

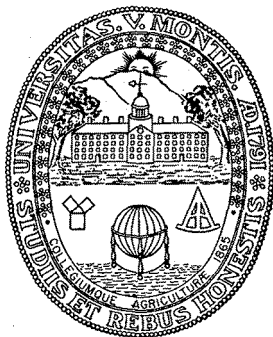


GRADUATE COLLEGE  
UNIVERSITY OF VERMONT  
1980-81 CATALOGUE

# **GRADUATE COLLEGE**

**UNIVERSITY OF VERMONT**

**Burlington, Vermont**



**CATALOGUE and ANNOUNCEMENTS**

**1980-81**

## 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 05405; telephone (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 05405.

Requests for Summer Session and Evening Division information should be addressed to the Office of Continuing Education, The University of Vermont, Burlington, Vermont 05405.

Please note the following deadlines (Details, and exceptions, Pg. ☐):

**March 1** — for applications requesting financial aid.

**April 1** — for applications to most 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, religion, sex or national origin.*

*The University has embarked on a program to remove architectural barriers to make facilities accessible to and usable by the handicapped. Questions should be referred to the Office of Architectural Barrier Control. The University of Vermont does not discriminate on the basis of handicap in the admission or funding of graduate students.*

*Please be advised that information provided herein is subject to change without notice in accordance with established University procedures. Circumstances occasionally require instructor changes and changes in the timing of specific course offerings.*

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# Academic Calendar

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## FALL SEMESTER 1980

September 3	Registration
September 4	Classes Begin
November 19-21	Preregistration
November 26-30	Thanksgiving Recess
December 12	Classes End
December 15	Exams Begin
December 19	Exams End

## SPRING SEMESTER 1981

January 13	Registration
January 14	Classes Begin
February 16	Washington's Birthday
March 3	Town Meeting Recess
March 30-April 3	Spring Recess
April 15	Honors Day
April 22-24	Preregistration
May 1	Classes End
May 4	Exams Begin
May 8	Exams End
May 15-16	Commencement

## SUMMER SESSION 1981

Two, three, four, and six week sessions  
Contact Continuing Education for further information

## FALL SEMESTER 1981

September 8	Registration
September 9	Classes Begin
November 18-20	Preregistration
November 25-29	Thanksgiving Recess
December 16	Classes End
December 17	Exams Begin
December 22	Exams End

## SPRING SEMESTER 1982

January 12	Registration
January 13	Classes Begin
February 15	Washington's Birthday
March 2	Town Meeting Recess
April 5-9	Spring Recess
April 21	Honors Day
April 28-30	Preregistration
May 4	Classes End
May 7	Exams Begin
May 12	Exams End
May 21-23	Commencement

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# **The University of Vermont**

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## **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 needs 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 1807. 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 has developed rapidly since its inception. In 1953, following its formal establishment by the trustees, 46 master's degrees were awarded. In 1979, 369 master's degrees and 24 Doctor of Philosophy degrees were awarded. The Graduate College currently enrolls over 900 students pursuing advanced degrees with about 200 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 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 col-

lege 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 substantial private support, University development has been identified closely 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, the College of Engineering, Mathematics and Business Administration, the College of Education and Social Services, the College of Medicine, the Graduate College, the School of Allied Health Sciences, the School of Nursing, the School of Natural Resources, and Continuing Education.

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 main Library was dedicated in 1961, and the physical facilities were expanded to double their original size in 1979, providing substantial additional study space and carrels for student use. It holds the largest book collection in Vermont, and acquires regularly major periodicals, scholarly journals and indexing and abstracting services. The University collections also include books in medicine and health-related sciences, and a strong collection in medical periodical literature, maintained in the Dana Medical Library of the Division of Health Sciences.

The Bailey-Howe Library is a depository for United States and Canadian government publications, and acquires newspapers, pamphlets, maps, and materials in microfilm. The Special Collections Department includes books and manuscripts from the library of George P. Marsh, and a significant Masefield poetry collection; its Wilbur Collection is rich in books and manuscripts of those associated with the State, including Ira Allen, Henry Stevens, Dorothy Canfield, Vermont Governors and members of the State Congressional delegation.

The Physics and Chemistry Library is located in the Clinton D. Cook Physical Sciences building.

The University Archives in the Waterman Building contain the permanent official records of the University.

**The Robert Hull Fleming Museum** The Museum houses a notable University collection of Western and non-Western art, and is a center for research and museological studies as well as a place for aesthetic exploration. The Reed Collection of Plains Indian Art and the Schnackenberg Collection of 19th- and 20th-century American Art, for example, are outstanding and of particular interest to students of American art and history. Exhibits are frequently rotated to serve class and seminar needs. Two galleries are given to changing exhibitions on special topics. These are frequently augmented by lectures, gallery talks, and films. Besides facilities to support the scholarly use of the collections, the Museum also houses class and seminar rooms for art history courses and the Art Department slide library of 40,000 slides.

**The Academic Computing Center** The Academic Computing Center was organized in 1960 to provide computing facilities for the campus community. The Center (DEC 2060) services the computation needs of the varied research projects on campus; its facilities are also used as an integral part of many graduate and undergraduate courses.

The staff of the Computing 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 Vermont Seminars** The Vermont Seminar Program augments the focus of teaching and research at the University and enriches educational offerings by bringing to campus individuals from a variety of walks of life, including faculty from elsewhere, statesmen, distinguished citizens, and leaders in special fields.

**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 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 number of special events throughout the year in Burlington and on occasion in other locations.

**The George Aiken Lectures** The annual George Aiken lectures, established in honor of Vermont's dean of the United States Senate, focus on issues of national and international importance. They bring

together speakers of prominence, University faculty, and the University community in an attempt to achieve greater understanding of significant human concerns.

**The Placement Service** To assist graduates in exploring and selecting among various career employment possibilities, the University operates an extensive placement program. Under the sponsorship of the Center for Career Development, a large number of representatives of business organizations, governmental agencies, and school systems come to the campus each year to interview students for full time positions. Related services include individual career counseling, the preparation of confidential credentials for employers, and educational placement.

**The Physical Education Facilities** The University's extensive physical education plant is available for recreational use 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.

*Graduate students may not enroll in physical education classes without prior approval by the Dean of the Graduate College; Graduate College tuition scholarships do not cover physical education activities.*

## 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 U. S. Air, Delta Airlines, Air New England, Vermont Transit and Greyhound Bus Lines, and Amtrak. The expanded Vermont interstate highway system has correspondingly shortened automotive travel time.

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## Degree Programs Offered

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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:

English	Greek and Latin
French	History
Geography	Political Science
German	Psychology

### MASTER OF SCIENCE

Programs are offered in the following fields:

Agricultural and Resource Economics	Geology
Anatomy	Historic Preservation
Animal Sciences	Human Nutrition and Foods
Animal Pathology	Mathematics
Biochemistry	Mechanical Engineering
Biomedical Engineering	Medical Microbiology
Biostatistics	Medical Technology
Botany	Microbiology
Cell Biology	Natural Resource Planning
Chemistry	Pathology
Civil Engineering	Pharmacology
Communication Disorders	Physics
Computer Science	Physiology and Biophysics
Electrical Engineering	Plant and Soil Science
Forestry	Statistics
	Zoology

### 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	Greek and Latin
Chemistry	History
English	Mathematics
French	Occupational and Practical Arts
Geography	Physics
Geology	Zoology
German	

### **MASTER OF SCIENCE FOR TEACHERS**

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

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

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	School Counseling
Community Counseling	(Elementary and Secondary)
Foundations of Education	Special Education
Occupational and Practical Arts	Student Personnel Services in
Organization and Human	Higher Education
Resource Development	Teacher Education
Reading and Language	
(Elementary and Secondary)	

### **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 for persons who have educational responsibilities outside of regular school settings. Programs are individually designed to provide knowledge and competencies associated with a career field. Emphasis is placed upon preparation for educational leadership functions. Programs are planned in the following specializations:

Agricultural Agencies and Organizations  
Business and Industry  
Youth Organizations

## DOCTOR OF PHILOSOPHY

Programs are offered in the following fields:

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

## FIFTH YEAR CERTIFICATE IN EDUCATION

A special program culminating in a fifth year certificate is offered by the College of Education and Social Services 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, advanced students who are meeting requirements for state certification, and 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 and Social Services.

Persons enrolled in the fifth year certificate program transferring to Master of Education programs are subject to the restrictions on validation of credit outlined on page 21.

## 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 and Social Services in the following fields:

- a. Administration and Planning which is designed to prepare administrators and planners for public schools, educational and social agencies, and middle management positions in higher education.
- b. Counseling. Individuals who have completed a master's degree in counseling or a related area may apply for admission to the C.A.S.

program. The program is designed to help people further develop skills in counseling, consultation, and program planning and coordination.

- c. Integrated Studies which is an inter-area program designed for students who have completed their master's degree and are interested in exploring a self-designed, integrated program of study drawing upon graduate level experiences currently provided by departments of Organizational, Counseling and Foundational Studies; Special Education, Social Work, and Social Services; Professional Education and Curriculum Studies; Physical Education, Health and Learning Studies of the College of Education and Social Services and other University departments. The program is under the general administration of the Dean of the College of Education and Social Services with direct supervision by a committee of representative faculty from the participating areas within the college.

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

A specialization on the area, leading to a Graduate Certificate, obtained in conjunction with a master's degree 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 master's 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 both 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.

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# Regulations of the Graduate College

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*Persons intending to apply to graduate school are urged to consider future employment opportunities in their proposed field of study. Specific information regarding employment prospects may be obtained on request from the appropriate department chairperson.*

## ADMISSION

To be eligible for admission a student must hold a baccalaureate degree prior to the date of first enrollment or have completed work equivalent to that required for a baccalaureate. The undergraduate record must 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 Examination. Foreign students, see special instructions on p. 15.

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

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 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 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 approval for further enrollment from the Dean of 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. 16. *All applications for admission must be accompanied by a \$20.00 application fee which is non-refundable.* Applications and associated correspondence must be sent directly to the Graduate College Admissions Office.

**When to apply** The deadline for receipt of completed applications and supporting materials for admission for the fall semester is *April 1* for most departments, except that a *February 1* deadline is observed in the Psychology programs and a *March 1* deadline is observed in the Historic Preservation, Student Personnel Services, and Counseling programs. The part-time program of study in Psychology is open only to Vermont residents. Most departments process applications 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 in the form of fellowships as well as admission must 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 fellowship assistance *must* include GRE aptitude scores. No special forms are required for requesting Teaching, Research, or Graduate College Fellowships, and Graduate Assistantships. Applicants interested in being considered for such fellowships must so indicate on the appropriate section of the application form. Student Affairs Fellowships must be applied for on a separate form through the Department of Residential Life, Mansfield House, 25 Colchester Avenue. Persons interested in obtaining information on loans and/or work-study should contact the Financial Aid Office, Waterman Building.

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** An opportunity for

qualified legal residents of New England states to enroll at reduced tuition rates (currently 125% resident tuition) for programs which are not offered by the home state university but are offered in another New England state is available under an arrangement entitled the New England Regional Student Program. A list of available graduate programs may be seen in the Graduate College Office or obtained from the New England Board of Higher Education, 68 Walnut Road, Wenham, Ma. 01984 at \$2 per copy.

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. In cases where the program of study is clearly unique or distinctive to the out-of-state institution, the UVM Graduate Dean's Office will certify directly. In cases where an apparently similar program of study is available at both institutions involved, the Graduate Deans of the two institutions will determine whether regional student status is appropriate.

**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 their 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, 833 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 submit evidence of independent financial support (approximately \$8,500 U.S. per year) in the form of a signed statement from a bank or scholarship source. In the case of non-English speaking countries, applicants must submit scores from the Graduate Record Examination and 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 must be submitted to the Graduate College by December 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 criteria; *however, funding is not usually available for the first year of study.*

Foreign applicants interested in services or activities available to foreign students are urged to contact the Advisor to International Students and Scholars, University of Vermont, Burlington, Vermont 05405.

**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 requirements). Business Administration applicants must submit scores on the Graduate Management Admissions Test.

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 or the Graduate Management Admissions Test 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 1981 so that test results will be available by March 1.

**Health Record** The University requires that students maintain a personal health record with the University Health Service. Generally, this is accomplished by completion of the DASH health form (\$9.00 fee) at the time of first enrollment. Persons with special medical problems or those wishing to submit an alternate health record must consult the University Health Service.

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

## 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 range of normal full-time graduate

enrollment for non-funded students is 9-12 hours; maximum enrollment is 15 hours. The normal range of full-time enrollment for funded students is 6 to 10 hours for Graduate Teaching Fellows, 6 to 12 hours for Graduate Research Fellows and Graduate Assistants, and 6 to 9 hours for Student Personnel Fellows. Following completion of all credit requirements, enrollment for *Continuous Registration* is equivalent to full-time enrollment when the student is working full-time completing degree requirements. Enrollment in excess of the respective normal full-time course load requires the written approval of the Graduate Dean.

**Change in Enrollment** Any change in enrollment must be approved by the student's advisor and authorized by the Dean of the Graduate College. Specific regulations regarding the adding or dropping of courses are available from the Registrar. The exact dates may be found in the schedule of courses, available at the Graduate College Office, or from the Registrar. Forms may be obtained from the department, Registrar, or Graduate College.

**Continuous Registration** A student who has enrolled for all credits required in the degree program, but has not completed all degree requirements (for example, comprehensive exam, thesis), must enroll for "Continuous Registration" (see p. 31 Fees). Enrollment for continuous registration may be accomplished by mail or in person through the Graduate College Office.

**Auditing Courses** Courses may be taken for audit; however, the credit hours are charged as usual. Under no circumstances will credit or grade be allowed for courses audited. *Tuition scholarships which are funded by the Graduate College and accompany fellowship awards do not cover courses enrolled for audit.*

**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.

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

**Undergraduate Enrollment for Graduate Credit** UVM senior undergraduates may enroll for graduate credit at UVM under the following circumstances: the course must be available for graduate credit; total enrollment including the graduate course must not exceed 12 credit hours in the semester in which the course is taken; the course must not be computed as part of the bachelor's degree; permission to seek such graduate credit must be requested of the Graduate Dean in writing by the Dean or Director of the undergraduate college or school prior to enrollment. Such graduate credit is limited to 6 hours, and is not available for

transfer to another institution as graduate credit. It can be used only at UVM if and when the student enters a UVM graduate program and only if the course is judged appropriate by the student's advisor for the particular graduate program.

### **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 the 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** 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 the 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** All degree candidates must acquire appropriate teaching experience in their chosen fields prior to the award of their degree. The nature and the amount of this teaching, for which no academic credit is allowed by the Graduate College, will be determined 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 computer science, it may be achieved by satisfactory completion of Computer Science 11 and 241 or by satisfactory completion of an examination (on a pass-fail basis) set and graded by the staff of the Academic Computing 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 the program with a minimum overall grade point average of 3.0. For the purpose of determining a grade 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 more than two grades below a B, or the designation of U in Thesis Research or Seminar, are received.

The designation "*Inc*" applies to work of acceptable quality when the full amount is not completed because of illness or emergency. It can be awarded only with the permission of the Graduate College Dean. The Dean may set the limit of time when the work of the course is to be completed. In no case shall this time be set longer than the beginning of the corresponding semester of the next academic year.

**Extended Course.** This grade (XC) is awarded at the end of the semester to a student who is enrolled in an identified course, the nature of which makes it unreasonable or impossible for the student to complete the required work within the regular semester.

Students withdrawing from courses after the date prescribed by the Registrar will receive a grade of WP - withdrawn passing, or WF - withdrawn failing, dependent upon the quality of work completed. The grade WP will not enter into the grade point average (GPA.). The grade of WF will enter the GPA as an F.

Graduate students may elect to take an undergraduate course on a pass-fail basis provided permission is obtained, prior to enrollment, from the department chairperson and the Dean of the Graduate College and a letter grade is not required by the Studies Committee for evaluation. Courses at the 200 level or above may not be taken on a pass-fail basis for graduate credit.

#### *Maximum Time Limits for Degree Completion*

##### *MASTER'S DEGREE*

##### *Full Time Student*

**3 Years**

**Part Time Student****5 Years****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. *It is important that students complete their programs within the time limits specified. Further educational opportunities or employment responsibilities alone will not justify delay in program completion.*

**Program Outline** A program outline detailing the coursework which the student will take during the program should be completed by the student and his or her advisor by the end of the student's first year in the Graduate College. The program outline, completed on a form available from the Graduate College, is an aid to planning, and may be revised during the course of the student's studies as appropriate.

**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 continuous registration for a period of one calendar year, and does not notify the department or the Graduate College in writing, the student will be considered to have withdrawn from the degree program. It will be necessary to apply for reactivation and pay a reactivation fee (p. 32) should the student wish to continue the graduate program.

**Leave of Absence** An approved leave of absence (up to a maximum of twelve months) suspends the time limit for degree completion for the duration of the leave. Students must obtain the approval of their department or program chairpersons and the Dean of the Graduate College on the form available in the Graduate College Office prior to the leave of absence in order to be considered on approved leave. A leave is not permitted for those who have completed all course credit requirements.

**Previous Credit** Course credit acquired prior to formal admission to the Graduate College may, within limits, be applied toward advanced degree requirements. The maximum number permitted is nine for a master's degree or 24 for a doctoral degree. These limits apply to either transfer credit, validation credit, or any combination of both.

**Transfer of Credit** Upon request from the department and approval by the Graduate College Dean, transfer of credit for appropriate courses completed at other institutions may be accepted by the Graduate College. In cases where such transfer is approved, it is the credit only, and not the grade, which is accepted for transfer. 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. 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.

**Validation of Credit** In order to insure effective planning of a graduate program, 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 student's record as applicable toward the credit requirements of an advanced degree. Validation of credit is subject to the same restrictions as stated for transfer of credit. If an applicant is enrolled as a non-degree student in appropriate graduate courses during the semester in which the application is approved for admittance, these credits, up to a maximum of 6 hours, will also be applied to the degree program and will not reduce the number of validation credits available.

**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 \$25 per credit is charged.

**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, a letter will be issued certifying that the graduate degree program has been completed 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 Dean of the Graduate College and 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. Departments and individual programs may require additional hours. 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.

**Language Requirement** Certain departments require a reading knowledge of an appropriate foreign language. The methods for satisfying the language requirement are described on page 26.

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

**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 of specialization. At the conclusion of the investigation the student must present a thesis which embodies the results of the work and which demonstrates capability for independent research.

In order to be eligible for an advanced degree in a particular academic year, a master's candidate must submit three copies of the thesis to the Graduate College Office by the date specified in *Guidelines for Thesis Writing* which is available from that office. 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 chairperson.

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

### **Examinations**

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

Success in the comprehensive 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 fields. Each MAT program is a cooperative venture between the specialist department and the College of Education and Social Services. Students with questions regarding the education component of their program should consult with the College of Education and Social Services Dean's Office.

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 courses 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 either 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 specialization, have submitted satisfactory scores on the Graduate Record Examination (Verbal and Quantitative), and be acceptable to the departments concerned. Advanced GRE scores are required for certain programs as indicated.

Candidates are expected to have completed the necessary courses in education to meet minimum requirements for a teaching certificate during their undergraduate programs. 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, candidates must present at least eighteen semester hours in education in their combined undergraduate and graduate programs. This requirement is specified to ensure that degree recipients can meet minimum certification requirements. Students without prior teaching experience will be required to complete satisfactorily an internship or an equivalent field experience which may or may not be graded and which would be in addition to the minimum MAT education course requirements. This internship or field experience will be an essential prerequisite to consideration for certification.

### *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 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 ex-

amination. It is the responsibility of the candidate to notify the respective department and the College of Education and Social Services to schedule the required examinations.

