCIOLOGY

217 CORRECTIONS Analysis of the social structures and processes involved in dealing with individuals who have been designated as offenders of criminal law. Probation, prison, parole, programs of prevention and rehabilitation. Three hours. Ms. Fishman and Mr. Stanfield.

219 RACE RELATIONS Examination of racial subordination in social and historical context. Special attention will be given to the analysis of the forms of interracial contact, racial sub-cultures and social structures, social psychological and protest responses to racial prejudice and discrimination. Emphasis on American experience. Three hours. Ms. Fishman.

225 COMPLEX ORGANIZATIONS Analysis of the structure and dynamics of large, formal organizations. Special attention will be given to the analysis of the forms of complex organization and their external relationships, and the role of bureaucracy in contemporary society. Three hours. Mr. Finney, Mr. Nixon and Mr. Sampson.

226 SMALL GROUPS IN COMPLEX ORGANIZATION Analysis of the emergence, structure and consequences of informal interaction in large, formal organizations. Special attention will be given to the reciprocal effects of small groups and their complex organizational environments. Three hours. Mr. Nixon and Mr. Steffenhagen. Alternate years, 1974-75.

230 SOCIAL VALUE PATTERNS IN AMERICAN FAMILY LIFE A detailed examination of both the similarities and differences in social value patterns characteristic of the different segments of American family life and the relation of each to the larger American society. Attention will be given to both continuity and change in value patterns, including radical alternatives, and their significance for future developments in the family and society. Three hours. Mr. Lewis. Alternate years, 1973-74.

232 SOCIAL STRATIFICATION Comparative analysis of the social causes, structures and consequences of the differential ranking of individuals and groups in society. Special attention will be given to the criteria for social ranking, their measurement and association, and intergenerational social mobility. Three hours. Mr. Finney, Mr. Lewis, Mr. Nixon and Mr. Schmidt.

237 OCCUPATIONS AND PROFESSIONS Analysis of the social organization of economic roles and associations in industrial society. Special attention will be given to an examination of the impact of the structure of work on the individual and the relationship of occupations and professions to other institutions in society. Three hours. Mr. Bradshaw and Mr. Mabry. Alternate years, 1974-75.

239 COOPERATIVES AND COOPERATIVE COMMUNITIES Analysis of the structure and dynamics of cooperatives as a distinctive form of complex organization in society. Special emphasis will be given to the analysis of problems associated with the development, organization and maintenance of cooperatives among the poor in developed and underdeveloped societies. Three hours. Mr. Finney.

240 POLITICAL SOCIOLOGY Analysis of the social organization of political roles and associations in modern society. Special attention will be given to an examination of the changing structure of the political institution and its relationship to other institutions in society. Three hours. Mr. Nixon and Mr. Polich.

241 PUBLIC OPINION Analysis of the factors affecting social attitude formation and change. Special attention will be given to political and social ideology. Three hours. Mr. Polich. Alternate years, 1974-75.

246 BUREAUCRACY IN EDUCATION Analysis of the formal organizational aspects of educational institutions. Special attention is given to the structure and dynamics of schools and colleges as organizations, their authority systems and relationships to other organizations and institutions of society. Three hours. Mr. Bradshaw.

249 SOCIOLOGY OF KNOWLEDGE Reviews the development and present state of sociological theory and research on the emergence and role of belief and normative systems in society. Special attention will be given to systematic attempts to understand the causes and consequences of shared constructions of social reality. Three hours. Mr. Sampson. Alternate years, 1974-75.

251 SOCIOLOGY OF RELIGION Analysis of the social organization of religious roles and associations in modern society. Special attention will be given to the changing structure of the religious institution and its relationship to other institutions in society. Three hours. Mr. Sampson. Alternate years, 1974-75.

254 SOCIOLOGY OF HEALTH AND MEDICINE The socio-cultural environment of physical well-being and illness. Special attention will be given to the role of socio-cultural factors in the etiology, identification, definition and treatment of illness in society. Three hours. Ms. Deck, Ms. Folta, Mr. Mabry and Mr. Steffenhagen. Alternate years, 1973-74.