### **MASTER OF EDUCATION**

Before acceptance to candidacy for the degree of Master of Education, the student must present satisfactory scores in the Graduate Record 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, and 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, professional experience, and aims and purposes in pursuing the master's degree.

Each program must include a minimum of 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 to begin study at the graduate level in certain aspects of the 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 foundations of education, unless this requirement or its equivalent has been previously met. Graduate courses which currently fulfill this requirement include: EDSS 202, 204, 205, 206, 252, 254, 255, 277, 313 and 399.

In order to insure effective planning of a graduate program for the degree of Master of Education, no 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 ex-

amination. It is the responsibility of the candidate to schedule the required examination with the College of Education and Social Services. Since each program has different options for meeting the oral and written comprehensive requirements, candidates should contact the respective program chairperson or advisor regarding 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**

Management is the art of applying principles of the mathematical and social sciences to decision making in an organizational environment characterized by uncertainty and limited resources. The program is designed (1) to develop the individual's ability to practice the art and (2) to build a foundation that will facilitate and encourage the continuation of this development beyond a formal university setting. Courses in the program emphasize the understanding and critical evaluation of conceptual and theoretical principles relevant to the decision process in the functional areas of business.

Upon completion of the program, students will have been exposed to each functional area, will have been required to demonstrate an ability to engage in individual and group research projects, and will have demonstrated capacity to present coherently and defend their views orally and in writing.

### *Examinations*

Written comprehensive examinations are required in Business Policy and two other areas selected by the student. Normally the comprehensive examinations are administered upon completion of all course work for the degree. One re-examination only is permitted for any final comprehensive examination.

While some MBA courses will be offered during the evening hours, others are offered only during the day. Most 300 level courses in the day program meet in late afternoon.

Not more than nine 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 thirty semester hours in courses numbered above 200 is required. At least six semester hours will be completed in agriculture, or a related field, and at least six semester hours in education courses offered by the College of Agriculture. A minimum of eighteen additional semester hours will be selected to meet individualized program objec-

tives. Normally, no thesis is required.

The candidate may complete the degree requirements through Summer Session, Evening Division and/or full-time residency. A candidate will be expected to spend at least one semester or a minimum of two summers in residence at the University of Vermont campus in Burlington.

A satisfactory score on the Miller Analogies Test is required. Before the degree is awarded, the candidate must have completed the equivalent of one year of professional experience. This requirement may be completed by an internship or practicum experience approved by the candidate's studies committee.

### *Examinations*

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

Satisfactory completion of the written examination is prerequisite to taking the oral examination. All comprehensive examinations are taken on the University of Vermont campus in Burlington. One re-examination 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 dissertation 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 chairperson. This committee will meet at least once a semester with the candidate to provide advice and to help plan the program of study. All courses taken in the program must be approved by this committee, the department chairperson 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 chairperson or from the Dean.

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

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 Dissertation** Each candidate, while in residence at the University of Vermont, must complete an acceptable original research project which contributes new knowledge or techniques in an academic field. Each candidate must enroll in a minimum of *twenty* credits of dissertation research. Only a member of the Graduate Faculty may supervise dissertation research for the Ph.D.

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

*The dissertation must be prepared and submitted in compliance with the detailed instruction sheet which is obtained in the Graduate College Office at least two weeks prior to the oral defense.*

**Dissertation Examining Committee** Upon submission of the completed dissertation, the Graduate Dean will approve a dissertation examining committee, appointed by the department, for oral examination of the candidate. The committee shall consist of the members of the student's studies committee and at least two faculty members from outside of the department who will be nominated by the chairperson of the department concerned for a total membership of six. One of the outside members will be designated chairperson by the Graduate Dean. The acceptability of the dissertation will be determined by the Dissertation Examining Committee. An announcement of the oral defense must be distributed two weeks in advance to all faculty of the department of specialization and to other appropriate departments.

#### *Examinations*

- (a) A comprehensive written examination in the field of study must be passed by the candidate at least six months before the dissertation 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 the dissertation, must be successfully completed. 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 dissertation must be forwarded to the Dean of the Graduate College after the successful defense of dissertation.

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## Definition of "Vermont Resident"

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ADOPTED BY BOARD OF TRUSTEES, DECEMBER 14, 1974

As amended December 2, 1978, and June 16, 1979

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 purpose of attending an institution of higher learning shall not constitute residence for tuition purposes.

The following requirements must be met by a student prior to being granted resident status for the purpose of admission, tuition and other University charges:

1. The applicant shall be domiciled in Vermont, said domicile having been continuous for one year prior to the commencement of the semester or summer session next following the date of application. There shall be one date designated each year for the commencement of each summer session. A semester shall commence on the day classes *begin* for that semester. Each summer session shall commence on the day classes *begin* for that summer session.
2. Domicile shall mean a person's true, fixed and permanent home, to which he/she intends to return when absent. A residence established for the purpose of attending an educational institution or qualifying for resident status for tuition purposes shall not of itself constitute domicile. Domicile shall not be determined by the applicant's marital status.
3. The applicant must demonstrate such attachment to the community as would be typical of a permanent resident of his age and education.
4. Receipt of financial support from the applicant's family will create a rebuttable presumption that the applicant's domicile is with his family.
5. An applicant becoming a student at an institution of higher learning in Vermont within one year of first moving to the state shall have created a rebut-

table presumption of residence in Vermont for the purpose of attending an educational institution.

6. Eligibility to enroll as a resident student in another state shall create a rebuttable presumption against eligibility to be enrolled at the University of Vermont as a 'Vermont Resident.'
7. A student enrolling at The University of Vermont shall be classified by the appropriate officer (appointed by the President) as a resident or non-resident for admission and tuition purposes. The decision by the officer shall be based upon information furnished by the student and other relevant information. The officer is authorized to require such written documents, affidavits, verifications or other evidence as he/she deems necessary.
8. The burden of proof shall in all cases rest upon the student claiming to be a Vermont resident and shall be met upon a showing of clear and convincing evidence.
9. The decision of the officer on the classification of a student as a resident or non-resident may be appealed in writing to the Committee on Residence, whose decision shall be final.

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## Student Expenses

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**Application Fee** All applications for admission must be accompanied by a \$20 application fee. This fee is non-refundable.

**Tuition** Rates for the 1980-81 academic year will be as follows: For Vermont residents, \$69 per credit hour, \$825 flat rate for 12 hours, and \$69 per credit hour in excess of 12 hours.

For non-residents of Vermont, \$190 per credit hour.

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

**Continuous Registration Fee** A fee of \$50 per semester is charged each graduate student who has paid tuition for all credits required in the degree program but who has not completed all degree requirements in order to maintain continuous enrollment.

**Library Bond Fee** A fee of \$17 per semester is required of each student enrolled in twelve credit hours or more; a fee of \$8.50 per semester is required of each student enrolled for less than twelve credit hours but more than three credit hours. No fee is assessed for registration of three credit hours or less. 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 construction of Bailey Library.

**Student Health Fee** A fee of \$42 per semester is charged all full-time degree students enrolled at the University. Part-time students will be eligible for University Health Service by paying this fee. *Student Accident and Sickness Insurance* — Through an arrangement with a commercial insurance company, students are able to procure health insurance which is designed to provide coverage for services beyond those provided by the University Health Service. The 1980-1981 cost for one year's coverage for single students is \$56. Married students may obtain coverage for their spouse and children. Further details are available from the University Health Service. In order to participate in this insurance, the student health fee must be paid each semester.

**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.

**Reactivation Fee** Reactivation following withdrawal without an approved leave of absence requires payment of a \$25.00 reactivation fee.

**Penalty Payment** Failure to complete financial arrangements and registration by the 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
Master's Degree (With thesis)	20.00
Master's 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.

It is the responsibility of the degree candidate to pay the appropriate amount at the Graduate College Office, 335 Waterman in order to have a degree awarded.

**Student Housing** A limited number of University owned apartments are available for married full-time students. Located just outside Winooski on Route 15 at Fort Ethan Allen, these apartments are on a bus route five miles from the main campus. Detailed rental information may be obtained from the Ethan Allen Housing Office, 600 Dalton Drive, Winooski, Vermont 05404. Telephone (802) 656-3228.

A limited number of University owned apartments for single graduate students are available at Fort Ethan Allen. These spacious apartments, which were formerly army officers' quarters, will each accommodate approximately eight students. Rent (which includes utilities) is currently \$125 per month per student; a nine or twelve month lease, at the option of the student, is required. Free and frequent transportation to and from campus is provided. Detailed rental information may be obtained from the Ethan Allen Housing Office listed above.

Up-to-date listings for available apartments, houses and rooms for rent in the area are maintained by the Department of Residential Life. This service allows community landlords and rental agents a way to make known their housing availability to persons associated with the University. Students may examine up-to-date listings at the Billings Center or on a bulletin board just off the College Street entrance of Waterman Building on the main campus. The University is not responsible for the approval of off-campus housing facilities. It is impractical to send information concerning individual listings by mail. A catalog of available

listings is issued each May, August, and December at the Office of Residential Life, 25 Colchester Avenue, Burlington, Vermont 05405. Telephone (802) 656-3434.

**Living Expenses** Rents in the Burlington area vary from approximately \$35.00 per week for a single furnished room to \$350.00 or more per month for a furnished, two-bedroom apartment. A single student should expect minimum overall living expenses of approximately \$400.00 per month. If desired, meals may be obtained in University dining halls.

**Bill Adjustment** A refund of 100 percent will be processed for reductions effected prior to the start of the semester; an 80 percent refund will be in effect for reductions in enrollment taking place from the first day of classes through the end of the add/drop period (third week of classes); a refund of 40 percent will be allowed for reductions during the fourth and fifth week of classes; no refund will be processed thereafter. At the end of the semester, an audit will be made of each student's record. If the audit reveals total hours are greater than at the end of the specified drop period, the student will be financially liable for the number of hours for which he was enrolled. Students will be charged for all hours as specified in policy statements regarding tuition.

**Withdrawals** A student may voluntarily withdraw from the University by notifying the Graduate Dean and the Registrar. Withdrawal for reasons of health requires the approval of the University physician. In either case, the student will receive a refund in accordance with the above policy. Date and time of withdrawal normally will be the date the withdrawal notice is received by the Registrar.

**Dismissal** If a student is suspended or dismissed, a refund will be processed according to the above schedule.

**Death** In case of death of the student, tuition which has been paid for the semester during which the death occurs will be fully refunded.

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## **Fellowships, Assistantships, and Traineeships**

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*Students who wish to be considered for fellowships as well as admission must submit completed applications, with supporting material, by March 1 of 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 must be made by completion of the appropriate section on the application form. No separate form is required except where indicated herein.

*Tuition scholarships accompanying Graduate Teaching, College, Research, and Student Affairs Fellowships do not cover physical education courses and activities, and cover courses numbered below 200 only upon prior approval of the Graduate Dean.*

### **GRADUATE COLLEGE FELLOWSHIPS**

The Graduate College offers ten fellowships in support of master's degree programs in the social sciences and humanities. Five fellowships provide a full tuition scholarship (36 credit hour maximum) for the degree program. The remaining five fellowships provide both the scholarship and a stipend (currently \$2,000).

These fellowships are open to applicants for Fall admission in the social sciences and humanities. Holders of Graduate College Fellowships are expected to carry full-time enrollment towards an advanced degree. The 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 Fellowships are awarded in many of the departments offering graduate work. Graduate Teaching Fellows are appointed for nine months with stipends averaging \$4,000. Teaching Fellows may enroll for a maximum of 10 hours per semester; the fellowship award includes a tuition scholarship covering the number of hours specified in the

award letter but not to exceed 10 hours per semester in addition to the stipend for the period of the fellowship.

Graduate Research Fellowships are awarded in some of the science departments offering graduate work. Fellows are appointed for nine or twelve months and receive stipends averaging \$4,000, and a tuition scholarship. 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, at least four calendar years must be expected for completion of the academic program. 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.

### **STUDENT AFFAIRS FELLOWSHIPS**

Graduate students, men and women, are eligible to apply for Student Affairs Fellowships. The candidates selected to fill these positions will normally be assigned administrative and advisory positions in the residence halls, although limited opportunities in other student services areas are available as well. Student Affairs 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. Student Affairs Fellows receive a stipend of \$4,000 plus a tuition scholarship covering a maximum of 9 credit hours per semester for a nine-month period. Room and board is deducted from this stipend for those people holding Fellowships in the residence halls. Requests for applications and additional information should be addressed to Office of Residential Life, Mansfield House. 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 are available in certain departments through grants from various state and federal agencies. Traineeships are available currently to graduate students enrolled in the following departments: Biochemistry, Communication Disorders, Medical Technology, and

Psychology. These traineeships generally carry stipends and include payment of tuition. The chairperson 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 may be for either nine or twelve months at a starting salary starting of about \$5,400 and \$6,500 per appointment period. Part of the salary is for tuition at the in-state rate with a maximum enrollment of ten 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 chairperson 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 Chairperson of the Department of Animal Sciences.

### **HUMPHREY CHEMICAL COMPANY FELLOWSHIP IN HYDROCARBON SYNTHESIS AND GEICO FELLOWSHIPS**

These fellowships are awarded annually to qualified students in the chemistry department working toward a Ph.D. The amount of the stipend is consistent with University policy determined by the Graduate College Office.

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# Financial Aid

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## **LONG TERM LOANS and/or WORK-STUDY JOBS**

The University is able to provide, through the Office of Financial Aid, long-term loans and/or work-study jobs for students who have demonstrable need for such aid.

### **LOANS**

The loans are primarily from the Federally funded National Direct Student Loan (formerly National Defense Student Loan). The availability of such loans is dependent on the level of federal allocation to the University. In addition the University has a limited amount of endowed loan funds. Both types of loan are interest free while the student is in at least half time attendance in a degree program; repayment and interest at the rate of 3 percent begins when the loan goes into repayment status.

### **WORK-STUDY**

The College Work-Study Program provides financial assistance through employment on campus or with certain kinds of off campus agencies. Every effort is made to place students in jobs related to their field of study, interest, and skills. The amount of CWSP assistance committed reflects both the degree of financial need and a reasonable projection of the amount it is possible to earn at a rate of pay commensurate with the student's skills and experience.

Additional information and application forms are available from the Office of Financial Aid, 330 Waterman Building. Only one application is needed in order to apply for either type of aid, as the applicant is able to indicate on the application if one or the other, or both are preferred.

*Interested students are encouraged to contact the Office of Financial Aid shortly after acceptance to graduate study since time is required for the processing of financial aid applications and awards.*

### **FINANCIAL AID REFUND POLICY**

For students receiving financial aid, change in student status or credit hour load may result in revision or loss of that financial aid, depending

on the regulations of the particular aid programs involved. Except when aid program regulations specify otherwise, any such change which reduces the student's University charges will usually result in a matching reduction of the financial aid award, with that reduction prorated among all aid sources making up the award. Such reduction of aid will usually require immediate repayment of the aid so reduced.

### **VETERANS BENEFITS**

Students who are eligible to receive educational benefits from the Veterans Administration should obtain advice from the University Registrar.

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## Courses of Instruction

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### 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 through 299 are advanced courses for undergraduates which may also be taken for graduate credit by graduate students. To obtain graduate credit the graduate student generally is expected to meet higher qualitative or quantitative expectations than the undergraduate student. 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 prior to enrollment. Non-degree students are not permitted to receive graduate credit for courses numbered 100-199. 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 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 AND RESOURCE ECONOMICS

*Professors Sargent, Sinclair, Tremblay, and Webster (Acting Chairman); Associate Professors Fife, Gilbert, and Pelsue; Extension Professors Bevins, Eddy, and Houghaboom.*

The department conducts research in agricultural production economics, marketing, and business management. It also has an active research program in the economics of recreation, regional planning and rural development, rural

land use and taxation and environmental quality and control.

The department offers options in two areas: Agricultural Economics and Resource Economics. Students interested in rural planning may select either option. Each student selects an option and then develops, with a studies committee, an academic program.

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

For the agricultural economics option: an undergraduate degree in agriculture, economics, business administration or a related area. For the resource economics option: an undergraduate degree in resource use, economics, recreation, forestry, or in the natural sciences.

All students must present satisfactory scores on the Graduate Record Examination. Transcripts are evaluated on an individual basis but must include courses in math, statistics, and economic theory, or these courses must be taken for non-graduate credit.

### **MINIMUM DEGREE REQUIREMENTS**

Advanced courses in agricultural and resource economics, general economics, or related fields, 21 to 24 hours, thesis research 6 to 9 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. *Prerequisites:* 61 or Economics 12; Junior standing; College of Agriculture major. Three hours. Tremblay.

**205 RURAL COMMUNITIES IN MODERN SOCIETY** See Sociology 205. Three hours. Schmidt.

**207 MARKETS, FOOD, AND CONSUMERS** Market structure, prices, and economic forces involved in the movement of farm products from producers to consumers. *Prerequisite:* 61 or Economics 12. Three hours. Webster.

**208 AGRICULTURAL AND FOOD POLICY** History and institutional development of agricultural policy. Price and income problems of American agriculture and alternative solutions. *Prerequisite:* 61 or Economics 12. Three hours. Staff.

**210 MARKETING INSTITUTIONS** Agricultural marketing institutions servicing northeastern U.S. Reading, lectures, and extended field trip. *Prerequisites:* Six hours in agricultural economics and permission of instructor. Three hours. Webster and Tremblay.

**218 COMMUNITY ORGANIZATION AND DEVELOPMENT** See Sociology 207. Three hours. Schmidt.

**222 NATURAL RESOURCES EVALUATION** An analysis of economic procedures used in the evaluation of public natural resource developments, with

emphasis on benefit-cost analysis. *Prerequisite:* 121. Three hours. Gilbert.

**225 ECONOMICS OF OUTDOOR RECREATION AND TOURISM** A socioeconomic analysis of recreation and tourism as an industry. Emphasis on regional, state, and community impact. *Prerequisites:* 61 or Economics 12. Three hours. Gilbert.

**233 REGIONAL PLANNING** Determination of public goals; economics and politics of rural planning; rural planning concepts and techniques; environmental, water resource, and recreational planning. *Prerequisite:* Senior standing. Three hours. Sargent.

**234 PRACTICUM IN REGIONAL PLANNING** Off-campus planning experience for seniors and graduate students. *Prerequisite:* 233 or permission of instructor. Students should advise of their intent to take this course by the end of the previous semester to provide time to make necessary arrangements. 1 to 6 hours credit. Sargent, Lapping.

**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 permission of instructor. Three hours. Lapping.

**243 SPATIAL ANALYSIS I** See Geography 243. Three hours. Bodman.

**254 PRODUCTION ECONOMICS** Principles and application of the economics of production in agriculture; emphasis on factor use, combination, enterprise selection, and decisionmaking. *Prerequisites:* 61 or Economics 12; Mathematics 18 or 19; or by permission of instructor. Three hours. Pelsue.

**255, 256 SPECIAL TOPICS IN AGRICULTURAL AND RESOURCE ECONOMICS** Readings and discussion of selected topics in economics at an advanced level. *Prerequisite:* Departmental permission. Credit as arranged. Staff.

**264 AGRICULTURAL PRICE ANALYSIS AND FORECASTING** Analysis and measurement of factors affecting supply, demand, and elasticity; their relation to the level and changes of market prices; and use of quantitative techniques in forecasting. *Prerequisites:* 61 or Economics 12; Mathematics 18 or 19; or by permission of instructor; Statistics 111 helpful. Three hours. Pelsue.

**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 12 or equivalent. Three hours. Fife.

**271 AGRICULTURE IN ECONOMIC DEVELOPMENT** A study of the process of economic development in underdeveloped countries with special reference to the role of agriculture in providing food, clothing, and foreign exchange necessary to achieve the national development goals. *Prerequisite:* 61 or Economics 12. Three hours. Sargent.