255 SOCIOLOGY OF MENTAL HEALTH The socio-cultural environment of mental well-being and illness. Special attention will be given to the role of sociocultural factors in the etiology, identification, definition and treatment of mental illness in society. Three hours. Ms. Deck, Ms. Folta, Mr. Mabry and Mr. Steffenhagen. Alternate years, 1973-74.

258 SOCIOLOGY OF LAW Analysis of the social organization of legal roles and associations in modern society. Special attention will be given to the changing structure of the legal institution and its relationship to other institutions in society. Three hours. Mr. Stanfield. Alternate years, 1974-75.

273 METHODOLOGY OF SOCIAL RESEARCH Basic issues in the construction and empirical testing of sociological descriptions, predictions and explanations. Consideration will be given to the philosophy and logic of social research and the socio-cultural nature of scientific inquiry; theoretical frames of

#### SOCIOLOGY

reference; concept formation, measurement and validation; socio-cultural causation and measures of association; models, theories and verification; and the formalization of theories. Three hours. Mr. Godfrey, Mr. Polich and Mr. Sampson. Alternate years, 1974-75.

274 METHODS OF DATA GATHERING IN SOCIAL RESEARCH An examination of the methods available for studying social phenomena including laboratory and field experiments, observational techniques, social surveys, content analysis, cross-cultural comparisons and others. Basic problems in research design, sampling methods, and measurement and scaling will be investigated. Three hours. Mr. Mabry, Mr. Polich and Mr. Schmidt. Alternate years, 1974-75.

275 METHODS OF DATA ANALYSIS IN SOCIAL RESEARCH An examination of approaches to the quantitative analysis of sociological data, including table analysis, regression and path analysis, scaling and factor analysis, and the analysis of variance with emphasis on the multivariate techniques. Three hours. Mr. Polich.

278 THE DEVELOPMENT OF SOCIOLOGICAL THEORY An examination of the major classical traditions in social theory and their contemporary research relevance. Detailed critical attention will be given, but not necessarily confined to, the theoretical and methodological contributions of Marx, Durkheim and Weber. Three hours. Mr. Sampson and Mr. Schmidt.

279 CONTEMPORARY SOCIOLOGICAL THEORY A detailed examination of selected major theoretical approaches and issues in modern sociology. Three hours. Mr. Sampson, Mr. Schmidt and Mr. Stanfield.

281, 282 SEMINAR Presentation and discussion of advanced problems in contemporary sociological analysis. *Prerequisite:* twelve hours in sociology and permission of the department. Three hours. Staff.

288, 289 SEMINAR: RESEARCH AND METHODS OF TEACHING SO-CIOLOGY The development and evaluation of teaching strategies in sociology. Open only to graduate students and advanced undergraduate sociology majors who are serving concurrently as teaching assistants in the Department. *Prerequisite:* twelve hours in sociology and permission of the department. Three hours. Staff.

295, 296 SPECIAL TOPICS

297, 298 READINGS AND RESEARCH

354 ADVANCED SEMINAR IN MEDICAL SOCIOLOGY Analysis of current problems relating to sociological aspects of medicine and the medical profession, with emphasis on an interdisciplinary approach. *Prerequisite:* Permission of the instructors. Three hours. Dr. McAree (psychiatry), Mr. Mabry (community medicine), Mr. Steffenhagen (sociology) and Staff.

355, 356 INDIVIDUAL STUDY IN MEDICAL SOCIOLOGY Independent study of socio-cultural factors influencing medicine and the medical profession.

Study and research topics are chosen by the student with the approval of the instructor from epidemiology, community medicine or social psychiatry. Open to medical students, residents and graduate students. *Prerequisite:* Permission of the instructors. Dr. McAree (psychiatry), Mr. Mabry (community medicine), Mr. Steffenhagen (sociology) and Staff.

## • SPANISH

Associate Professors Julow (Chairman), Ugalde and Weiger; Assistant Professors Zarate and Wesseling; Instructors Murad and Nuñez-de-Cela.

Opportunities for thesis research exist in Spanish literature of the 16th, 17th, 19th and 20th centuries and in Spanish-American literature of the 20th century.

# PREREQUISITE FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

An undergraduate major or its equivalent in Spanish. Satisfactory scores on the Aptitude and Advanced Graduate Record Examinations.

#### **MINIMUM DEGREE REQUIREMENTS**

Twenty-four hours in Spanish which may also include 6 hours in a related field; 6 hours of thesis research.