**272 SEMINAR ON WORLD FOOD PROBLEMS AND POLICIES** Review

of recent books and periodical literature; discussion and written or oral reports on topics of contemporary interest. *Prerequisite:* 271 or permission. Three hours. Staff.

**322 ADVANCED RESOURCE ECONOMICS** A critical evaluation of contemporary natural resource allocation procedures in the public sector. *Prerequisite:* 222 or equivalent. Three hours. Gilbert.

**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. Pelsue.

**381 AGRICULTURAL AND RESOURCE ECONOMICS SEMINAR** Discussion problems and research in agricultural and resource economics and regional planning. One hour. Staff.

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

## ANATOMY

*Professors Parsons (Chairperson), and Young; Associate Professors Freedman, Krupp, and Wells; Assistant Professors Ariano, Boushey, Kriebel, Levitt, and Schwaber; Instructor Wait.*

Departmental research activities center around investigations on nervous system structure and function and thyroid cytophysiology. Specific areas of interest include physiology and pharmacology of synaptic transmission, cytochemistry of neurotransmitter and cyclic nuclei interactions in the basal ganglia, development of monoamine neurons *in vivo* and *in vitro*, analysis of the avian motor system, neural control of circulation, the caudal neurosecretory system of fish, neuronal "sprouting" and recovery of function, and cellular dynamics of thyroid follicular cells. Additional opportunities exist for a multidisciplinary program in Neurobiology. Preference for admission and financial support will be given to Ph.D. applicants.

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

Bachelor's degree; a course in Organic Chemistry or Biochemistry; at least two semesters of advanced Biology; one course in College Physics; at least one course in Calculus. Graduate Record Examination required.

### MINIMUM DEGREE REQUIREMENTS

30 credits of courses and research, including Anatomy 301, 302, 311; comprehensive examination. Additional credits as arranged for laboratory research leading to a dissertation (Anatomy 391).

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

Bachelor's Degree; a course in Organic Chemistry or Biochemistry; at least two semesters of advanced Biology; one course in College Physics; at least one course

in Calculus. Additional courses in Differential Equations, Statistics, or Computer Science are recommended. Graduate Record Examination required.

### MINIMUM DEGREE REQUIREMENTS

Anatomy 301, 302, 311, 342, 351, 491; additional elective courses and teaching assignments as arranged with the department; dissertation research; credits as required by the Graduate College. Comprehensive and candidacy examinations; successful completion of dissertation.

### COURSES OFFERED

Note: Departmental permission for all courses.

**201 HUMAN GROSS ANATOMY** Emphasizes the structure, function and clinical correlations of the musculoskeletal, peripheral nervous, cardiovascular and respiratory systems. Laboratory includes detailed regional dissections, projections, other demonstrations and microscopic anatomy of selected tissues. *Required for physical therapy students.* Five hours. Kriebel.

**202 NEUROANATOMY AND HISTOLOGY** Structural basis of human nervous system function, presented from peripheral nervous system and spinal reflex organization to detailed analysis of motor and sensory systems, with clinical examples. Laboratory includes dissection of the human brain; selected microscopic slides; demonstrations. *Required for physical therapy students.* Three hours. Schwaber.

**301 MEDICAL GROSS ANATOMY** This course consists of individualized laboratory instruction, small group conferences and clinically correlated lectures. It provides a sound base of anatomical information and stresses the importance of the relationship between normal human structure and function. Six hours. Krupp, Boushey.

**302 NEUROSCIENCE** A correlated presentation of the neuroanatomy and neurophysiology of the mammalian central nervous system. The course consists of lectures, demonstrations, laboratory, and clinical correlation workshops. *Prerequisite:* Permission of instructor. Four hours. Anatomy and Physiology Staff.

**311 MEDICAL HISTOLOGY** The course as presented to medical students. Microscopic study of cells, tissues and organs emphasizing the correlation of structure and function. Three hours. Freedman, Wells, Young.

**323 NEUROENDOCRINOLOGY** Consideration of the diencephalic regulation of hormonal activity. The major emphasis will be devoted to morphological features of hypothalamic mechanisms controlling pituitary hormone secretion. *Prerequisite:* Anatomy 302. Two hours. Kriebel, Freedman. Alternate years.

**324 ADVANCED NEUROANATOMY** A detailed analysis of the morphology of the nervous system as 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 con-

sist of brain dissection and microscopic examination of brain stem sections.  
*Prerequisite:* Anatomy 302. Three hours. Staff.

**342 SPECIAL DISSECTIONS IN GROSS ANATOMY** This course provides for a detailed and independent study of a single anatomical region, utilizing gross, microscopic and embryologic materials. *Prerequisite:* Anatomy 301. Credit as arranged. Krupp, Boushey.

**351, 352 SPECIAL TECHNIQUES IN HISTOLOGY** A study of selected cells, tissues or organs by means of special techniques in light and electron microscopy. Specific work as agreed upon. *Prerequisites:* 311; permission 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; permission of instructor. Same course as Botany 374. Two hours. Young, Hyde (Botany). Alternate years.

**381 SEMINARS IN ANATOMY AND NEUROBIOLOGY** Research presentations and 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.

**392 INDEPENDENT LITERATURE RESEARCH** Reading and literature research of a topic of current interest in Anatomy leading to a review paper. Credit as arranged.

**491 DOCTORAL DISSERTATION RESEARCH** Credit as arranged.

## ANIMAL PATHOLOGY

*Professor Bolton (Chairperson); Associate Professors Kunkel and Murray; Extension Professor Wadsworth.*

Research interests include virus agents as causes of abortions and breeding problems in dairy cattle, improved diagnostic techniques for bovine brucellosis and a study of growth and milk production from parasite-controlled dairy heifers. 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).

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

## ANIMAL SCIENCES

*Professors Atherton (Acting Chairperson), Balch, Duthie, Foss, Nilson, Smith, and Welch; Associate Professor Simmons; Assistant Professor Gilmore; Extension Professor Mercia; Extension Associate Professors Gibson and Leamy; Extension Assistant Professor Wildman.*

Research activities in basic and applied science encompass a broad range of interests. The areas of study and research include genetics; nutrition; physiology; dairy and food plant management, chemistry, or bacteriology; 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 Graduate Record Examination must be presented.

### 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 Graduate Record Examination must be presented. The applicant must satisfy the prerequisites 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 the requirements as prescribed by the Graduate College for the degree of 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 dissertation 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; sherbets and specialties; merchandising; and sanitary control. *Prerequisites:* 104; credit or concurrent enrollment in 109. Three hours. Nilson. Alternate years, 1981-82.

**232 QUANTITATIVE GENETICS IN ANIMAL AND PLANT IMPROVEMENT** Principles of quantitative and statistical genetics including systems of mating and forces which change gene frequency are studied in relation to animal and plant breeding. *Prerequisites:* Introductory course in genetics; Statistics 111 or permission of instructor. Three hours. Gilmore.

**242 ADVANCED NUTRITION** See Human Nutrition and Foods 242. Three hours. Tyzbir.

**249 NUTRITION SEMINAR** See Human Nutrition and Foods 249. Two hours. Staff.

**250 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:* 140. Three hours. Wildman.

**256 DAIRY PLANT MANAGEMENT** Organization and operation of milk processing and manufacturing milk products plant. *Prerequisites:* 153; Agricultural and Resource Economics 61. Three hours. Nilson.

**270 ENDOCRINOLOGY** Anatomy, physiology, glandular interrelationships, and assay methods of the endocrine glands and their hormones. *Prerequisite:* Departmental permission. Four hours. 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. Simmons.

**282 ANIMAL SCIENCES SEMINAR** Reports and discussions of problems and special investigation 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 Human Nutrition and Foods 294. One hour. Staff.

**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. *Prerequisite:* One of the following: 242, Human Nutrition and Foods 242, or a 200 level course in biochemistry. Three hours. Staff. Alternate years, 1979-80.

**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. *Prerequisites:* A 200 level course in nutrition and in biochemistry. Two hours. Staff.

**391 MASTER'S THESIS RESEARCH** Credit as arranged:

491 DOCTORAL DISSERTATION RESEARCH Credit as arranged.

## ANTHROPOLOGY

*Professors Haviland, Mitchell (Chairperson); Associate Professors C. Pastner, S. Pastner, and Woolfson; Assistant Professors Gordon, Power; Research Assistant Professor Thomas.*

### No Graduate 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; tradition and change in Africa and New Guinea; the organization of American-Jewish kinship; and the study of therapeutic systems in New Guinea and the United States.

**212 CULTURE AND PERSONALITY** The crosscultural comparison of personality development; the problem of delineating modal personality types. *Prerequisites:* 21, Sociology 10 and one 100 level course in sociology or anthropology. Three hours. Mabry, Mitchell, Steffenhagen.

**225 CURRENT ANTHROPOLOGICAL THEORY** Schools of Anthropological thought; evolutionism, cultural ecology, functionalism, relativism, diffusionism, structuralism and cognitive school, examined in relation to data on non-western societies and the historical/social context in which the anthropologist works. *Prerequisites:* 21 and one 100 level course. Three hours. C. Pastner.

**228 SOCIAL ORGANIZATION** The cross-cultural study of group and person oriented relationships organized into social systems and articulated to other aspects of culture and the environment. Major topics include the family, kinship, marriage, descent, alliance, local groups, and voluntary associations. *Prerequisites:* 21 and one 100 level course. Three hours. Mitchell.

**229 POLITICAL AND ECONOMIC ANTHROPOLOGY** The analysis of traditional exchange and subsistence systems and the ways these relate to interest-based, or political behaviors. *Prerequisites:* 21 and one 100 level course. S. Pastner.

**267 THE FRANCO AMERICANS** A seminar designed to explore the cultural patterns of French speaking peoples in New England, with particular reference to Vermont. Each student will be expected to develop a research project exploring some aspect of Franco American culture. *Prerequisite:* Permission of the instructor. Three hours. Woolfson.

**270 REVITALIZATION MOVEMENTS** An examination of prophetic, millenarian and revolutionary sects and movements with an emphasis on non-western, non-industrial societies. Analytical perspectives will be drawn from a variety of disciplines. *Prerequisites:* 21 and one advanced course in anthropology, sociology, or religion. Three hours. S. Pastner.

**283 CULTURE CHANGE** The study of socio-cultural transformations in

non-western countries with emphasis on such topics as industrialization, urbanization and modernization and their impact on the lives of previously traditional peoples. *Prerequisites:* 21 and one 100 level course, or 21 and six hours in the social sciences. Three hours. Gordon.

**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. *Prerequisites:* 21 and one 100 level course, or 21 and six hours in the social sciences. Three hours. Gordon.

**290 METHODS OF ETHNOGRAPHIC FIELD WORK** Examination of the theoretical and ethical premises of field work methodology with practical experience using selected techniques including participant observation, interviewing, the genealogical method and the recording of date. *Prerequisite:* Twelve hours of anthropology. Three hours. Mitchell.

**295, 296 ADVANCED SPECIAL TOPICS** *Prerequisites:* 21 and one 100 level course.

## ART

*Professors Janson and Zucker (Chairperson); Associate Professors Davison, Hewitt, Lipke, and Owre; Assistant Professors Blasdel, Fengler, Higgins, McIntyre, Okino, Rindler, and Roland; Instructor Spivak; Lecturers Aschenbach and Liebs.*

### No Graduate Program Offered

**201 ARCHITECTURE AND THE ENVIRONMENT** See Historic Preservation 201. Three hours. Liebs.

**207 STUDIES IN AMERICAN ART OR ARCHITECTURE** Selected topics in American art and/or architecture, individual research and reports. Three hours. Janson or Lipke.

**282 DIRECTED STUDIES** Individual or group study in a special area. *Prerequisites:* Six hours advanced, three in the chosen area and permission. Three hours.

**285, 286 MUSEUM STUDIES** Museum methods as concerning the research, care and administration of a collection; as furthering aesthetic insight and the communication of ideas. *Prerequisite:* Permission of instructor. Three hours.

## BIOCHEMISTRY

*Professors Bresnick (Chairperson), Lamden, J. Thanassi, and Woodworth; Associate Professors Chiu, Cutroneo, Hart, and Meyer; Assistant Professor Cidlowski; Research Assistant Professors Eastman, N. Thanassi, Tierney.*

Current research programs include studies of the relationship of polycyclic hydrocarbon metabolism to carcinogenesis (E. Bresnick); nuclear protein chemistry (J.-F. Chiu); biochemical endocrinology (J. Cidlowski); the effects of anti-inflammatory steroids on proline metabolism and collagen synthesis (K.R.

Cutroneo); DNA repair mechanisms (A. Eastman); the toxicity of cadmium and its reactions in biological systems (B.A. Hart); nutritional biochemistry; vitamins A, C, E and lipid peroxidation (M.P. Lamden); regulatory mechanisms for protein and nucleic acid processing and breakdown in muscle (W.L. Meyer); Chemistry and biochemistry of vitamin B<sub>6</sub> (J.W. Thanassi); and the nature of the binding of metals to proteins, particularly the ironbinding proteins of blood plasma (R.C. Woodworth).

### **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 15, 16); quantitative chemistry; mathematics through differential and integral calculus; a year course in a biological science.

### **MINIMUM DEGREE REQUIREMENTS**

Thirty credit hours, sixteen of which must be taken from graduate courses offered by the Department of Biochemistry, including Biochemistry 301, 302, 303, 381, and 391 or 392.

#### **Thesis Option**

Up to fourteen credit hours of Master's Thesis Research (Biochemistry 391.)

#### **Non-thesis Option**

Up to eight credit hours of Independent Literature Research (Biochemistry 392.)

### **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 15, 16); quantitative chemistry; mathematics through differential and integral calculus; a year course in a biological science.

### **MINIMUM DEGREE REQUIREMENTS**

A total of seventy-five hours, including 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 Seminars; three hours from graduate courses offered by the Department of Chemistry; ten additional hours from courses in physical or biological sciences; thirty hours of Doctoral Dissertation Research.

### **COURSES OFFERED**

Biochemistry 211-212, 301-302, 303, 305-306, and 381 are offered annually. Advanced courses are given in alternate years.

**211-212 BIOCHEMISTRY FOR HEALTH SCIENCES** Primarily for

medical technology students. Lectures provide a comprehensive study of mammalian biochemistry particularly as it relates to man. Medically-oriented experiments utilizing modern clinical chemistry techniques are performed in the laboratory. Case studies from the files of the MCHV are used to correlate lecture and laboratory material. *Prerequisites:* 102 or quantitative chemistry; organic chemistry. Physiology is strongly recommended. Four hours per semester. Hart.

**301-302 GENERAL BIOCHEMISTRY** Survey of biochemistry primarily 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. *Prerequisites:* Chemistry 131, 132 and departmental permission. Three hours per semester. Staff.

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

**305-306 MEDICAL BIOCHEMISTRY** For medical students. A survey of physiological and molecular biochemistry with special reference to man: chemistry and metabolism of cellular and dietary constituents; enzymes and bioenergetics; blood, respiration, acid-base balance, and mineral metabolism; metabolic controls. *Prerequisites:* Chemistry 131, 132 and departmental permission. Given on a trimester basis in the College of Medicine calendar; equivalent to three hours per semester for two semesters. Staff.

**307, 308 SPECIAL TOPICS IN BIOCHEMISTRY** Areas of biochemistry not treated in concurrent offerings of advanced courses. Topics are from the fields of intermediary metabolism, organic and physical biochemistry, enzymology, and physiological chemistry. Two areas will usually be covered each semester. *Prerequisites:* 301, 302 or 305-306; Chemistry 141, 142. Two hours per semester. 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 control of multienzyme systems. *Prerequisites:* 301, 302 or 305-306; Chemistry 141, 142. Three hours. Meyer.

**331 NUCLEIC ACIDS** The structure and function of ribonucleic acids and deoxyribonucleic acids. *Prerequisites:* 301-302 and 305-306. Two hours. Cutroneo.

**340 BIORGANIC CHEMISTRY** Organic reaction mechanisms as related to substances of biochemical interest, with emphasis on catalytic mechanisms. *Prerequisite:* 301, 302 or 305-306. Two hours. 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 departmental permission. Three hours. Staff.

**367 BIOCHEMICAL ENDOCRINOLOGY** Studies of the biochemical

mechanisms by which hormones recognize and interact with eukaryotic cells. Topics will include detailed analysis and comparison of the metabolic action and mechanisms of gene activation by hormones. *Prerequisites:* 301, 302 or permission. Three hours. Cidlowski.

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

**375 CANCER BIOLOGY** Designed to give students in the Health Sciences an overview of cancer biology and to provide the foundation for individuals interested in cancer research. Lecture format; interdisciplinary viewpoint; outside lecturers. *Prerequisites:* 301-302 or 305-306; under special circumstances, 211-212. Three hours per semester. Bresnick.

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

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

**392 INDEPENDENT LITERATURE RESEARCH** Reading and literature research culminating in a paper on a topic of current interest in biochemistry. Credit as arranged.

**491 DOCTORAL DISSERTATION RESEARCH** Credit as arranged.

## BIOMEDICAL ENGINEERING

A cooperative program offered by the Department of Electrical Engineering (S. Rush, *Chairperson*) and the Department of Physiology and Biophysics (N.R. Alpert, *Chairperson*).

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

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

### MINIMUM DEGREE REQUIREMENTS

Physiology and Biophysics 301; twelve hours in Electrical or Mechanical Engineering, Physics and Mathematics; additional approved courses; thesis research (6-12 hours) in the Department of Electrical or Mechanical Engineering. Each applicant should consult the department to determine if the program offered meets his specific educational objectives.

Biomedical engineering is one of the areas of research interest in the graduate programs in Electrical and Mechanical Engineering.

## BIOSTATISTICS

This program is administered through the Statistics Program. Dr. D.L. Sylwester 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 Statistics Program and includes experience in a wide variety of health, biomedical, and related research projects at the University of Vermont. The program aims 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.

### PREREQUISITES 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. Three semesters of calculus including multiple integration, partial differentiation, infinite series, and introductory differential equations are required. Students without a background in linear algebra and various topics included in Mathematics 271 may be required to make up deficiencies as part of their graduate degree program. The Graduate Record Examination is strongly advised and is required of any applicant who wishes to be considered for a teaching fellowship.

### MINIMUM DEGREE REQUIREMENTS

**Plan A:** Twenty-four semester hours of coursework. This would generally include Statistics 251, Biostatistics 211, 221, 231, 262, and 300; six hours of approved thesis research.

**Plan B:** Thirty semester hours of coursework. This would generally include Statistics 251, Biostatistics 211, 221, 231, 262, 300, 381, and six hours of approved electives; no thesis required.

All students are expected to participate in the projects of the Biometry Facility and to attend the regular seminar series 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.

### COURSES OFFERED

202 POPULATION DYNAMICS See Sociology 202.

211, 221 STATISTICAL METHODOLOGY I, II See Statistics 211, 221.

231 EXPERIMENTAL DESIGN See Statistics 231.

233 SAMPLING METHODS See Statistics 233.

237 NONPARAMETRIC METHODS See Statistics 237.

262 STATISTICAL THEORY See Statistics 262.

300 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.

354 MEDICAL SOCIOLOGY See Sociology 354.

381 BIOMETRY PRACTICUM See Statistics 281.

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

*Professors Etherton, Hyde, Klein, and Vogelmann (Chairperson); Associate Professors Cook, Ullrich, and Worley; Assistant Professor Barrington; Research Associate Professors Laing and Morselli; Extension Associate Professor Gotlieb; Research Assistant Professor Lintilhac.*

The Botany Department has ongoing research programs in: ecology including plant communities, biogeography, limnology, phycology, bryology, and pteridology; physiology including growth and development, mineral nutrition, translocation, tissue culture, photobiology, cellular electrophysiology, and membrane function; phytopathology and physiological virology; and cell biology including ultrastructure of cytoplasm and nucleus, and genetics of fungi. The Botany Department participates actively in the Cell Biology Program and provides opportunities for interdisciplinary research with other life science departments.

### 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). Each candidate must participate in the teaching of at least one undergraduate course.

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

The department offers a program leading to the degree of Master of Arts in Teaching: see page 23. 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 Departments 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 where approved by the advisor and the Dean. Appropriate courses in related science departments may be used 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 of organic chemistry comparable to Chemistry 141, 142; two semesters of calculus comparable to Mathematics 21, 22 and in some cases a third semester of calculus comparable to Mathematics 121; a year of physics comparable to Physics 15, 16. 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 foreign 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 dissertation 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**

**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:* 104. Three hours. Etherton. Alternate years, 1980-81.

207 WATER RELATIONS OF PLANTS See Forestry 207.

209 BIOLOGY OF FERNS Evolutionary biology of ferns; a survey of New England ferns and their phylogenetic relationships; current research on ferns emphasizing morphological, biogeographical, genetic and phytochemical aspects of speciation. *Prerequisites*: 108; 101 recommended. Three hours. Barrington.

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. Vogelmann.

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

234 ECOLOGY OF FRESHWATER ALGAE Environmental factors influencing the distribution and seasonal succession of freshwater algae of lakes, ponds, and streams; quantitative methods for estimating standing crop productivity; kinetics of algal growth; competitive and synergistic interactions. *Prerequisite*: 160 or Biology 102. Three hours. Cook. Alternate years, 1980-81.

241 TROPICAL PLANT SYSTEMATICS The diversity of tropical flowering plant communities; recent systematic and evolutionary angiosperm research; practical introduction to anatomy, morphology, ecology and geography of major families of tropical angiosperms. Student presentations on an aspect of recent research. *Prerequisite*: 109. Three hours. Barrington. Alternate years, 1980-81.

250 MICROTECHNIQUE Theory and practice in the preparation of biological materials for anatomical and cytological study, including histochemistry and photomicrography. *Prerequisites*: Introductory chemistry; some knowledge of organic chemistry, anatomy, or cytology is desirable. Three hours. Cook. Alternate years, 1981-82.

252 MOLECULAR GENETICS II: REGULATION OF GENE EXPRESSION IN EUKARYOTES Processing of information present in nucleic acids; knowledge generated from recombinant DNA techniques applied to higher cells; control in transposition, transformation, transcription, and processing transcript. *Prerequisites*: Biology 101 or Biochemistry 301, or equivalents; Medical Microbiology 211 preferred; permission of the instructor. Three hours. Ullrich.

255 STRUCTURE AND FUNCTION OF CHROMOSOMES Advanced analysis of recombination in eukaryotes. Arrangement of DNA and proteins in chromosomes. DNA duplication and mapping of certain DNA regions. Molecular nature of meiotic processes and control of gene expression with particular reference to the nucleolus. *Prerequisites*: 101; Chemistry 42 or 141, 142. Three hours. Hyde.

**257 PHYSIOLOGY OF THE PLANT CELL** Detailed study of photosynthesis, plant cell membrane function, and plant cell growth. *Prerequisites:* 104; Chemistry 141, 142 or Chemistry 42; Physics 11, 12 or 15, 16; Four hours. Ethern. Alternate years, 1981-82.

**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.

**295 SPECIAL TOPICS** Courses for advanced students within areas of expertise of faculty and staff. Various aspects of ecology, physiology, genetics, cytology, bryology, pteridology, paleobotany, photobiology, membrane physiology, cell biology. *Prerequisite:* Permission of instructor. Credit as arranged.

**301 CELL BIOLOGY** Advanced survey of cell organelles, their composition, origin and the relationship between their structure and function. Stress will be placed on recent literature and current controversies. *Prerequisites:* Chemistry 142, graduate standing in biology or permission of instructor. Three hours. Hyde.

**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.

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

**491 DOCTORAL DISSERTATION RESEARCH** Credit as arranged.

## BUSINESS ADMINISTRATION

*Professors Greif, Grinnell, Laber, and Severance (Chairperson); Associate Professors Gatti, Michael, Shirland, Squire and Tashman; Assistant Professors Antil, Battelle, Gurdon, Mills, Parke, and Rogowski.*

### BUSINESS ADMINISTRATION

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

The MBA program consists of three Tiers of courses. Tiers I and II must be completed successfully before a student is admitted to candidacy for the degree. Students will be admitted to the Graduate College before Tiers I and II are completed, and enrollment in Tier II courses will be restricted to students who have applied for admission to the Graduate College.

Elementary knowledge of computer programming is expected and may be acquired through the non-credit course available at UVM.

In addition to transcripts of prior undergraduate and graduate training, the applicant is required to submit scores on the Graduate Management Admissions Test. (GMAT scores are accepted in lieu of Graduate Record Examination scores for financial assistance in this program.)

**MINIMUM DEGREE REQUIREMENTS**

Students must complete all of the courses listed in Tiers I, II, and III. Tier I must be completed before enrollment in any Tier II courses.

**TIER I**

(UVM course equivalents listed)

Principles of Economics, 6 hours	(Economics 11, 12)
Calculus, 3 hours	(Math 18)
Statistics, 3 hours	(Statistics 111)

**TIER II**

BSAD 304	Fund. of Quantitative Methods	1.5 hours
BSAD 305	Fund. of Marketing Management	1.5 hours
BSAD 306	Fund. of Financial Accounting	1.5 hours
BSAD 307	Fund. of Organizational Behavior	1.5 hours
BSAD 308	Fund. of Managerial Finance	1.5 hours
BSAD 309	Fund. of Legal Environment of Business	1.5 hours
		<hr/>
		9 hours

Normally, Tier II will be completed before enrollment in Tier III courses. Tier II courses may be waived by qualifying examinations in the event of previous academic or work experience. Students are encouraged to complete all Tier II courses in one semester.

**TIER III**

BSAD 340	Quantitative Methods	3 hours
BSAD 359	Marketing Management	3 hours
BSAD 365	Managerial Accounting	3 hours
BSAD 375	Organizational Theory	3 hours
BSAD 380	Managerial Finance	3 hours
BSAD 396	Business Policy	3 hours

Electives from 300-level courses	<hr/>	9 hours
		27 hours

A minimum of 30 hours of 300-level credit must be completed at UVM for the MBA degree.

**COURSES OFFERED**

**304 FUNDAMENTALS OF QUANTITATIVE METHODS.** An accelerated introduction to quantitative decision making. Topics include probability, decision theory, optimization techniques, and economic analysis. *Prerequisites:* Tier I, MBA standing. One and one-half hours.

**305 FUNDAMENTALS OF MARKETING MANAGEMENT** An ac-

celerated course focusing on marketing principles and theory. An analytical approach is taken to the study of product and pricing strategies; distribution, communication, and promotional; consumer behavior and the development of corporate marketing strategy. *Prerequisite:* MBA standing. One and one-half hours.

**306 FUNDAMENTALS OF FINANCIAL ACCOUNTING** An introduction to the basic concepts, assumptions, and conventions which provide the foundation for developing financial statements. Emphasis is placed on analysis and interpretation of the income statement, balance sheet, and statement of changes in financial position. *Prerequisite:* MBA standing. One and one-half hours. Grinnell/Mills.

**307 FUNDAMENTALS OF MANAGEMENT AND ORGANIZATIONAL BEHAVIOR** An accelerated study of individual and group behavior in organizational settings. A managerial perspective is used to examine theories of motivation, perception, communication, group dynamics, leadership, organization design, and organization development. *Prerequisite:* MBA standing. One and one-half hours. Parke.

**308 FUNDAMENTALS OF FINANCIAL MANAGEMENT** An accelerated introduction to the principles of financial management. Tools and techniques of financial decision making are developed and applied through cases and problems to various decision faced by financial managers. *Prerequisites:* BSAD 306, MBA standing. One and one-half hours. Gatti/Laber/Rogowski.

**309 FUNDAMENTALS OF LEGAL ENVIRONMENT OF BUSINESS** A general overview of the areas of interaction between businesses and governments is developed. The course will examine governmental policy toward business and review the laws governing business-government interactions. *Prerequisite:* MBA standing. One and one-half hours. Squire.

**340 QUANTITATIVE METHODS IN MANAGEMENT** The application of statistical tools to management problems. Sampling, decision making, and strategy selection are covered. *Prerequisite:* MBA standing. Three hours. Shirland.

**341 STATISTICAL METHODS FOR RESEARCH AND FORECASTING** The application of statistical models to business research and forecasting. Emphasis on understanding the rationale, structure, and capabilities of techniques including smoothing, Box-Jenkins, and regression. *Prerequisite:* MBA standing. Three hours. Tashman.

**359 MARKETING POLICY** Concepts from quantitative methods, economics and the behavioral sciences are applied to marketing management. Included for consideration are: marketing opportunities, organizing for marketing, planning the marketing program and the control of marketing effort. Case book method. *Prerequisite:* MBA standing. Three hours.

**360 CONTEMPORARY FINANCIAL ACCOUNTING AND REPORTING** A study of current financial and reporting practices, focusing on contemporary issues and problems. The impact of pronouncements of the Accounting Principles Board, the Financial Accounting Standards Board, the Securities and

Exchange Commission, and other bodies is reviewed. *Prerequisite:* MBA standing. Three hours. Grinnell/Mills.

**365 MANAGEMENT ACCOUNTING** A study of the development and utilization of accounting information for product costing and pricing purposes, for routine planning and control of organizational activities, and for decision-making purposes. *Prerequisite:* MBA standing. Three hours. Grinnell/Mills.

**371 PERSONNEL ADMINISTRATION** The emphasis is on critical examination of contemporary problems and controversies in the field of personnel administration. Current issues and topics such as affirmative action, and discrimination in employment will be covered alongside the more traditional topics of wage and salary administration, etc. *Prerequisite:* MBA standing. Three hours. Parke.

**375 ORGANIZATION THEORY** Organization theories are examined for insights into the behaviors of organizations and their members. An open systems perspective is used to identify contingencies in organization design based on human, structural, technological and environmental variables. *Prerequisite:* MBA standing. Three hours. Parke.

**376 THE MANAGEMENT OF CHANGE IN ORGANIZATIONS** This course adopts an applied behavioral science perspective to identify conceptual issues, develop diagnostic skills and examine alternative intervention strategies relevant to the accomplishment of planned changes in organizational systems. *Prerequisite:* MBA standing. Three hours.

**380 MANAGERIAL FINANCE** This course focuses on key financial decisions that affect asset values. Topics include optimal capital structure, leasing, mergers and acquisitions, and capital market theories and evidence. *Prerequisite:* MBA standing. Three hours. Laber.

**384 FINANCIAL MARKETS AND INTEREST RATES** A study of the mechanism determining the level and structure of interest rates. Specific subjects include: flow of funds accounting, market vs. natural rate of interest, interest rate structure, and behavior of interest rates over the business cycle. *Prerequisite:* MBA standing. Three hours. Gatti.

**394 INDEPENDENT READINGS & RESEARCH** This course is intended to allow a student to pursue independent research under the direction of a faculty member. Normally, the course will include a research paper. *Prerequisite:* Permission of the Graduate Studies Committee. One to three hours.

**395 SPECIAL TOPICS** This course will include topics and material that may develop later into a regular course offering; in addition, it may include topics and material offered only once. *Prerequisite:* Permission of the Graduate Studies Committee. One to three hours.

**396 BUSINESS POLICY** A case course focusing on the resolution of complex cases involving simultaneous solutions of problems in two or more functional areas. *Prerequisite:* 21 hours of graduate credit. Three hours. Staff.

## CELL BIOLOGY (Interdisciplinary)

*Participating faculty are from the following departments: Botany; Biochemistry; Medical Microbiology; Medical Technology; Medicine; 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, Richard Landesman, Department of Zoology.

Research includes: (Absher) cellular aging and cellular mechanisms of pulmonary fibrosis; (Adler) role of contractive proteins in secretion and non-muscle cells; (Albertini) human somatic cell genetic mutations, histocompatibility genetics; (Bresnick) effects of cancer-producing agents on replicative and transcriptive mechanisms; (Chiu) regulation of gene activities in developing and neoplastic tissues; (Cidlowski) action of steroid hormones on cultured cells; (Clemmons) biochemistry and pathology of embryonic growth and development; (Craighead) pathogenesis of viral infections; (Cutroneo) regulation of collagen synthesis; (Davison) population regulation in fresh-water invertebrates; (Etherton) electrophysiology and membrane transport in plants; (Glade) morphogenesis in amphibian limb and tail regenerates investigated by transplantation; (Happ) hormone control of differentiation in insects; (Hart) metal toxicity in the lung; (Hyde) plant cytogenetics, nuclear ultrastructure; (Jaffe) biochemical parasitology and chemistry of filariasis; (Kelleher) control of protein synthesis in mammalian cells, oncodevelopmental gene products; (Kelley) connective tissue proteins and *in vitro* models of disease; (Kilpatrick) electrophoretic and chromosomal analysis of populations; (Landesman) gene control and the role of morphogenic information during amphibian development; (Little) RNA turnover and ribonucleases in skeletal muscle; (Low) protein metabolism in eukaryotic systems; (McCormack) biology and chemistry of pteridine compounds; (Meyer) physiological control of neural proteases, ribonucleases and esterases in normal and diseased skeletal muscle; (Moehring) cell structure; mechanisms of pathogenesis of toxins; replication of animal viruses; (Morselli) tissue and organ culture studies on growth and differentiation of woody plants; chemistry and microbiology of maple sap; (Mossman) carcinogenesis of tracheo-bronchial tree; (Newman) cancer chemotherapy; (Novotny) synthesis and assembly of bacterial pili and their function in conjugation; (Nyborg) biophysics of ultrasound; (Pennypacker) influence of extracellular matrix on cell behavior; (Racusen) biochemistry of plant proteins; (Schaeffer) transformation of normal rat liver cell cultures to the tumorigenic state using the carcinogen aflatoxin B<sub>1</sub>; (Sjogren) microbial ecology and fungal metabolism; (Smith) physical chemistry and metabolism of oncodevelopmental proteins; (Stevens) tumor immunology; (Ullrich) regulation of gene expression and cellular differentiation in eukaryotes, especially fungi; (Weller) structure and function of ribosomes and ribonucleases; (Woodworth) biochemistry of iron-binding and transport proteins and cellular iron metabolism.

### **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 Record 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 hours of graduate level credit including 301 and one course in each of the three following areas: genetics, biochemistry (one year), and cell physiology; cell biology seminar each semester; thesis research.

### **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.

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

Minimum of 20 additional hours of course work. Studies Committee will advise course selection. Dissertation research, minimum 20 credits. Regular participation in seminar program.

### **COURSES OFFERED**

- 252 MOLECULAR GENETICS II See Botany 252.
- 295 SPECIAL TOPICS Credit as arranged.
- 301 CELL BIOLOGY See Botany 301.
- 381 SEMINAR One hour. Staff.
- 391 MASTER'S THESIS RESEARCH Credit as arranged.
- 491 DOCTORAL DISSERTATION RESEARCH Credit as arranged.

### **CHEMISTRY**

*Professors Allen, Brown, Bushweller (Chairperson), Flanagan, Krapcho, Kuehne, Strauss, White, and Wulff; Associate Professors Geiger, and Weltin; Assistant Professors Carrano, Elliot, and Leenstra.*

Current research in organic chemistry includes dynamic NMR studies of intramolecular stereodynamics, syntheses of medicinally valuable natural products, isolation and structure determination of natural products, studies of the stereochemistry of C-alkylation of  $\alpha$ -anions, decarboxylation of geminal diesters, biomimetic syntheses, preparation of benzomorphans and their

analogues which have chemotherapeutic potential, and mechanistic studies of organic chemical reactions.

Physical chemistry research projects include hydrogen absorption by metals, alloys and intermetallic compounds with a view toward storage of hydrogen as a fuel, theoretical studies of the electronic structure of chemical bonds in small molecules using *ab initio* variation calculations, chemical thermodynamics, statistical mechanical modeling of chemical systems, and optically detected magnetic resonance studies of porphyrins and related compounds.

Research in inorganic chemistry includes investigations of the syntheses, structure, and spectroscopic properties of main-group ring systems and polymers with an emphasis on phosphazenes and sulfur nitrides, syntheses and characterization of new molecular metals, metal ion catalysis in carbon-carbon bond formation, syntheses of new platinum complexes for potential use in cancer chemotherapy, studies of the roles of metal ions in the modification and/or control of properties of proteins and other biologically important molecules, and dynamic NMR studies of restricted rotation about metal-phosphine bonds in various metal-phosphine complexes.

Research in analytical chemistry includes electrochemical studies of transition metal complexes and organometallic complexes, electron spin resonance studies of materials in unusual oxidation states, novel reactions of reactive compounds generated electrochemically under high vacuum, studies of factors influencing heterogeneous electron transfer processes in non-aqueous media, chemically modified electrodes, metalloporphyrin redox catalysts, metalloenzyme models, surface analysis.

### **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 141 and 162, 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.

A program is also offered leading to the degree of Master of Arts in Teaching, See p. 23.

### **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 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 231 and six semester hours of Chemistry chosen from Chemistry 163, 232, 201, 264 and 241. 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 four 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 386 (only for those electing Plan A), (d) Chemistry 381 (Seminar), and (e) Chemistry 231; and (4) maintenance of an overall point-hour ration 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:** 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) Two additional hours of Chemistry 381 (Seminar).

**Plan B:** 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) Two additional hours of Chemistry 381 (Seminar).

M.S. students should decide at the beginning of their program whether they will pursue Option A or Option B and inform the department and Graduate College of their decisions.

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 the second year of residence: (1) at least fifteen hours of research (Chemistry 491); (2) satisfactory performance in the cumulative examinations in his or her specialty field; (3) demonstration of basic competence in four fields of chemistry (analytical, 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 386 and 381 (4 credits), 3 semester hours credit of advanced level work in three of the four areas of chemistry (analytical, inorganic, organic and physical). The remainder of each student's program will be determined by a departmental studies committee on the basis of qualifying examination performance, background, and research interests. In the normal course of events a student should expect to devote much of the 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 a doctoral research project, write an acceptable dissertation, 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, Chemistry 388, (at least six months prior to the submission of the dissertation). The student must also demonstrate a reading knowledge of scientific German and of either French, Russian or computer programming.

## COURSES OFFERED

**201 ADVANCED CHEMISTRY LABORATORY (2-6)** Lectures emphasize analytical instrumentation (spectroscopic instrumentation, electrochemistry, electronics, synthetic techniques as applied primarily to inorganic systems.

*Prerequisites:* 146, credit for or concurrent enrollment in 162 or 163. Four hours.

**202 ADVANCED CHEMISTRY LABORATORY (1-8)** Laboratory and discussion only. Problems require modern analytical, physical, and synthetic techniques. *Prerequisite:* 146, credit for or concurrent enrollment in 162 or 163.

Note: Although it is highly recommended that 201 be taken before 202, in special cases this may not be necessary. Four hours.

**211 CHEMICAL KINETICS AND MECHANISM** Important aspects and applications of chemical kinetics. Theoretical and mathematical aspects are covered at an introductory level. Considerable emphasis is placed on interpretation of experimental rate laws in terms of mechanistic hypotheses for selected reactions. *Prerequisites:* 142, 162, 163. Three hours.

**214 POLYMER CHEMISTRY** Polymer size and weight distributions. Synthesis and properties of organic and inorganic polymers. Kinetics of polymerization Polymer characterization. Polymer formulation. *Prerequisites:* 144, 162. Three hours. Allen.

**221 ADVANCED ANALYTICAL CHEMISTRY.** A systematic survey of modern methods of chemical analysis. Principles and applications of analytical and molecular spectroscopy, electrochemistry, and separation techniques. *Prerequisites:* 162, 163. Three hours. Elliott, Geiger.