A program is also offered leading to the degree of Master of Arts in Teaching. Satisfactory scores on the Graduate Record Examinations are prerequisite for acceptance to candidacy for this degree. Cf. p. 24.

#### COURSES OFFERED

The following courses are available for graduate credit. In literature, the twohundred level courses, open to both undergraduates and graduates, cover the history of Spanish literature from the Golden Age to the present time, by means of division into centuries and genres. Emphasis is placed on major figures and works, with a view to studying them for their intrinsic value as well as in their historical context. The courses specifically offered for graduate students are regularly supplemented by special topics given under the rubric of the Graduate Seminar; content may vary from year to year, depending on student and staff interests. For more detailed information on specific courses, consult with department chairman and the course instructor.

223, 224 ADVANCED COMPOSITION AND CONVERSATION 3 hours (each course). Mr. Ugalde.

### VOCATIONAL EDUCATION AND TECHNOLOGY

261, 262 GOLDEN AGE 3 hours (each couse). Alternate years, 1974-75. Mr. Nuñez-de-Cela.

263, 264 CERVANTES 3 hours (each course). Alternate years, 1973-74. Mr. Nuñez-de-Cela.

271, 272 SPANISH-AMERICAN LITERATURE OF SOCIAL PROTEST 3 hours (each course). Alternate years, 1974-75. Mr. Zarate.

281 19th CENTURY 3 hours. Alternate years, 1973-74. Mr. Ugalde.

282 20th CENTURY 3 hours. Alternate years, 1973-74. Mr. Ugalde.

301, 302 GENERATION OF 1898 3 hours (each course). 1974-75. Mr. Ugalde.

305 REGIONAL NOVEL OF SPANISH AMERICA 3 hours. Mr. Zarate.

306 PSYCHOLOGICAL NOVEL OF SPANISH AMERICA 3 hours. Mr. Zarate.

313 THE SPANISH COMEDIA 3 hours. Mr. Nuñez-de-Cela.

314 SPANISH THEATER 3 hours. Mr. Nuñez-de-Cela.

381 GRADUATE SEMINAR 3 hours. Mr. Wesseling.

391 MASTER'S THESIS RESEARCH Credit as arranged. Staff.

For undergraduate courses see the undergraduate catalogue.

# VOCATIONAL EDUCATION AND TECHNOLOGY

Professors Fuller (Chairman), Schneider; Associate Professor Kelley; Instructor Hull. Adjunct Faculty: Associate Professor Bornstein; Assistant Professors Halloran, Kisko, Kumble, Moore.

The Department offers opportunities for graduate study to education professionals in occupational and practical arts fields, and persons having educational responsibilities in non-school settings. Programs are tailored to meet individual needs. Research is designed to solve practical problems.

OCCUPATIONAL AND PRACTICAL ARTS EDUCATION A Master of Education Degree program is offered for educational professionals. Satisfactory scores on the Graduate Record Examination are prerequisite for acceptance to candidacy. The degree is offered in cooperation with the College of Education and details concerning degree requirements are listed on page 25.

VOCATIONAL EDUCATION AND TECHNOLOGY A Master of Arts in Teaching is offered in this area in cooperation with the college of Education. Satisfactory GRE scores are required for candidacy. MAT requirements are indicated on page 24.
EXTENSION EDUCATION The degree of Master of Extension Education is offered for candidates concentrating in extension education, continuing education, or having educational responsibilities in other non-school settings. Satisfactory scores on the Millers Analogies Test are prerequisite for acceptance to candidacy.

## **COURSES OFFERED**

251 METHODS FOR TEACHING OCCUPATIONALLY ORIENTED SUBJECTS Study of advanced techniques in teaching and program management. *Prerequisites:* Concurrent enrollment in 153 or 155, or departmental permission. Three hours. Mr. Fuller.

253 TEACHING ADULTS Needs, problems, and objectives for the education of adults. *Prerequisites:* senior standing, or permission of the department. Three hours. Mr. Kelly.

273 TECHNICAL REPORTING Study of communication of information through research and technical operations reports and articles in professional journals. Three hours. Mrs. Kumble and Mr. Spaven.