**222 ELECTROANALYTICAL CHEMISTRY** Principles of modern electrochemical analysis focusing mainly on finite current methods — voltammetry,

polarography, chronoamperometry, cyclic voltammetry, etc. Introduction to modern operational amplifier instrumentation. Double layer theory and electron transfer kinetics. *Prerequisites:* 163. Three hours. Elliott, Geiger.

**224 CHEMICAL SEPARATIONS** Theory and practice of chromatographic separations. Emphasis on gas-liquid, liquid-liquid, and liquid-solid chromatography. *Prerequisites:* 221. Two hours. Elliott, Geiger.

**227, 228 SPECIAL TOPICS IN ANALYTICAL CHEMISTRY** Selected topics of current interest in the area of analytical chemistry. New techniques and methodologies, especially in chemical instrumentation, are typically covered. Credit as arranged. Elliott, Geiger.

**231 INORGANIC CHEMISTRY** Fundamental concepts and facts of inorganic systems. Molecular symmetry, models for structure and bonding, acid-base chemistry, descriptive chemistry of ionic and covalent compounds, introductory crystal field theory, reaction mechanisms. *Prerequisites:* 162. Three hours., Allen, Brown, Carrano.

**232 ADVANCED INORGANIC CHEMISTRY** Selected topics include applications of group theory to vibrational spectroscopy and electronic structure, multiple bonding in main group and transition metal compounds, electron-deficient bonding, bioinorganic chemistry. *Prerequisite:* 231. Three hours. Allen, Brown, Carrano.

**234 ORGANOMETALLIC CHEMISTRY** A systematic survey of the syntheses, properties, structures, bonding and reactions of both main group and transition series organometallic compounds. Variation of the structure and stability of the metal-carbon bond throughout the periodic system. *Prerequisite:* 231. Three hours. Allen, Brown.

**236 PHYSICAL INORGANIC CHEMISTRY** The fundamental physical basis for spectroscopic techniques and other observable phenomena important to the field of inorganic chemistry. Topics include ligand field theory, magnetism, magnetic resonance, Mossbauer spectroscopy, and optical activity. *Prerequisites:* 163, 232. Three hours. Allen, Brown.

**237, 238 SPECIAL TOPICS IN INORGANIC CHEMISTRY** Advanced theoretical treatment of bonding and of physical properties of transition metal complexes; detailed treatment of inorganic reaction mechanisms. Credit as arranged. Allen, Brown, Carrano.

**241 ADVANCED ORGANIC CHEMISTRY** Stereochemistry, reactivity criteria, reaction mechanisms and synthetic methods are stressed. Reactive intermediates such as carbanions, carbocations, carbenes, and free radicals are used to systemize mechanistic discussions. *Prerequisites:* 142, 162. Three hours. Krapcho, Kuehne, Strauss, White.

**242 ADVANCED ORGANIC CHEMISTRY** Detailed mechanistic descriptions of processes which may include enolate reactions and stereochemical considerations, addition processes such as halogenation, cycloadditions, hydroboration, hydride and metal-ammonia reductions, annulations such as biomimetic

**cyclizations, oxidation processes, rearrangements, eliminations, and examinations of approaches to multi-step syntheses. *Prerequisite:* 241. Three hours. Krapcho, Kuehne, Strauss, White.**

**251 PHYSICAL ORGANIC CHEMISTRY** Structure-reactivity relationships, molecular properties and their interpretation. Methods and results of investigations of mechanisms of common organic reactions. *Prerequisites:* 142, 162. Three hours. Bushweller, Krapcho, White, Strauss.

**257, 258 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. Credit as arranged. Bushweller, Krapcho, Kuehne, Strauss, White.

**262 CHEMICAL THERMODYNAMICS** Systematic study of the application of thermodynamics to chemical problems. Concepts of statistical thermodynamics to be introduced. *Prerequisites:* 162, 163. Three hours. Flanagan.

**263 INTRODUCTION TO QUANTUM MECHANICS** General consideration of quantum mechanics. Development of techniques pertinent to the application of quantum mechanics to chemical problems. *Prerequisite:* 162, 163. Three hours. Weltin.

**264 FUNDAMENTALS OF SPECTROSCOPY** A general discussion of molecular spectroscopy, rotational and vibrational states of molecules, symmetry of vibrations; introduction to electronic spectra. *Prerequisite:* 162, 163, mathematics 121. Three hours. Weltin.

**265 STATISTICAL MECHANICS** Development of statistical mechanics and its application to problems of chemical interest. *Prerequisite:* 162, 163; 263 recommended. Three hours. Flanagan.

**266 MOLECULAR ORBITAL THEORY** An introduction to the Hückel molecular orbital method. Energy levels and orbitals, molecular properties and their interpretation. Effects of substituents on electronic structure. Extensions of the Hückel method. *Prerequisite:* 142, 163. Three hours. Weltin.

**267, 268 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. Flanagan, Leenstra, Weltin.

**285, 286 SPECIAL TOPICS** Selected topics of an interdisciplinary nature, designed particularly for advanced undergraduate chemistry majors. Possible subjects include environmental chemistry, chemical technology, chemical economics. Offered as occasions arise. Variable credit.

**342 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. *Prerequisites:* Credit or concurrent enrollment in 242. Three hours. Alternate years. Kuehne.

**344 NATURAL PRODUCTS — THE TERPENES** The chemistry of mono,

sesqui, di and triterpenes, including degradations, structure proofs, total syntheses, rearrangement reactions and biogenesis. *Prerequisite:* Credit or concurrent enrollment in 242. Three hours. Alternate years. Kuehne.

363 **QUANTUM CHEMISTRY** Applications of quantum mechanical techniques to problems of chemical interest. *Prerequisite:* 263. Three hours. Offered as occasion warrants. Weltin.

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

386 **METHODS OF CHEMICAL INVESTIGATION** Introduction to advanced modern chemical methods. *Prerequisite:* Permission of department. Two hours.

388 **RESEARCH PROBLEM CONCEPTION AND SOLUTION** Independent origination of research problems and the methods of their solution. Required of all doctoral candidates. *Prerequisites:* Permission of department. This course shall be completed at least six months in advance of the Ph.D. thesis defense, and in no case later than the end of the seventh semester of graduate studies at UVM. One hour.

395 **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.

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

491 **DOCTORAL DISSERTATION RESEARCH** Credit as arranged.

## CIVIL ENGINEERING

*Professors Cassell, Dawson, and Oppenlander (Chairperson); Associate Professors Downer, Hemenway, Laible; Lecturer Dunham; Adjunct Professor Knight.*

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

### 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. Satisfactory scores on the Graduate Record Examination.

### 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 credit 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.

## RECOMMENDED CORE COURSES

It is recommended that the student's plan of study include one course in each of the following areas: advanced statistics, engineering economics, systems engineering, and computer-based numerical methods.

## COURSES OFFERED

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

**226 CIVIL ENGINEERING SYSTEMS ANALYSIS** Graph theory, dynamic programming, linear programming, scheduling, resource allocation, simulation; applications to public works problems; comparison of solution models and selection of models for complex problems. Three hours. Dawson.

**227 DISCRETE SIMULATION** Discrete simulation using monte-carlo techniques and the GPSS simulation processor; mathematical modeling of systems; validation and sensitivity analyses. *Prerequisite:* Statistics 111, 141, or 151. Three hours. Dawson.

**230 COMMUNITY PLANNING TECHNIQUES** Size, spacing, and functions of cities; economic, social, and physical determinants of land-use elements; studies for urban planning; and the process of land-use planning. Three hours. Oppenlander.

**231 COMMUNITY 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. Downer, Oppenlander.

**232 COMMUNITY DESIGN** Basic principles and methods of planning and designing the 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. Downer, Oppenlander.

**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. Dawson.

**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. 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; and location and design of terminal facilities. Three hours. Oppenlander.

**250 ENVIRONMENTAL FACILITIES DESIGN-WATER** Design of water supply systems including: source evaluation, transmission, distribution; water treatment plant design; equipment selection, and wells. *Prerequisite:* 151. Three hours. Cassell.

**251 ENVIRONMENTAL FACILITIES DESIGN-WASTEWATER** Design of wastewater conveyance and treatment facilities; sewage-treatment plant design, and equipment selection. *Prerequisite:* 151. Three hours. Cassell.

**252 INDUSTRIAL HYGIENE** Industrial hygiene problems; effects of pollutants on health; threshold limit values, and emphasis on the engineering evaluation of the hazard and control techniques. *Prerequisites:* Chemistry 5 and Physics 25. Three hours. Hemenway.

**253 AIR POLLUTION** Sources of air pollution, methods of measurement, standards, legal aspects and control techniques available. Emphasis placed on source testing and source control. *Prerequisites:* Chemistry and Mathematics 21. Three hours. Hemenway.

**254 SOLID WASTES** Significance of solid wastes from municipal, industrial, agricultural, mining; optimization and design of collection, disposal, recycle systems; and sanitary landfills, incineration, composting, material recovery. *Prerequisites:* Chemistry 5 and Physics 25. Three hours. Cassell.

**255 WATER RENOVATION PROCESSES — CHEMICAL/PHYSICAL** Design theory of chemical/physical processes for treating waters and wastewaters; mass transfer, coagulation/precipitation, sedimentation, filtration, mixing, absorption, ion exchange, and membrane processes; and pilot plant experimentation. *Prerequisites:* 160, Chemistry 5, Mathematics 22. Three hours. Staff.

**256 WATER RENOVATION PROCESSES-BIOLOGICAL** Design theory of biological processes for treating waters and wastewaters; aerobic, anaerobic, photosynthetic processes; disinfection; and pilot plant experimentation. *Prerequisite:* Mathematics 22. Three hours. Staff.

**257 ANALYSIS OF AQUATIC SYSTEMS** Quantitative study of biological, chemical and physical phenomena in lakes, streams and estuaries; and mathematical modeling applied to management of water quality. *Prerequisites:* 150 and 160. Three hours. Staff.

**258 ENVIRONMENTAL FACILITIES DESIGN-AIR** Advanced design principles for air pollution control equipment including scrubbers, precipitators, cyclones, and filter. *Prerequisites:* 150 and 252 or 253. Three hours. Hemenway.

**259 MEASUREMENT OF AIRBORNE CONTAMINANTS** Quantifying airborne contaminants from processes and ambient levels. Laboratories demonstrate calibration and measurement, stack sampling and ambient air monitoring of specific contaminants. *Prerequisite:* 252 or 253. Three hours. Hemenway.

**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 Statistics 141. Three hours. Downer.

**261 OPEN CHANNEL FLOW** Application of the basic laws of fluid mechanics to flow in open channels; design of channels and transition structures including riprap and culverts; and gradually-varied flow problems including flood plain and floodway studies. *Prerequisite:* 160. Three hours. 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. Downer.

**270 ADVANCED INDETERMINATE STRUCTURES** Matrix analysis of framed structures; finite element theory and application in structural mechanics and hydrodynamics; emphasis on computer applications and numerical analysis techniques. *Prerequisites:* 171 and a basic knowledge of matrix algebra and computer programming. Three hours. Laible.

**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. Staff.

**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. 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. 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.

**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. Downer.

**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

*Emeritus Professors Bliss and Kidder; Professors Ambrose (Chairperson), Davison, Gilleland, and Schlunk; Assistant Professor B.S. Rogers, Adjunct Professor R.H. Rogers.*

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; lyric and elegiac poetry; Petronius; satire; Roman Imperial Families; Mythology; Etruscology; Medieval Studies.

### PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS IN GREEK AND LATIN

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 and Latin, six hours of which must be 381; 6 additional hours in Greek and Latin, History or Philosophy; thesis research (normally 6 hours). Comprehensive examinations in Greek and Latin translation, Greek and Roman history, literature, and philology are required. In addition to course work, students will have a reading list of authors in Greek and Latin.

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.

A program is also offered leading to the degree of Master of Arts in Teaching: See p. 23. Satisfactory scores on the Graduate Record Examination are prerequisite for acceptance to candidacy for this degree.

Consult the Summer School catalogue for occasional offerings for graduate credit.

### COURSES OFFERED

#### GREEK

201 GREEK ORATORS Selected speeches of Lysias and Demosthenes. Three hours. Rodgers. Alternate years, on request.

202 GREEK COMEDY Two plays of Aristophanes. Three hours. Ambrose. Alternate years, 1980-81.

203 GREEK HISTORIANS Thucydides, Books I and II; selections from Herodotus and Xenophon's Hellenica. Three hours. Rodgers, Davison. Alternate years, 1980-81.

204 GREEK TRAGEDY Sophocles, *Antigone* and Euripides, *Medea*, or two equivalent plays. Three hours. Ambrose. Alternate years, on request.

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

**206 GREEK EPIC** Readings in the *Iliad* and *Odyssey*. Problems of epic composition and language together with mythological and historical background. Three hours. Davison. Alternate years, on request.

### LATIN

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

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

**227 ROMAN LYRIC POETS** Selections from the works of Catullus, Horace, Propertius, Tibullus. Three hours. R. Rodgers. Alternate years, 1980-81.

**252 COMEDY** Two plays of Plautus and Terence. Study of the precursors of this literary form. Three hours. Ambrose. Alternate years, on request.

**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. Gilleland. Alternate years, on request.

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

**256 SATIRE** Selections from Horace and Persius; Juvenal, Petronius. Study of the development of this literary form. Three hours. Gilleland. Alternate years, 1980-81.

**271 SILVER LATIN** Extensive reading of post-Augustan authors not included in other advanced courses. Three hours. Gilleland. Alternate years, on request.

### GREEK AND LATIN

**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 and 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

*Professors Lewis, London, Manchel; Associate Professor Worden; Assistant Professors Schultz, Yadav (Acting Chairperson); Instructors Catt, Goodwin.*

No Graduate Program Offered.

Communication faculty interest and research centers in two major areas: Mass Media in Society or Communication Studies. Current interests and research in the area of Mass Media in Society include film study of movie genres and motion picture history; international broadcasting with emphasis on Canada, Britain,

China, and India; creative filmmaking; evaluation of mass media campaigns; and studies of violence on television. Research in Communication Studies involves communication in the recreational setting; leadership emergence and decision-making in the small group; cross-cultural communication, political rhetoric and movement theory, and rhetorical theory and criticism.

### **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. Yadav.

**210 CLASSICAL ORIGINS OF COMMUNICATION THEORY** Major trends in rhetorical thought. An examination of outstanding works of criticism, speaking, and writing. Selected works from classical and contemporary sources. *Prerequisite:* Nine hours of related courses. Three hours.

**211 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.

**213 THEORIES OF SPEECH ANALYSIS (RHETORICAL CRITICISM)** An in-depth study of major theories of criticism of public address and an application of those theories to speakers, speeches, and religious, social, and political movements. *Prerequisite:* Nine hours of related courses. Three hours.

**214 ISSUES IN PUBLIC ADDRESS** Each semester this course will emphasize analysis of specific speakers, movements, theses and strategies encompassed by a selected topic of public address. *Prerequisite:* Nine hours of related courses. (May be repeated up to nine credit hours.) Three hours.

**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. Schultz.

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

**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. Yadav.

**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.

**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. Lewis, Worden.

**263 INTERNATIONAL MASS COMMUNICATION** Mass media systems of other countries, i.e., Britain, China and India. *Prerequisite:* Nine hours of related courses. Three hours. May be repeated up to nine credit hours. London.

**264 ADVANCED TELEVISION PRODUCTION** Emphasis on the following types of programs: educational, news, documentary, dramatic and variety. *Prerequisite:* 164. Three hours.

**265 CINEMATOGRAPHY** Advanced study of film expression and production of student films. *Prerequisite:* 167 or permission of the instructor. Three hours. 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 nine credit hours. Manchel.

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

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

**293 CANADIAN MASS MEDIA** A study of Mass Communications in Canada to include an analysis of radio-television-film and press, and how they reflect that nation's social, political, and cultural components. Field trip to CBC, the National Film Board, and other Montreal-based media centers will be included. *Prerequisite:* Six hours of related courses. Three hours. London.

**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:* Twelve hours. Three hours. London.

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

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

**381,382 ADVANCED READINGS** Readings, with conferences, intended to contribute to the programs of graduate students in phases of communication for which formal courses are not available. Credit as arranged up to three hours each semester.

## COMMUNICATION SCIENCE AND DISORDERS

*Professors Daniloff (Chairperson), and Wilson; Associate Professor Guitart; Assistant Professor Hoffman; Lecturer Houghton.*

Faculty members in the department are engaged in ongoing research in language development and disorders, articulation processes and disorders, biofeedback and fluency management.

The Master's Degree program in Communication Disorders is accredited by the Education and Training Board of the American Board of Examiners in Speech Pathology and Audiology (ABESPA). The Eleanor M. Luse Center for Communication Disorders, the primary practicum site, holds accreditation from the Professional Services Board of ABESPA. Students are required to fulfill academic requirements for the Certificate of Clinical Competence in Speech Pathology from the American Speech and Hearing Association. All students are supervised by members of the faculty as well as staff members of the E.M. Luse Center.

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

A minimum of 30 hours in communication disorders and selected areas to include 101, 270, 281 (or their equivalent), a course in Statistics, and 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

#### **Thesis Option.**

The student will take 30 hours of graduate level courses; 6 require the degree candidate to write a quality M.S. thesis. All students who appear to be research-oriented or who are considering a higher degree will be encouraged to pursue this option.

#### **Non-Thesis Option**

The student will take 36 hours of graduate level coursework without completing a master's thesis. In lieu of the thesis requirement, students will take two additional courses in clinical disorders of communication; one course in research methods which requires the completion of a clinical research project, and 3 credits of Clinical Study (CSD 275-76). As a part of the latter 3 credits, students will be required to give a diagnostic and/or therapeutic presentation which will be critiqued by the faculty as a whole.

### COURSES OFFERED

**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. Wilson.

**271 COMMUNICATION DISORDERS I** Etiology, symptomatology, and principles of habilitation for voice disorders (including the laryngectomized) and cleft palate. *Prerequisites:* 74, 101 and 270. Three hours. Staff.

**272 COMMUNICATION DISORDERS II** The nature of articulation and the etiology, diagnosis, and treatment of disorders of articulation. *Prerequisites:* 281. Three hours. Staff.

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

**275, 276 CLINICAL STUDY** Supervised practicum experiences with children and adults presenting disorders of speech, hearing, and language. *Prerequisites:* 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, *Prerequisites:* Nine hours of speech and psychology including 74. Three hours. Staff.

**282 ANATOMY-PHYSIOLOGY OF AUDITION** Anatomy and physiology of the normal auditory system. Basic acoustics and subjective correlates of the auditory stimulus. *Prerequisites:* Nine hours of speech and psychology including 74. Three hours. Daniloff.

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

**287 CURRENT RESEARCH IN LANGUAGE ACQUISITION** Recent advances in child language. *Prerequisite:* 270. Three hours. Wilson.

**377 HABILITATION AND REHABILITATION PROCEDURES FOR THE HEARING IMPAIRED** *Prerequisite:* 273. Three hours. Houghton.

**381, 382 ADVANCED READINGS** Readings, with conferences, intended to contribute to the programs of graduate students in phases of communication science and disorders for which formal courses are not available. Credit as arranged, up to three hours each semester. Staff.

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

**384 SEMINAR IN ARTICULATION** Etiology, diagnosis, pathology, and habilitation and rehabilitation of articulation. *Prerequisites:* 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. *Prerequisites:* 271, 272. Three hours. Staff.

**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. *Prerequisites:* 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. Wilson.

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

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

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

## COMPUTER SCIENCE

*Professors Absher, Dawson, and Margolis (Chairperson); Associate Professor Shub; Lecturers Charbonneau, Fischel, Halsted, and Thomas.*

Research activities in Computer Science encompass a broad range of topics including Formal Language Theory, Operating Systems, Simulation, Architecture, and Performance Evaluation.

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

Bachelor's degree from an accredited institution; Mathematics 21, 22, 104, 124 or the equivalent; Computer Science 11, 101, 102, 103, 104, or the equivalent. Satisfactory scores on the aptitude portion of the Graduate Record Examination.

### MINIMUM DEGREE REQUIREMENTS

Thirty semester hours of acceptable graduate credit. Thesis is optional. Required courses are Computer Science 201, 202, 222, 241, 242, and Electrical Engineering 237. CS 311 and 312 are recommended for the student selecting the non-thesis option. Up to 9 hours from an area of minor concentration may be used to fulfill degree requirements. CS 301 is suggested for entering students with an undergraduate major other than computer science.

### COURSES OFFERED

**200 DISCRETE SIMULATION** See Civil Engineering 227.

**201 OPERATING SYSTEMS** An introduction to the principle components and algorithms involved in operating systems design and implementation. Memory, processor, device and file management techniques are presented and compared. Protection and security schemes are examined for both memory and file organizations. Synchronization primitives are discussed. *Prerequisite:* 222. Three credits. Shub.

**202 COMPILER CONSTRUCTION** Organization of a compiler including compile and run time symbol tables, lexical scan, syntax scan and object code generation. *Prerequisite:* 104. Three hours. Staff.

**204 ADVANCED SYSTEMS PROGRAMMING** Advanced study and

research in a selected area of systems programming. *Prerequisite:* 301. Three hours. Staff.

**222 COMPUTER ARCHITECTURE** The architecture of computing systems. Levels of computer description. Taxonomy of computing machines. Addressing structures, memory concurrency, processor concurrency. Hardware features desirable for various software systems. Hardware, software, firmware tradeoffs. *Prerequisites:* 102, Mathematics 104, Electrical Engineering 231 or 237. Three hours. Staff.

**241 SEQUENTIAL MACHINES AND AUTOMATA THEORY** Capabilities and limitations of finite state automata. Minimization, control and identification of machines. Structure and loop-free decomposition of machines. State-identification and fault-detection experiments. Finite state recognizers and regular expressions. *Prerequisites:* Mathematics 104 or Electrical Engineering 230. Three hours. Margolis.

**242 INTRODUCTION TO THE THEORY OF COMPUTING** A study of various theoretical models of computing devices including the basics of automata theory, recursion theory, formal grammars and Turing machines. *Prerequisite:* Mathematics 104. Three hours. Margolis.

**283 SPECIAL TOPICS IN COMPUTER SCIENCE** Lectures, reports and directed readings on advanced topics. *Prerequisite:* Permission of instructor. Three hours. Staff.

**301 INTRODUCTION TO COMPUTER SOFTWARE FOR GRADUATE STUDENTS** Language translation, operating systems fundamentals, data base organization. *Prerequisite:* 101. Three hours. Halsted.

**311 LITERATURE SEMINARS** The literature seminar introduces students to the Computer Science research literature through directed readings. A complete literature survey and a state of the art report is required of all students. *Prerequisite:* 12 hours of Computer Science courses numbered 200 or above. Three hours.

**312 PROBLEM SEMINAR** Solution of advanced problems of current interest in Computer Science. *Prerequisite:* 311. Three hours.

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

## ECONOMICS

*Professors Alnasrawi, Campagna, Chase (Chairperson) and Nadworny; Associate Professor Bates; Assistant Professors Heaps, Woolf.*

No Graduate Program Offered

**200, 201 ECONOMIC HISTORY OF THE UNITED STATES** Economic development and the evolution of capitalism in the United States. First Semester (200): Origins and growth of the economy to 1900. Second Semester (201): The American Economy in the Twentieth Century. *Prerequisite:* 186 or 190 or permission of the instructor. Three hours. Nadworny.

**210 INCOME, WEALTH AND WELFARE** Analysis of the distribution of income and wealth and policies which affect them. *Prerequisite:* Nine hours in economics. Three hours. Bates.

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

**217 URBAN AND REGIONAL ECONOMICS** Economic analysis applied to the problems of cities, states and regions. *Prerequisite:* Nine hours in economics. Three hours. Bates.

**234 ADVANCED MACRO AND MONETARY THEORY** Analysis of classical, Keynesian and modern macroeconomic models; micro and macro demand for and supply of money; portfolio choice and the influence of financial intermediaries. *Prerequisites:* 101 and 190. Three hours. Campagna.

**241 HUMAN RESOURCES** The theory and policy, the labor sector, and human capital in an advanced economy. *Prerequisite:* 141. Three hours. Nadworny.

**242 LABOR-MANAGEMENT RELATIONS** Economic influences of unionization. The grievance process, arbitration and labor relations laws. *Prerequisite:* 141. Three hours. 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:* Twelve hours in history and/or other social sciences. Three hours. Staff.

**267 ECONOMETRICS** A combination of economic theory, mathematics, and statistics for the testing of economic hypotheses and developing economic models. *Prerequisites:* 131, 186, 190; 130 recommended. Three hours. Staff.

**290 THE SOVIET AND EASTERN EUROPEAN ECONOMIES** Analysis of the economic development, structure, performance and direction of the Soviet and related economies. *Prerequisite:* Nine hours in economics or permission of the instructor. Three hours. Staff.

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

**296 SEMINAR AND SPECIAL TOPICS**

**297 READINGS AND RESEARCH**

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

## EDUCATION

*Professors: Abruscato, Agne, Boller, Carlson, Ducharme, Fox, Gobin, Hanley, Hunt, Leggett, McKenzie, Nash, Peterson, Petrusich, Rippa, Saurman, and Tesconi; Associate Professors Burrell, Clements, Conrad, Erb, Griffin, Lang, Larson, Meyers, Nevin, Nichols, Rathbone, Sandoval, Shiman, Thompson, and Whittlesey; Assistant Professors Bright, Chase, Cheney, Holmes, Lekan, Letteri, McKay, O'Donnell, Pierce, Ponzo, Reichle, and Williams; Lecturers Burdett, Christie, Hasazi, Knight, McEntee, Paolucci-Whitcomb, Perelman, Pierson, Roberts, Royce, Slack, Smith, Watson, and Wood.*

The College of Education and Social Services 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 and social service agencies. 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 may not apply to the Student Personnel Services in Higher Education, Counseling, Administration and Planning, or Interdisciplinary Major Programs in OHRD. This is particularly true of persons seeking positions which do not require public school certification.

### MINIMUM DEGREE REQUIREMENTS

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

### DEPARTMENTS

#### I. ORGANIZATIONAL, COUNSELING, AND FOUNDATIONAL STUDIES

This department results from the merging of the Administration and Planning, Counseling, Student Personnel and Foundational Studies Programs. In addition to the four previously mentioned graduate level programs, a fifth option is available which is referred to as an Interdisciplinary Major in Organizational and Human Resource Development. Inquiries regarding this program and the specializations listed below should be addressed to the Chairperson.

#### *Programs*

1. *Administration and Planning* This program is designed to prepare administrators and planners for public schools, educational and social agencies and middle management positions in higher education. The M.Ed. program usually requires 30-36 credit hours of courses, seminars, practicums, and research experiences. The Certificate of Advanced Study (C.A.S.) Program usually requires 30-36 credit hours of study beyond the M.Ed. requirements.

Courses with an administration/planning focus include 264, 266, 268, 295, 332, 333, 335, 337, 352, 353, 354, 355, 356, 358, and 386.

**2. Counseling** This degree program provides preparation for the individual who intends to become a school counselor (program is state-approved for certification in school counseling); a director of pupil personnel services, or a community counselor. The program, which requires 42-48 credit hours of course work, covers four broad areas of study: (1) personal growth and development, self-awareness, interpersonal relations, physical and mental health; (2) the foundations and dynamics of human development and behavior; (3) theory and skill for individual, group and family counseling; (4) administrative and planning concepts and skills as related to guidance, social service, and psychological education programs. Particular emphasis is placed upon the implementation of theory in practice with opportunities provided for student-counselors to work under supervision in schools and community agencies.

Program planning is done with the assistance and approval of a faculty advisor. When relevant, the student may take courses from other areas of the University.

Courses in the counseling program include 220, 221, 250, 251, 258, 260, 295, 305, 306, 319, 350, 351, 368, 370, 374, 381, 383, 384, 386, 388, 389.

In addition to the general admissions procedures a personal or group interview is required for this program. For a more detailed description of the program contact the departmental office, 228 Waterman Building.

**3. Student Personnel Services in Higher Education** This program area is aimed at providing a general background for the individual who is preparing to work within the broad area of student personnel services in colleges and universities. The program allows flexibility for the student to strengthen his/her major area of interest (i.e., admissions, housing, student activities, financial aid, counseling, placement, and others), while pursuing a strong academic core. Emphasis is on the dynamics of the college student's growth and development, human behavior, and a practical and conceptual understanding of the culture of higher education and its organizational structure and its impact on the individual student. The student personnel program seeks to link the theoretical and conceptual knowledge of higher education and student development with its most immediate practical applications. To implement this aspect of the program, a comprehensive program of practicums and internships has been developed to provide experiences in a variety of University offices and departments as well as in nearby colleges. The program attempts to prepare student development educators to serve as teachers, counselors, facilitators, and administrators. It defines education broadly to consciously reflect a basic understanding of the teaching-learning process and the role of the student development educator in perpetuating this process.

Program planning is done with the assistance and approval of a faculty advisor. When relevant, the student may take courses from other areas of the University.

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

In addition to the general admissions procedures, a personal interview is required for this program. If interested in a student affairs or residence hall

fellowship, write directly to the Office of Residential Life. For a more detailed description of the program contact the OCFS Office, 228 Waterman Building.

**4. 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) inservice 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 underpinings 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, 203, 204, 205, 206, 209 213, 252, 254, 255, and 277.

Inquiries regarding this program should be addressed to Professor David A. Shiman.

**5. Interdisciplinary Major** This degree program is for students who wish to pursue a self-designed, integrated program of study. The program draws primarily from graduate courses in administration and planning, Counseling, Student Personnel Services, and Foundational Studies. It may include courses from other departments within the College and the University. A minimum of 36 credit hours is required for completion of the program. The program is ideally suited for persons whose personal and professional development requires a combination of coursework not readily available in other graduate programs, or for individuals who plan to assume new or emerging roles in the fields of Education or Social and Human Services.

Applicants should have a clear understanding of how the Interdisciplinary Program will serve their career goals. For this reason, major emphasis in admission is placed upon the applicant's Statement of Purpose. Applicants are strongly encouraged to contact the Department of Organizational, Counseling, and Foundational Studies, 228 Waterman Building, prior to making application for admission. Detailed information about the program and admissions criteria will be supplied upon request.

Certificate of Advanced Study in Integrated Studies is also available for work beyond the M.Ed. Information is available in the College of Education and Social Services, Dean's Office, 306 Waterman.

## II. SPECIAL EDUCATION, SOCIAL WORK, AND SOCIAL SERVICES

The Special Education Graduate Program in this department is designed to prepare teachers of pre-school, elementary, secondary and multi-handicapped

children and youth. The following options are available:

***Intensive Special Education*** The Intensive Special Education option prepares educators of the moderately, severely and multi-handicapped. Only certifiable educators or experienced mental retardation service providers are considered. The course sequence consists of 30 credit hours of coursework, laboratory (practicum) experience and internship. Courses in Intensive Special Education include: EDSP 301, 302, 217, 228, 290, 218 and 382. A six-week summer course is followed by a full-time year or a part-time sequence of at least two years.

***Essential Early Education*** The Essential Early Education option prepares educators of pre-school handicapped children. Only certifiable educators or experienced service providers are considered. The course sequence consists of 30 credit hours of coursework, laboratory (practicum) experience and internship. Courses in Essential Early Education include: EDSP 301, 302, 217, 310, 312 and 382. A six week summer course is followed up by a full-time year or a part-time sequence of at least two years.

***Mainstream, Special Class and Resource Teacher*** The Mainstream, Special Class and Resource Teacher option prepares educators of school age handicapped children and youth. Only certifiable educators currently employed as service providers are considered. The course sequence consists of 30 credit hours of inservice coursework and laboratory (practicum) experience. Courses include: EDSP 216, 224, 290, 297, 298, 301, 310 and 312. Courses are offered in a part-time sequence of at least two years.

***Consulting Teacher/Learning Specialist*** The Consulting Teacher/Learning Specialist option prepares experienced teachers, administrators, human service personnel and vocational educators to provide on-site inservice training. Only experienced applicants are considered. The graduate program consists of 36 credit hours of coursework and internship. Courses include EDSP 301, 310, 312, 319 and 382. Courses are offered in a part-time or full-time sequence of at least two years.

Inquiries regarding the Special Education Graduate Program should be addressed to the Chairperson.

### III. PROFESSIONAL EDUCATION AND CURRICULUM DEVELOPMENT

In the event of restrictions on enrollment, preference will be given to Vermont residents holding professional positions in education and social services.

1. ***Individually Designed Concentration(Teacher Education)*** This program area is designed to develop leadership in such education fields as teaching, curriculum and research for elementary and secondary school teachers as well as those with teaching roles in human service agencies.

Programs are developed to provide a comprehensive background in 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 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 and Social Services.

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 to develop strong programs of professional education which include academic offerings in the various teaching fields in elementary and secondary education.

Degree concentrations, in addition to those listed below, can be developed on an interdisciplinary basis responding to student strengths and needs.

Courses in teacher education include 211, 217, 218, 225, 227, 228, 241, 242, 244, 248, 256, 257, 259, 270, 271, and 333.

Inquiries regarding these programs should be addressed to the Chairperson.

**2. 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.

### **COURSES OFFERED**

Organizational, Counseling, and Foundational Studies — EDOH; Graduate level foundations courses listed under EDSS.

Any questions concerning instructor and course structure should be addressed to the chairperson.

**220 PERSONALITY DEVELOPMENT** Approaches to understanding human behavior in applied settings. With emphasis on behavior development as an interpersonal process. *Prerequisite:* Twelve hours in education and psychology. Three hours.

**221 COUNSELOR-TEACHER-PARENT CONSULTATION** The consultative relationship in educational settings. *Prerequisites:* Education 220 and permission of instructor. Three hours.

**250 FOUNDATIONS OF REHABILITATION** Basic course in the Rehabilitation work. *Prerequisite:* Permission of instructor. Three hours.

**251 CASE MANAGEMENT IN REHABILITATION** Development of individualized programs and roles of the counselor as manager or coordinator of services are stressed. Emphasis placed upon systems of organization. *Prerequisite:* Permission of instructor. Three hours.

**258 COMMUNITY ORGANIZATIONS AND RESOURCES** Introduction to the range of clients served by Human Service Agencies and response patterns

typically initiated. **Survey of facilities** and services available. *Prerequisite:* Permission of instructor. Three hours.

**260 VOCATIONAL DEVELOPMENT AND PLACEMENT PROCESSES** Survey of occupational development theories with analysis of jobs and human resources potential to facilitate optional placements. Emphasis upon persons with special needs. *Prerequisite:* Permission of instructor. Three hours.

**264 EVALUATION IN EDUCATION AND SOCIAL SERVICES** This course is designed to acquaint educational and social service personnel with an overview of the state-of-the-art of evaluation, emerging concepts, related models and potential applications to settings requiring data to be systematically analysed. Twelve hours in education or permission of instructor. Three hours.

**266 EDUCATIONAL FINANCE** Consideration will be given to the National and State statutes and practices in Educational Finance and Taxation; local practices in taxation; other revenue sources; methods for school budgeting; and financial expenditure procedures. *Prerequisites:* Twelve hours in education or permission of instructor. Three hours.

**268 EDUCATIONAL LAW** Survey of the legal basis for Education. Investigations of the State and Federal statutes; related court cases; Attorney General opinions; Special Education procedures; Vermont State Board and State Education Department policies and regulations. *Prerequisites:* Twelve hours in education or permission of instructor. Three hours.

**291 SPECIAL TOPICS IN ORGANIZATIONAL AND HUMAN RESOURCE DEVELOPMENT** Designed to accommodate various special issues in counseling, administration and planning, social work, or higher education which are not appropriate to the content of an existing course. Courses will reflect the social services orientation of OHRD. Variable hours.

**305 MEDICAL INFORMATION FOR COUNSELORS** Emphasis upon disabilities; causes, diagnostic methodologies and employment implications, Basic anatomy, physiology and medical terminology. Clinical demonstrations. *Prerequisite:* Permission of instructor. Three hours.

**306 PSYCHOLOGICAL ASPECTS OF DISABILITY** Psychological impacts of disability upon the individual and family; factors affecting adjustment, vocational implications. *Prerequisite:* Permission of instructor. Three hours.

**319 INTERNSHIP IN REHABILITATION COUNSELING** Credit as arranged. *Prerequisite:* Permission of instructor.

**332 SEMINAR AND SIMULATION TRAINING IN ADMINISTRATION AND PLANNING** Provides an opportunity for the student to experience and apply selected administrative and planning concepts and skills in a simulated public school setting. Three hours.

**333 CURRICULUM CONCEPTS, PLANNING & DEVELOPMENT** An overview of conceptions of curriculum for elementary and secondary education; examination of contemporary curriculum trends and issues; processes for initiating, planning and developing curriculum activities and programs. *Prerequisites:* Twelve hours of education or permission of instructor. Three hours.

**335 STAFF EVALUATION AND DEVELOPMENT** Supervisory roles, behavior, responsibilities, and relationships in educational and social service organizations; processes for evaluating the performance and promoting the development of staff, and increasing organization effectiveness. Three hours.

**337 POLITICAL PROCESSES IN EDUCATION AND SOCIAL SERVICE ORGANIZATIONS** Political and operational relationships of social organizations to multiple publics and governmental bodies at the local, state, and national levels. Three hours.

**350 FOUNDATIONS OF THE HELPING PROCESS** Critical analysis of the various facets of counseling within the current cultural setting. Special emphasis upon goals of the helping process and their justification. *Prerequisite:* Twelve hours in education and psychology. Three hours.

**351 UNDERSTANDING INDIVIDUAL DIFFERENCES** Current and traditional techniques used to explore the psychology of individual differences and group assessment. Experience given in taking, administering, interpreting various tests; study project allows for application to any setting. *Prerequisite:* Twelve hours in education. Three hours.

**352 ANALYSIS OF EDUCATIONAL AND SOCIAL SERVICE ORGANIZATIONS** Organizations and open or closed systems; examination of goals, power and conflict, leadership and decision making, roles, communication; diagnosing causes of organizational problems; factors aiding and impeding organizational change. Three hours.

**353 SEMINAR IN ORGANIZATIONAL LEADERSHIP** Administrative roles, functions, and responsibilities in maintaining and changing organizations; hierarchical relationships; leadership styles and behavior appropriate for managing in contemporary and future organizations. Three hours.

**354 GENERAL AND SOCIAL SYSTEMS THEORY** General Systems Theory is analyzed in terms of its utility for examining social systems, macro-systems analysis of research, planning, and interdisciplinary dialogue. Three hours.

**355 SYSTEMS ANALYSIS AND PLANNING** An analysis of and experience with planning theories and techniques that derive from General Systems Theory. Three hours.

**356, 357 SEMINAR IN FUTURISM AND PLANNING** Knowledge, values, and attitudes relating to the concept of the future; ways of looking at the future; alternative futures, trend analysis, and goal setting; planning processes applied to educational and social service organizations. Six hours (each semester can be taken independently).

**358 SEMINAR IN COMMUNITY EDUCATION** The seminar participants will analyze the Community Education process, relate the process to community development, and develop strategies for the planning and implementation of Community-Education. Three hours.

**360 HIGHER EDUCATION IN AMERICA** A critical, contemporary overview of the American university in crisis. The American university will be examined from the perspectives of differing value positions, and the implications of these conflicting value philosophies for the theory and practice of higher education. Three hours.