282 SEMINAR Evaluation of student teaching experiences. *Prerequisites:* 155. Mr. Fuller.

295 SPECIAL TOPICS Lectures, laboratories and/or readings and reports, relating to a contemporary area of study. A student may enroll more than one time and accumulate up to nine hours. *Prerequisite:* Departmental permission. Credit as arranged. I, II. Staff.

301 RESEARCH Investigation of a research topic under the direction of an assigned staff member. A student may enroll more than one time and accumulate up to nine hours. Credit as arranged. I, II. Staff.

# ZOOLOGY

Professors Bell, Glade (Chairman), Henson, Lochhead, Moody, Potash, and Rothstein; Associate Professors Davison and Stevens; Assistant Professors Brammer, Keen, Landesman, and Woods.

Faculty research interests fall within the general areas of environmental biology, developmental biology, and cell biology. Current on-going projects include research in insect taxonomy and ecology, especially of the Carabidae; aquatic ecology; chemical and experimental embryology of amphibians and crustaceans; arthropod anatomy and physiology; mechanisms of cell division; the synthesis of macromolecules during mitosis; comparative anatomy. When applying, students are requested to indicate their general area of interest for research to the extent it is known.

### ZOOLOGY

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major in zoology or its equivalent. Satisfactory showing on a candidacy examination to be given at the end of the first year of residency. Acceptability to the faculty member with whom the candidate wishes to do his thesis research.

### **MINIMUM DEGREE REQUIREMENTS**

Zoology Seminar each semester; 15-22 additional hours in zoology and related fields; thesis research (8-15 hours).

The department also offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 24. Satisfactory scores on the Graduate Record Examination are prerequisites for acceptance to candidacy for this degree.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE FOR TEACHERS (BIOLOGY)

A bachelor's degree from an accredited institution and certification as a teacher of biology or an associated field. At least three years of secondary school teaching. Satisfactory scores on the Graduate Record Examinations.

### **MINIMUM DEGREE REQUIREMENTS**

Thirty hours of course work to include a selection of courses in the Department of Botany and Zoology which will broaden and balance the undergraduate work in biology. At least two 200 level courses in each department. Courses in four of the five following areas: anatomy; morphology and systematics; genetics; developmental biology; and environmental biology. Up to 12 hours of 100 level courses may be used for the above requirements. Students will be encouraged to select courses in related science departments, mathematics, and in education to complete the required thirty hours. No thesis is required, however, each degree recipient must complete a written and oral examination. Botany or Zoology seminar each semester.

# PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Satisfactory completion of: an academic year of graduate study in the University of Vermont; a year of Mathematics and one of Physics (college courses of appropriate level for students majoring in science); Organic Chemistry; at least one year of Zoology; a reading knowledge of two appropriate foreign languages, or one foreign language and an adjunct area of special competency as determined by the studies committee. Students whose programs are to include Physical Chemistry should have had, or should take, mathematics through Mathematics 121 or its equivalent. Satisfactory showing in a candidacy examination to be given at the end of the first year of residency. Acceptability to the faculty member with whom the candidate wishes to do his thesis research.

## **MINIMUM DEGREE REQUIREMENTS**

Of the 75 credit hours required for the degree, at least 40 hours must be earned in courses suitable for graduate credit, the selection of courses to be designated for each student by his Studies Committee. Of these courses a minimum of 13 credits must be in courses other than Zoology. At least 20, but not more than 40, credits must be earned in thesis research. Zoology Seminar each semester. Each candidate must participate in the teaching of at least one undergraduate course.

# **COURSES OFFERED**

201 CONTROL OF GROWTH AND DIFFERENTIATION Three hours. *Prerequisites:* 101, 211 and Chemistry 131, 132. Mr. Davison. Alternate years, 1973-74.

203 POPULATION ECOLOGY Analysis of growth, regulation, and interrelations of biological populations in theoretical, laboratory, and natural systems. *Prerequisite:* 102. Three hours. Mr. Keen.

205 NATURAL HISTORY OF BIRDS AND MAMMALS History, identification, evolution, ecology, behavior, zoogeography, conservation and aesthetics. *Prerequisite:* 102 or 104. Four hours. Mr. Woods. Alternate years, 1974-75.

207 NATURAL HISTORY OF THE LOWER VERTEBRATES Classification, ecology, behavior, evolution, and distribution of fish, amphibians, and reptiles. *Prerequisite:* 104. Four hours. Mr. Bell. Alternate years, 1974-75.

208 GENERAL ENTOMOLOGY Morphology, physiology, and evolution of insects. *Prerequisite:* 102 or 103. Four hours. Mr. Bell. Alternate years, 1973-74.

209 FIELD ZOOLOGY Collection and identification; study of local habitats, their nature, and adaptations to them; factors governing distribution methods of preparing study speciments. *Prerequisite:* 102 or 103. Four hours. Mr. Bell.

211 EMBRYOLOGY Principles exemplified by typical invertebrate and vertebrate embryos. *Prerequisite:* 104. Four hours. Mr. Glade.

212 COMPARATIVE HISTOLOGY Anatomy of tissues, chiefly vertebrate. Tissue similarities and specializations of organs among the various groups of animals in relation to function. *Prerequisite:* 104. Four hours. Mr. Glade.

216 HUMAN GENETICS Inheritance; population genetics; interaction of heredity and environment; application to human problems. *Prerequisite:* 101.

### ZOOLOGY

Three hours. Mr. Moody.

219 COMPARATIVE VERTEBRATE ANATOMY Structure, function, and phylogeny; evolutionary and functional trends; investigation of the structure of all chordate groups. *Prerequisite:* 104. Four hours. Mr. Woods.

220 MECHANISMS OF CELL DIVISION Fine structure and physiology of normal and abnormal cell division; emphasis on mechanisms. *Prerequisite:* 103, a course in biochemistry, and the consent of the instructor. Three hours. Mr. Stevens. Alternate years, 1974-75.

222 EXPERIMENTAL EMBRYOLOGY Theoretical approach based on research in embryology, genetics, physiology, bacteriology, and related fields. *Prerequisite:* 211 and consent of the instructor. Four hours. Mr. Glade. Alternate years, 1973-74.

223 BIOCHEMICAL EMBRYOLOGY Biochemical and structural differentiation of cells and tissues during oogenesis and embryogenesis. *Prerequisite:* 101, 211. A course in biochemistry is recommended. Three hours. Mr. Landesman. Alternate years, 1974-75.

225 ENVIRONMENTAL PHYSIOLOGY Processes by which animals cope with moderate, changing, and extreme environments. *Prerequisite:* 102 and 104. Four hours. Mr. Woods. Alternate years, 1973-74.

231 CELL PHYSIOLOGY Experimental techniques used to elucidate chemical and physical mechanisms within living cells. *Prerequisite:* 103; Chemistry 131, 132 and consent of the instructor. Four hours. Mr. Rothstein. 236 LIMNOLOGY The ecology of standing waters: the biota of lakes as related to the geological, physical, and chemical conditions of lakes. *Prerequisite:* Zoology 102, Inorganic Chemistry. Four hours. Mr. Henson.

237 ECOLOGY OF RUNNING WATERS Stream and river environments, adaptations of organisms to varying physical, chemical, and biotic conditions. *Prerequisite:* Zoology 102, Inorganic Chemistry. Four hours. Mr. Potash.

240 INVERTEBRATE ECOLOGY OF THE MOUNTAINS An intensive study of the invertebrate fauna of Camel's Hump and vicinity. *Prerequisite:* Zoology 102 or a course in invertebrate or insect taxonomy. Four hours. Mr. Bell.

250 INVERTEBRATE ZOOLOGY Anatomy, physiology, and life histories of representatives of the more important phyla. *Prerequisite:* 104. Four hours. Mr. Lochhead.

251 INSECT STRUCTURE AND FUNCTION Anatomy and physiology with emphasis upon growth, reproduction, and sensory physiology. *Prerequisite:* 104 or consent of instructor. Four hours. Mr. Brammer. Alternate years, 1974-75.

255 COMPARATIVE ANIMAL PHYSIOLOGY General principles of function in invertebrates and vertebrates. *Prerequisite*: 104; Chemistry 131, 132; and consent of the instructor. Four hours. Mr. Rothstein.

### ZOOLOGY

267 GENETICS OF DEVELOPMENT Differentiation and morphogenesis from the viewpoint of gene action and biosynthesis; influence of hereditary material during ontogeny. *Prerequisite:* 101 and 104, and consent of the instructor. Four hours. Staff. Alternate years, 1974-75.