**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:* Twelve hours in education, psychology, and sociology or related areas. Three hours.

**366 SOCIAL WELFARE AND SOCIAL WORK AS SOCIAL INSTITUTIONS** 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.

**368 LIFE STYLE APPRAISAL** A specialized technique for developing and understanding of an individual's subjective method of perceiving life events. Applications of the technique in various counseling modalities. Practice in the use of the technique. *Prerequisites:* EDOH 220, 374, and permission of instructor. Three hours.

**370 ELEMENTARY SCHOOL GUIDANCE** The development of counseling programs in the elementary school. Use of techniques appropriate to elementary school settings: classroom discussions, parent education, teacher consultation, appraisal techniques, etc. Emphasis placed on utilizing the total social milieu to enhance the development of positive self-concept in the child. *Prerequisites:* 220 and 350. Three hours.

**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. *Prerequisites:* Graduate standing, twelve hours in education and/or psychology, and permission of instructor. Three hours.

**381 COUNSELING FOR CAREER DEVELOPMENT** Psychology of career development with emphasis upon counseling for career decision-making within the current cultural context. *Prerequisite:* Graduate standing. Three hours.

**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 instructor. Three credits.

**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. *Prerequisites:* 374 and permission of instructor. Three hours.

**385 STUDENT DEVELOPMENT IN HIGHER EDUCATION** Purposes, organization, and administration of student personnel services in higher education. Focus on general practices, current research, and future trends within a human development framework. The various personnel services will be examined as they assist the student to grow and develop within the unique college culture and environment. An understanding of the role, objectives and philosophical assumptions of student development education will be provided. Three hours.

**386 ORGANIZATION AND HUMAN RESOURCE DEVELOPMENT** The concept and practice of organization development, analysis of and laboratory experience in the utilization of intervention methodologies. *Prerequisite:* One course relating to human relations and one course relating to organizations or equivalent (e.g., 220, 332, 352, 353, 355, 374, 383), or permission of instructor. Three hours.

**387 SEMINAR IN HIGHER EDUCATION** Designed for graduate students concentrating in programs in Higher Education. Analysis and discussion of current issues and problems in higher education. *Prerequisite:* Permission of instructor. One to three hours.

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

**389 COUNSELING PRACTICUM** Supervised practice in family counseling. *Prerequisites:* EDOH 388, permission of instructor.

*Education, Special — EDSP; Social Work — SOSE.*

Any questions concerning instructor and course structure should be addressed to the Chairperson.

**201 FOUNDATIONS OF SPECIAL EDUCATION** An examination of historical and current trends in the treatment of handicapped individuals, including the effects of litigation, legislation and economic considerations on educational and residential service delivery systems. *Prerequisite:* Twelve hours in education and related areas, or permission of instructor. Three hours.

#### **216 INSTRUCTION FOR MILDLY HANDICAPPED INDIVIDUALS I**

An introduction to curriculum for instruction of children with learning disabilities, mental retardation and behavior disorders with emphasis on objectives, assessment, task analysis, curriculum and evaluation. *Prerequisite:* Permission of instructor. Three hours.

#### **217 INSTRUCTION FOR SEVERELY HANDICAPPED INDIVIDUALS**

Individualized instruction for severely handicapped learners with emphasis on objectives, assessment, task analysis, curriculum and evaluation. *Prerequisite:* Permission of instructor. Three hours.

#### **224 INSTRUCTION FOR MILDLY HANDICAPPED INDIVIDUALS II**

Students apply principles of behavior analysis to improve academic and social skills of individuals with learning disabilities, mental retardation and behavior disorders. *Prerequisite:* Permission of instructor. Three hours.

**228 INSTRUCTION FOR SEVERELY HANDICAPPED INDIVIDUALS II**

Students apply principles of behavior analysis to improve skills in learners severely handicapped in motor, social, communication or self-care areas. *Prerequisite:* Permission of instructor. Three hours.

**290 CURRICULUM FOR HANDICAPPED INDIVIDUALS I** This course provides intensive study of that aspect of curriculum that constitutes the basic skills and knowledge to be learned at a given instructional level. The curriculum is specified in terms of instructional objectives and an evaluation system is developed to measure each learner's achievement. *Prerequisite:* Permission of instructor. Three hours.

**295 SPECIAL EDUCATION PRACTICA FOR ELEMENTARY CLASSROOM TEACHERS** Credit as arranged.

**296 SPECIAL EDUCATION PRACTICA FOR SECONDARY CLASSROOM TEACHERS** Credit as arranged.

**297 CURRICULUM FOR HANDICAPPED INDIVIDUALS II** Students develop and implement an objectives-based curriculum for learners with learning disabilities, mental retardation, behavior disorders and/or multi-handicaps. *Prerequisite:* Permission of instructor. Three hours.

**298 SPECIAL EDUCATION PRACTICUM** Students provide direct instruction for six learners with learning disabilities, mental retardation, behavior disorders and/or multi-handicaps. *Prerequisite:* Permission of instructor. Credit as arranged.

**301 CURRICULUM AND TECHNOLOGY IN SPECIAL EDUCATION** Development and application of procedures for curriculum analysis, curriculum sequencing, and assessment of learning disabilities, mental retardation, and behavior disorders. Sections will be offered in Essential Early Education, Elementary, Secondary and Intensive Special Education. *Prerequisites:* EDSP 216. Three hours.

**302 PHYSICAL AND DEVELOPMENTAL CHARACTERISTICS OF INDIVIDUAL WITH MULTI-HANDICAPS** Students will study normal development — birth through six years, developmental disorders and handicapping conditions, medical and health considerations for the multi-handicapped, and management of the multi-handicapped learner through the employment of appropriate handling and positioning, feeding and toileting procedures. *Prerequisite:* Permission of instructor. Three credits.

**310 CURRICULUM AND TECHNOLOGY IN SPECIAL EDUCATION** Development and application of procedures for curriculum analysis, curriculum sequencing, and assessment of learning for instruction of learners with learning disabilities, mental retardation and behavior disorders. *Prerequisites:* EDSP 216, 224, and permission of instructor. Three hours.

**312 ADVANCED BEHAVIORAL PRINCIPLES IN SPECIAL EDUCATION** A survey on behavior theory and research applications for learners with learning disabilities, mental retardation and behavior disorders. *Prerequisites:* EDSP 216, 224 and permission of the instructor. Three hours.

**316 SEMINAR IN SPECIAL EDUCATION** Students apply social psychology and learning theory to promote specialization of handicapped and nonhandicapped learners in integrated home, school and community settings. *Prerequisites:* EDSP 310, 312 or permission of instructor. Three hours.

**317 DESIGN AND EVALUATION OF EDUCATION FOR SEVERELY HANDICAPPED INDIVIDUALS** Students analyze and adapt curricula for the severely handicapped, utilizing knowledge of normal and abnormal motor development, feeding techniques, adaptive and prosthetic devices, medical aspects, parent/professional partnership, socialization and normalization, and legal aspects. *Prerequisites:* Permission of the instructor. Three hours.

**319 INTERNSHIP IN SPECIAL EDUCATION: THE TRIADIC MODEL OF CONSULTATION** Competency-based instruction in oral and written communication, consultation and workshop level training is provided. *Prerequisites:* EDSP 310, 312 or permission of instructor. Three hours.

**319 INTERNSHIP IN SPECIAL EDUCATION: SYSTEMS DEVELOPMENT** Competency-based instruction in identifying system-level needs. *Prerequisites:* EDSP 310, 312 or permission of instructor. Three hours.

**320 LABORATORY EXPERIENCE IN EDUCATION: EDUCATIONAL PROGRAMMING FOR THE SEVERELY HANDICAPPED** Students identify and evaluate severely handicapped learners and demonstrate competency in handling, positioning and feeding. Additionally, they assess current skill levels and design educational programs, including objectives, teaching/learning procedures, evaluation and measurement. *Prerequisites:* Master's Degree or equivalent and permission of instructor. Three hours.

**382 TEACHING INTERNSHIP: SPECIAL EDUCATION COURSE DEVELOPMENT AND IMPLEMENTATION** Instruction in developing competency-based courses in special education for inservice teacher training is provided. Practicum involves team teaching with University Special Education Faculty. *Prerequisite:* EDSP 319 (6 hours) and permission of instructor. Six hours.

**382 TEACHING INTERNSHIP: ADVANCED SYSTEMS DEVELOPMENT AND MANAGEMENT IN SPECIAL EDUCATION** Competency-based instruction in developing and adapting technological programs for system-level change is provided. *Prerequisite:* EDSP 319 (6 hours) and permission of instructor. Three hours.

**382 TEACHING INTERNSHIP: MANAGEMENT OF LEARNING ENVIRONMENTS FOR THE SEVERELY HANDICAPPED** Implementation of data-based individualized education in one-to-one, small group and large group instruction for severely handicapped student(s) in special or regular classrooms, utilizing interdisciplinary input to enable learner(s) to achieve objectives, providing for individual needs, such as removal of architectural barriers, special dietary considerations and other medical problems, and training of other school personnel to implement or aid in educational programs. *Prerequisites:* EDSP 217, 290, 228 or permission of instructor. One to eight hours.

*Education, General — EDSS:*

Any questions concerning instructor and course structure should be addressed to the Chairperson.

**202 PHILOSOPHY OF EDUCATION** A critical examination of key beliefs and values which underlie such current philosophies of helping, e.g. phenomenological, behavioral, holistic, as these are practiced in a variety of educational and social service institutions. *Prerequisite:* Twelve hours in education and related areas. Three hours.

**203 THE ETHICS OF HELPING RELATIONSHIPS** The general objectives of the course will be to clarify the ethical dimensions of professional rights and obligations for educators, counselors, administrators, and other helping professionals. This course will examine selected ethical controversies currently facing the helping professionals. *Prerequisite:* Twelve hours in education and related areas. Three hours.

**204 SEMINAR IN EDUCATIONAL HISTORY: STRUGGLES FOR FREEDOM AND EQUALITY** Study of selected topics in history of education. Special attention to education in democratic and authoritarian social orders. Discussions of such topics as education of women, black heritage, and American higher education in transition. *Prerequisite:* Twelve hours in education and related areas or permission of instructor. Three hours.

**205 HISTORY OF AMERICAN EDUCATION** Educational principles and practices in the United States as they relate to the main currents of social history. Discussions will focus on key ideas of historic and contemporary significance. *Prerequisite:* Twelve hours in education and related areas or permission of the instructor. Three hours.

**206 COMPARATIVE EDUCATION** A cross-cultural examination of education and selected social services in several countries, e.g. China, U.S.S.R., England, and Tanzania. Ideology, social class, and social change are some of the themes to be explored. *Prerequisite:* Twelve hours in education and related areas. Three hours.

**209 INTRODUCTION TO RESEARCH METHODS IN EDUCATION AND SOCIAL SERVICES** Seminars and research projects will introduce the students to the methods of historical, descriptive, experimental, quasi-experimental, field studies, and survey research. Three hours.

**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:* Twelve hours in education and related areas. Three hours.

**212 CHILD AND ADOLESCENT DEVELOPMENT** A critical analysis of research and theoretical literature, with particular emphasis on cognitive, moral and self development of children and adolescents. Other issues involving youth, and processes for working with youths in various environments are examined. *Prerequisite:* Twelve hours in education. Three hours.

**213 STATISTICAL METHODS IN EDUCATION AND SOCIAL SERVICES** Introductory course covering the basic concepts of descriptive and inferential statistics. Topics include frequency distributions, measures of central tendency and hypothesis testing. Special emphasis will be placed upon the application of these concepts to educational situations. Three hours.

**236 PROFESSIONAL WRITING** Course will focus on problems in writing faced by professionals in human services settings. Students will write reports, critiques and reviews; analyze examples of published work in similar modes; a detailed critiques of their work. Three hours.

**238 TEACHING FOR GLOBAL AWARENESS** Focus on three important value issues — peace and the prevention of war, social and economic justice, and environmental harmony — and their relationship to global problems. Curriculum materials will be developed and shared. Ways of teaching about global

issues will be stressed and links made between local and global concerns. *Prerequisite:* Twelve hours of education and related areas. Three hours.

**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.

**252 SEMINAR IN AESTHETIC EDUCATION** A critical examination of aesthetic values in contemporary society. The aesthetic quality of natural and built environments with implications for present and future educational practice will be given special attention. *Prerequisite:* Twelve hours in education and related areas. Three hours.

**254 ANTHROPOLOGY OF EDUCATION** An introduction to ideas and research in cultural anthropology and its relationship to education, popular culture, and human services. An anthropological perspective on teaching, learning, and helping as these occur in selected American institutions. A cultural appraisal of media 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:* Twelve hours in education and related areas. Three hours.

**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:* Twelve hours in education and related areas. 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:* Twelve hours in education and related areas. Two to six hours. (EDSS, EDEL, EDSC, EDOH, EDSP, EDPE)

**295, 296, 297, 298 LABORATORY EXPERIENCE IN EDUCATION** Supervised field work designed to give students experience in specialized areas for their professional development. *Prerequisite:* Permission of instructor in the appropriate program area. Credit as arranged. (EDSS, EDEL, EDSC, EDMU, EDOH, EDSP, EDPE)

**319 INTERNSHIP FOR SPECIALIZED PERSONNEL IN EDUCATION** Students will undertake and approved internship in an institution which reflects the particular area of interest and needs of the student. *Prerequisite:* Permission of instructor. Credit as arranged. (EDSS, EDEL, EDSC, EDOH, EDSP, EDPE)

**333 CURRICULUM CONCEPTS, PLANNING AND DEVELOPMENT**  
See EDOH 333.

**382 TEACHING INTERNSHIP** Supervised teaching experiences on a full-time basis, with related seminars in teaching subject. *Prerequisite:* Permission of coordinator of Professional Laboratory Experiences, College of Education and Social Services. Three to eight HOURS. EDSS, EDEL, EDSC, EDOH, EDSP, EDPE)

**391 MASTER'S THESIS RESEARCH** Thesis topic must be approved by a faculty committee. Credit as arranged.

**397 PROBLEMS IN EDUCATION** Individual work on a research problem selected by the student in consultation with a staff member. *Prerequisites:* Twelve hours in education and related areas; endorsement by a sponsoring faculty member. Credit as arranged. (EDSS, ESEL, EDSC, EDOH, EDSP, EDPE)

*Education, Elementary — EDEL:*

Any questions concerning instructor and course structure should be addressed to the Chairperson.

**222 IMPROVEMENT OF READING INSTRUCTION IN THE ELEMENTARY 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 permission of instructor. Three hours.

**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 permission of instructor. Three hours.

**241 SCIENCE FOR THE ELEMENTARY SCHOOL** This course will examine a number of elementary school science programs including: Elementary Science Study (ESS), Science Curriculum Improvement Study (SCIS), Science: A Process Approach (AAAS), Environmental Studies (ES). Emphasis will be on the methods and materials relating to the construction and use of science units for children in grades K-6. *Prerequisites:* Twelve hours in education and related areas and permission of instructor. Three hours.

**242 MODERN TRENDS IN ELEMENTARY EDUCATION** Study of modern educational principles and practices in elementary schools. Emphasis will be on communication in the classroom, interaction between students and teachers, materials and emerging trends as they affect the school. *Prerequisite:* Twelve hours in education and related areas. Three hours.

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

**256 METHODS AND MATERIALS IN ELEMENTARY SCHOOL MATHEMATICS** 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:* Twelve hours in education and related areas. Three hours.

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

**271 KINDERGARTEN EDUCATION WITH LABORATORY EXPERIENCES** 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:* Twelve hours in education and related areas. Three hours.

**275 ANALYSIS OF READING AND RELATED LANGUAGE DIFFICULTIES** 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 permission of instructor. Three hours.

**276 LABORATORY EXPERIENCES IN READING AND RELATED LANGUAGE 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:* 275 or permission of instructor. Three to six hours.

**378 ADVANCED STUDY AND RESEARCH IN READING AND RELATED LANGUAGE ARTS** Survey of research, comparison and evaluation of emerging programs, design and development of projects in reading. *Prerequisite:* Fifteen hours in education including nine hours in the field of reading and language education, or permission of instructor. Three hours.

**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:* Fifteen hours in education including nine hours in the field of reading and language education or permission of instructor. Three hours.

#### *Education, Secondary — EDSC:*

Any questions concerning instructor and course structure should be addressed to the Chairperson.

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

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

**225 TEACHING SOCIAL STUDIES IN SECONDARY SCHOOLS** Includes multiple teaching modes, questioning techniques, micro-teaching laboratory, analysis of historical content to determine students, prerequisite cognitive skills and processes for construction of historical scenarios. *Prerequisite:* Twelve hours of education and related areas. Three hours.

**227 TEACHING SCIENCE IN SECONDARY SCHOOLS** Consideration of science curricula for grades 7-12. Opportunity for study will be provided in: BSCS, IMB, IME, IET, IPS, PSII, CHEM, CBA, IIS, PSSC, HPP, ECCP, TSM, ESS, ISCS, and locally developed minicourses. The following is a representative listing of topics to be examined: teaching science as problem- solv-

ing, research in science teaching, evaluation strategies, instructional techniques, and affective education through science. *Prerequisites:* Twelve hours in education and related areas, and permission of instructor. Three hours.

**294 SEMINAR FOR PROSPECTIVE TEACHERS OF COMMUNICATION** See Communications 294.

**303-304 PROBLEMS AND RESEARCH IN TEACHING SECONDARY SCHOOL ENGLISH** See English 303-304.

*Education, Music — EDMU:*

Any questions concerning instructor and course structure should be addressed to the Chairman of the Music Department.

**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. *Prerequisite:* An undergraduate major in music education or permission of instructor. Three hours.

**243 RECENT TRENDS IN MUSIC EDUCATION** Study of recent thought and practices in music education. Examination of current trends. *Prerequisite:* An undergraduate major in music education or permission of instructor. Credit variable, one to four hours.

**253 PRACTICUM IN MUSIC EDUCATION** Current methodology in music education for music specialist and classroom teacher. Each year the emphasis will be in a different area of concentration. *Prerequisites:* An undergraduate major in music education or elementary education and teaching experience or permission of instructor. Credit variable. Course may be taken for one to four hours each semester and may be repeated for a maximum of eight hours of credit.

**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.

**390 ORGANIZATION AND ADMINISTRATION OF MUSIC EDUCATION** Study of the organization and administration of vocal and instrumental music in the public schools. *Prerequisites:* Graduate standing in music education and teaching experience or consent of instructor. Three hours.

*Education, Physical Education — EDPE:*

Any questions concerning instructor and course structure should be addressed to the chairperson.

**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. Includes scheduling, budgeting, management, equipment, policy, and public relations. *Prerequisite:* Twelve hours in education and related areas. Three hours.

**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:* Twelve hours in education and related areas. Three hours.

**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:* EDPE 116 or equivalent. Three hours.

**240 PRINCIPLES OF MOTOR LEARNING AND HUMAN PERFORMANCE** Principles of motor learning as they relate to teaching physical education and coaching athletics. A study of the nature of motor learning; factors affecting motor learning; concepts of transfer and retention; alternatives in teaching and coaching methodologies based upon applied principles in motor learning. *Prerequisites:* EDSS 145 or 145 and EDPE 166. Three hours.

**241 SEMINAR IN PHYSICAL EDUCATION AND ATHLETICS** An examination and analysis of contemporary issues and trends in physical education and athletics. Designed so that its content and structure may accommodate special issues in education and sport not especially appropriate within the boundaries of an existing course. Variable credit(2-4 hours).

**253 CURRICULUM DESIGN IN PHYSICAL EDUCATION AND HEALTH** The role of health education and physical education in the comprehensive school curriculum. Philosophy and techniques of curriculum innovation. Emphasis upon interrelationships that exist between student needs and interests, teaching methodology, evaluative procedures, community involvement and administrative organization patterns. *Prerequisites:* EDPE 46, 104, 105 or 155. Three hours.