270 MODERN EVOLUTIONARY THEORY Contributions of modern research in genetics, systematics, distribution, experimental embryology, serology, and related fields to problems of evolutionary change. *Prerequisite:* 101 (102 recommended). Three hours. Mr. Moody. Alternate years, 1973-74.

271 ADVANCED LIMNOLOGY Analysis of current concepts and problems. *Prerequisite:* 236. Four hours. Mr. Henson. Not offered 1973-74.

281 SEMINAR Review and discussion of current zoological research. Graduate students and seniors in zoological research programs are expected to enroll each semester. Without credit. Staff.

381 SPECIAL TOPICS Readings with conferences, small seminar groups, or laboratories intended to contribute to the programs of graduate students in phases of zoology for which formal courses are not available. *Prerequisite:* an undergraduate major in zoology. Credit as arranged.

391 MASTER'S THESIS RESEARCH Credit as arranged.

491 DOCTORAL THESIS RESEARCH Credit as arranged.

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Booth House Buckham Hall

- Carrigon Dairy Science Building Centennial Field Chittenden Hall Christie Hall Christie Hall Classics and Philosophy Classics and Philosophy Clement House Converse Hall Cook Physical Science Building Coolidge Hall Counseling and Testing – Jacob Champloin College 2 Colchester Ave.
- Davis Hall Dental Hygiene Building
- Englesby House
- Fleming Museum Forbush Natatorium
- Given Medical Building Grasse Mount Gutterson Field House

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#### NUMERICAL LISTING

EAST WOODS NATURAL

AREA

Medical Center Hospital of Vermont

 DeGoesbriend Unit
 John Deway Hall

3. Rowell Nursing and Allied Health Science Building 4. Vermont-N.H. Regional Red Cross Blood Center

5. 2 Colchester Ave 6. Varmont State Hi 7. Centennial Field 

11, Ira Allen Chape

17. Converse Holi 18. Chittenden Holi 19. Suckham Hall 20. Wills Hall

Lis Allen Chapel
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 Medical Alumni Building
 Medical Sciences Building
 Given Medical Building

21. Votey Engineering Building 22. Billings Student Center 23. 41 South Prospect St. 24. Williams Hall

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32. Harris-Millis Hall 33. Maintenance Office Building

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38. University Store 39. Old Mill 40. Military Science Building \* 41. Mortill Hall

42. Waterman Building 43. Music Annex 44. Music Building

45. Afumni House Annex 46. Alumni House 47. 479 Moin St. 48. Classics and Philosophy

- 49. Pomeroy Hall 50. Pringle Herbari 50, Fringle Herbarium 51, Living Learning Center \*\* 52, Tupper Hon 53, Austin Holl 54, Marsh Holl

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- 55. Newman Center, St. Augustine's S6. Protestant and Episcopul Center, S1. Anselm's 57. WRUY Building

  - 58. Clement House Admissions
  - 59. Allen House
  - 60. Bitlersweet 61. Wosson Infirmary

  - 62. Englesby House 63. Jacobs House Counseling and Testing 64. Grasse Mount

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  - 65. Redstone Lodge 66. Blundell Home Man-Building 67. Roy L. Patrick Gymn 68. Forbush Natatorium

  - 69. Gutterson Field House
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  - 81. Wing Holl 82. Davis Hall

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  - 89. Socialogy and Anthropology 90. Vermont State Colleges offices 91. Post Field 92. Hillel House

  - 92. Hills House 93. Booth House 94. 196 South Prospect St. 95. Wadhams House 96. U. S. Forest Service Station (under construction)

Under renavation for Theatre and Drama Classrooms.
 Under construction. Scheduled completion August 1973.
 Under renovation and construction for Music Recital Holl, Offices and Classrooms.



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THE UNIVERSITY'S LOCATION IN ONE OF NEW ENGLAND'S MOST BEAUTIFUL CITIES PROVIDES MANY SPECIAL DIVIDENDS FOR STUDENTS AND STAFF.

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WINTER WORKS MANY BRANDS OF MAGIC IN VERMONT AND THE UNIVERSITY IS WITHIN AN EASY DRIVE OF SOME OF THE WORLD'S BEST SKIING. THIS PHOTO WAS TAKEN AT NEARBY BOLTON VALLEY.

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