**260 ADAPTIVE PHYSICAL EDUCATION** Recognition, prevention and correction of functional and structural deviations from normal body mechanics. Special emphasis given to the organization of programs adapted to the needs of physically, emotionally and mentally handicapped individuals in both special class and mainstreamed settings. *Prerequisites:* EDPE 104, 105, 155 or equivalent. Three hours.

#### *Library Science — EDLS:*

Within the Teacher Education Program Area, it is possible to concentrate in school library media. Inquiries should be directed to Professor H. Lang.

**272 PUBLIC AND SCHOOL LIBRARY SERVICES** *Prerequisite:* Twelve hours in education and related areas, or permission of instructor. Three hours.

**273 CATALOGING AND CLASSIFICATION** *Prerequisite:* EDLS 272 or equivalent. Three hours.

**274 REFERENCE MATERIALS AND TEACHING THE USE OF LIBRARIES** *Prerequisite:* EDLS 272 or equivalent. Three hours.

**275 SELECTION OF BOOKS AND MATERIALS FOR YOUNG ADULTS** *Prerequisite:* EDLS 272 or equivalent. Three hours.

**276 REFERENCE SOURCES AND SERVICES** *Prerequisite:* EDLS 274. Three hours.

**277 LIBRARY MATERIALS AND SERVICES FOR MEDIA PERSONNEL** *Prerequisites:* EDLS 272, 273. Three hours.

**278 CATALOGING AND ORGANIZATION OF MEDIA MATERIALS** *Prerequisite:* EDLS 273.

**279 SELECTION OF LIBRARY MATERIALS FOR CHILDREN** *Prerequisite: EDLS 272 or equivalent. Three hours.*

### ADDITIONAL GRADUATE COURSES

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

**209 EDUCATION OF TEACHERS OF THE MENTALLY RETARDED I - EARLY YEARS** *Variable credit. Three to six hours.*

**210 EDUCATION OF TEACHERS OF THE MENTALLY RETARDED II - LATER YEARS** *Variable credit. Three to six hours.*

**214 THE SLOW LEARNER (EXCEPTIONAL CHILD WITH LEARNING DISABILITY)** *Three hours.*

**215 THE GIFTED CHILD** *Three hours.*

**218 WORKSHOP IN CURRICULUM (EDSS, EDEL, EDSC, EDOH, EDSP, EDPE)** *Variable credit. One to four hours.*

**219 WORKSHOP IN ECONOMIC EDUCATION** *Four hours.*

**228 LITERATURE IN THE JUNIOR-SENIOR HIGH SCHOOL CURRICULUM** *(Literary Criticism for Teachers). Three hours.*

**229 COMMUNICATIVE ARTS IN SECONDARY SCHOOLS** *(Teaching English in Secondary Schools). Three hours.*

**257 TEACHING MATHEMATICS IN SECONDARY SCHOOLS** *Three hours.*

**259 TEACHING FOREIGN LANGUAGE IN THE ELEMENTARY (Secondary) SCHOOL** *Three hours.*

**260 IMPROVEMENT IN TEACHING BOOKKEEPING AND BUSINESS SUBJECTS** *Three hours.*

**261 SEMINAR IN BUSINESS EDUCATION** *Three hours.*

**262 PRINCIPLES, PROBLEMS, AND TRENDS IN BUSINESS EDUCATION** *Three hours.*

**263 IMPROVEMENT IN TEACHING SECRETARIAL SUBJECTS** *Three hours.*

**264 BUSINESS EDUCATION CURRICULUM** *Three hours.*

**373 INDIVIDUAL TESTING** *Three hours.*

**380 PROFESSIONAL PROBLEMS IN EDUCATION (EDSS, EDEL, EDSC, EDOH, EDSP, EDPE)** *Three hours.*

**386 SOCIAL WELFARE AND SOCIAL WORK AS SOCIAL INSTITUTIONS** *Three hours.*

### ELECTRICAL ENGINEERING

*Professors Absher, Anderson, Evering, Handelsman, Lai, Mirchandani, Roth, Rush (Chairperson) and Williams; Adjunct Professor Kwan; Adjunct Associate Professors Koss and Whatley; Adjunct Lecturers Bullis and Ellis.*

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 en-

couraged 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, pattern recognition and communication theory.

### **PREREQUISITES 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) with at least 15 credit hours appropriately distributed in basic areas of study in the Electrical Engineering Department; thesis research (6-12 hours).

Although a thesis is normally required in the program leading to the M.S. in Electrical Engineering, for students having substantial professional level engineering experience or having written high-quality technical reports which can be submitted as evidence, the thesis may be waived, with departmental approval, in favor of additional courses.

### **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 42 credit hours in courses and seminars and 30 credit hours in dissertation. Normally, 12 additional credit hours in an area of specialization are found necessary. The language requirement for the Electrical Engineering Ph.D. program is comprised of the following: satisfactory passing of a reading proficiency examination in one foreign language. The selection typically shall be made from French, German, Japanese or Russian. The requirements specified under the Regulations of the Graduate College must also be met.

### **COURSES OFFERED**

**201 LINEAR SYSTEM THEORY(3-0)** Basic methods for analysis of systems and application to problems in electrical engineering. Modelling and analysis of both discrete and continuous-time linear systems in the time and frequency domains. Continuous-time and discrete-time Fourier transforms. Approximation and model reduction techniques using state-space methods. *Prerequisite:* Graduate standing in Electrical Engineering. Three hours. Mirchandani.

**202 NETWORK ANALYSIS (3-0)** Characterization of and computational methods for the analysis of linear and nonlinear circuits with emphasis on large-scale circuits. State variable, modified nodal and sparse tableau formulations.

Detailed transistor modelling for D.C., transient and steady-state analysis. Methods for determining sensitivity. *Prerequisites:* 171 and Math 124 or equivalent background. Three hours. Mirchandani.

**209 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:* 171. Three hours. Rush.

**231, 232 DIGITAL COMPUTER DESIGN** Hardware components and design. Hardware organization and realization. Design concepts and procedures illustrated through the design of a small instructional computer. Microprogrammed control units, memory organization, hardware realization of high-speed arithmetic operations. Interrupt and I/O systems, interfacing and inter-system communications. *Prerequisite:* Departmental permission. Three hours. Absher, Lai.

**233, 234 MICROPROCESSOR-BASED SYSTEMS AND THEIR APPLICATIONS (2-3)** Introduction to mini/microcomputers; description of major types of peripheral components; programming peripheral devices; interface designs of analog and digital systems to mini/microcomputers; principles of micro-programming; bit-slice-based microcomputers. *Prerequisites:* Departmental permission, CS 101 recommended, EE 233 for EE 234. Three hours. Williams.

**237 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. *Prerequisite:* Graduate standing or departmental permission. Three hours. Absher.

**238 COMPUTER APPLICATIONS TO DESIGN AND MANUFACTURING (3-0)** Computer hardware and software concepts. Basic and advanced APL (Program Language), practical computer applications in information management and process control. *Prerequisite:* Departmental permission. Three hours. Staff.

**239 COMPUTER ASSISTED DESIGN (2-0)** Circuit design, modeling and analysis via visual display computer terminals. Use of ASTAP system to analyze device characteristics and diffusion parameters. *Prerequisites:* 261 and departmental permission. Two hours. Staff.

**240 BOUNDARY VALUE PROBLEMS IN ELECTROMAGNETISM** Solution of classical problems of Electromagnetism using images, conformal mapping and separation of variables methods. *Prerequisite:* 141. Three hours. 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. Handelsman.

**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:* 174 or departmental permission. Three hours. Handelsman.

**261 SEMICONDUCTOR DEVICES AND MATERIALS I** Introduction to energy band theory and the effective mass concept. Effect of band structure on electronic properties of semiconductors. Transport of electrons and holes in bulk materials and across potential barriers. Homojunctions, heterojunctions and Schottky barriers. *Prerequisites:* Phys. 128, Math. 121. Three hours. Williams, Anderson.

**262 SEMICONDUCTOR DEVICES AND MATERIALS II** Operating principles of bipolar junction transistors and field effect transistors. Derivation of equivalent circuits. Applications to integrated circuits, charge-transfer devices, integrated injection logic. *Prerequisite:* EE 261. Three hours. Williams, Anderson.

**263 SOLID STATE PHYSICAL ELECTRONICS I (3-0)** Introduction to the physics of atoms and crystals through quantum and statistical mechanics. Application of these principles to semiconductor devices. *Prerequisite:* Physics 128. Three hours. Anderson.

**264 SOLID STATE PHYSICAL ELECTRONICS II (3-0)** Electronic properties of dielectric, magnetic and superconducting materials. Applications to devices. *Prerequisite:* EE 263. Three hours. Anderson.

**270 SIGNAL ANALYSIS (3-0)** General signal concepts. Random signals. Correlation techniques. Noise in linear systems. Wiener and Kalman filters for data smoothing and prediction. Spectral estimation. *Prerequisite:* 171 or equivalent. Three hours. Lai.

**275 ANALOG SIGNAL PROCESSING AND FILTERING (3-0)** Introductory filter concepts. Approximation techniques. Filter realizations. Design of practical filters. Switched capacitor filters. A/D and D/A converters. Processing and filtering of real-world signals. *Prerequisite:* 201 or 171 and 172 or equivalent. Three hours. Lai, Mirchandani.

**276 DIGITAL SIGNAL PROCESSING AND FILTERING (3-0)** Introductory digital signal concepts. Structure of digital filters. Design of digital filters. Use of FFT in signal processing and filtering. Hardware implementation. Applications to signal processing and filtering. *Prerequisite:* 275. Three hours. Lai, Mirchandani.

**277 ADVANCED TOPICS IN DIGITAL SIGNAL PROCESSING AND FILTERING (3-0)** Approximation methods in design of digital filters. Effect of finite word length. Two-dimensional signal sampling, transforms and digital filters. Hardware implementation. Application in signal processing. *Prerequisite:* 276. Three hours. Lai, Mirchandani.

**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 process control, biomedical engineering, communications, circuit design. *Prerequisite:* Graduate standing in Electrical Engineering or departmental permission. Three hours. Staff.

**295 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 problems, 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. Absher.

**314, 315 NONLINEAR SYSTEM THEORY** Analysis and synthesis of piecewise 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.

**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.

**365 OPTICAL PROPERTIES OF SOLIDS** Optical and optoelectronic properties of semiconductors. Applications to photodetectors, solar cells, light emitting diodes and lasers. *Prerequisites* EE 262, EE 242, Phys. 273. Three hours. Anderson.

**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:* Physics 342; 366 for 367. Three hours. Staff.

**378 SPECIAL TOPICS IN STATISTICAL COMMUNICATION AND RELATED 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. Lai.

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

**491 DOCTORAL DISSERTATION RESEARCH** Credit as arranged.

The following courses are offered infrequently but may be taught where sufficient student interest is demonstrated.

220 ELECTRONIC INSTRUMENTATION FOR SCIENTISTS Three hours.

235, 236 HYBRID COMPUTERS Three hours.

251 APPLICATIONS OF LINEAR ALGEBRA Three hours.

272 INFORMATION THEORY Three hours.

317, 318 THEORY OF OPTIMUM CONTROL SYSTEMS Three hours.

319, 320 SPECIAL TOPICS IN CONTROL SYSTEM THEORY Three hours.

345 ELECTROMAGNETIC ANTENNAS AND PROPAGATION Three hours.

372 ADVANCED COMMUNICATION ENGINEERING Three hours.

374 THEORY OF SIGNAL DETECTION Three hours.

376 CODING AND SIGNALING Three hours.

## ENGLISH

*Professors Bogorad, Broughton, Clark, (Acting Chairperson) Cochran, Eschholz, Howe, Jones, Long, Orth, Poger, Rosa, Rothwell, and Shepherd; Associate Professors Bradley, Dickerson, Edwards, Gutman, Hall, Huddle, Stanton (Director of Graduate Studies), and Thompson; Assistant Professors Biddle, Simone, Stephany, and Sweterlitsch.*

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 of the discipline.

### 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

The department also offers a program leading to the degree of Master of Arts in Teaching: See p. 23.

For MA and MAT: Eighteen hours in English, including 302, 311, and 318, and six additional hours in English or a related field. Also for MA: 371, six hours of thesis research, and reading knowledge of a foreign language, normally French or German.

*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**

At the 200 level, the Department of English offers four or five seminars each semester which are numbered as described below. The specified topics vary each semester, depending on the instructors assigned. However, over the normal course of a graduate student's program, every member of the department's graduate faculty will offer a seminar in his area of special interest and expertise. The range of such subjects covers the entire breadth of the discipline, from linguistics and folklore and criticism to the historical orientation to language and literature — from special studies in Old English or *Beowulf* to transformational generative grammar to Norman Mailer or post-structuralist criticism.

201, 202 Seminar in Language, Criticism or Rhetoric.

211, 212 Seminar in British Literature to 1660.

221, 222 Seminar in British Literature, 1660-1900.

231, 232 Seminar in Modern British Literature.

241, 242 Seminar in American Literature to 1900.

251, 252 Seminar in Modern American Literature.

261, 262 Seminar in Literary Themes, Genres or Folklore.

282 Seminar for Prospective Teachers of English. Grammar and language; literary interpretation and criticism; allied problems useful to teachers of English. 3 credit hours. Biddle.

301 STRUCTURE OF THE ENGLISH LANGUAGE A descriptive study of Modern American English. Three hours. Clark.

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

311 CHAUCER Study of the principal works of Chaucer, with emphasis on Chaucer's literary scope, talents, and position in medieval literature. Three hours. A.I. Dickerson; Stephany.

318 MILTON Study of *Paradise Lost*, *Paradise Regained*, *Samson Agonistes*, minor poems, and selected prose works. Three hours. Bogorad.

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

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. *Prerequisites:* Permission by the executive committee and Dr. D. Kinnard 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.

**GRADUATE COLLEGE 301 SEMINAR IN COLLEGE TEACHING** Practical assistance to the beginning teacher in developing an effective, individual teaching style. Activities include analysis of approaches to teaching; discussion with faculty from various departments; micro-teaching exercises. *Prerequisites:* Graduate Teaching Fellowship and selection by department. Three hours. Holmes.

**GRADUATE COLLEGE 395 SPECIAL TOPICS** Workshop in the Social Sciences. Staff.

**TECHNOLOGY 201 SYSTEM DYNAMICS SEMINAR** Review of system-dynamics literature. Detailed study of conceptualization, paradigms, generic structures, validation and implementation. Term project and paper in field of interest of student are required. *Prerequisite:* TECH 101 Principles of System Dynamics. Three hours. Roth.

## FRENCH

Associate Professors Carrard, Crichfield, T. Geno, Julow, and Whatley (Chairperson); Assistant Professors Senecal, Whitebook, Wiley-Sandler; Lecturer M. Geno.

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 and African literature of French expression.

## 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, and in addition:

Plan A: Thesis research (six hours)

Plan B: In lieu of a thesis the candidate may write a series of master's essays with variable credit of up to three credits per paper (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. See p. 9.

## 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. For more detailed information on specific courses, consult with department chairperson and the course instructor.

### FRENCH LANGUAGE

**209 ADVANCED GRAMMAR** Designed to help the student progress from an average workable knowledge of French grammar to a much more sophisticated level of speaking and writing French. Written and oral exercises are employed. Three hours. M. Geno.

**210 ROMANCE PHILOLOGY** Phonological and morphological development of French, Spanish and Italian from their Latin origins, with emphasis on study of existing documents. Permission of the instructor. Course will be taught in English. Three hours. Whitebook.

**215 METHODS OF TEXT ANALYSIS** An introduction to procedures and terminology used in the analysis of texts of various genres. Three hours. Carrard.

**216 STYLISTICS** On a comparative basis, study of the main idiomatic difficulties faced by English-speaking people who learn French; translation; analysis of the various "levels of speech" in French, with their stylistic features. Three hours. Carrard.

### FRENCH LITERATURE AND CIVILIZATION

**225, 226 MEDIEVAL FRENCH LITERATURE (1100-1500)** Lectures and readings on aspects of Medieval culture, history, philosophy, and their relation to the literature of the period. *Prerequisite:* 225 for 226. Three hours. Whitebook. Alternate years, 1981-82.

**235 16TH CENTURY FRANCE: A WORLD IN TRANSITION** The 16th Century as a pivotal era between medieval and modern society, focusing on literary and esthetic movements, related to their historical and social contexts.

Texts presented will illustrate the changing attitudes towards man and his place in the world. Three hours. Wiley-Sandler. Alternate years, 1981-82.

**236 THE DEVELOPING RENAISSANCE IN FRANCE** The cultural, historical, social and esthetic origins of Renaissance ideals, their development through the years 1530-1560, the breakdown of their influence, and some of their lasting effect in French thought. Among the topics to be covered: Humanism, the Italian influence, classical models and imitation, educational reforms, women writers, Rabelais, Du Bellay, Sceve, Ronsard, Montaigne. Three hours. Wiley-Sandler. Alternate years, 1981-82.

**245 THE BAROQUE AGE, 1600-1650** A study of the literature after France's religious civil wars, up to the triumph of Classicism. Readings may include religious, lyric and political poetry; idealistic, picaresque and fantastic novels; Corneille and Rotrou; the *Pensees* of Pascal. Three hours. Whatley. Alternate years, 1980-81.

**246 17TH CENTURY** Selected works of the Century with emphasis on Corneille, Racine and Moliere. Three hours. Julow. Alternate years, 1980-81.

**255 18TH CENTURY LITERATURE** Readings in writers of the early 18th century such as Bayle, Fontenelle, Montesquieu, Marivaux, Prevost, Voltaire. Topics to be treated might include the impact of the new science on thought and art; the reflection in literature of new social types; the "pursuit of happiness"; the early evolution of the novel. Three hours. Whatley. Alternate years, 1981-82.

**256 18TH CENTURY LITERATURE** Readings in writers such as Rousseau, Diderot, Laclos, Bernardin de Saint-Pierre, Sade: the literature of the generation before the Revolution. Topics to be treated might include the attempts to define "natural man"; the relationship between the arts and morality; the relationship between liberty and libertinism. Three hours. Whatley. Alternate years, 1981-82.

**265 THE ROMANTIC PERIOD** Major figures, themes and tenets of the Romantic movement, including Chateaubriand, Madame de Stael, Hugo, Balzac, Stendhal, Constant, Musset, Vigny. Topics may include the revolt against Classicism, the Romantic view of nature, and the *roman d'analyse*, among others. Three hours. Crichfield. Alternate years, 1981-82.

**266 THE SECOND EMPIRE THROUGH 1900** The rise of modern literary Realism, Naturalism, Symbolist poetry, Decadence. Authors will include Flaubert, Zola, Maupassant, Baudelaire, Verlaine, Rimbaud, Mallarmé, Huysmans. Topics may include the image of *la bourgeoisie*, the theme of Paris vs. *la Province*, Symbolism and Impressionist painting and music, the influence of Positivism on the novel, and others. Three hours. Julow. Alternate years, 1981-82.

**275, 276 TWENTIETH CENTURY LITERATURE** Selected topics, dealing with poetry and/or narrative related either to an historical period or a literary movement. Subjects may include the novel in the *entre-deux-guerres*, politics and the novel, World War II and literature, Surrealism, the literature of existentialism, the new novel, the development of modern poetry (1870-1940), etc. Each may be repeated up to six hours. Three hours. Carrard. Alternate years, 1980-81.

**277 TOPICS IN 20TH CENTURY FRENCH THEATRE** Subjects may include 1) le theatre traditionnel: Claudel, Sartre, Giraudoux, Salacrou, Anouilh, (2) le theatre "de l'absurde": Ionesco, Beckett, Genet, Arrabal, (3) le theatre dela marge: Ghelderode, Pinget, Vian, Shehade, Audiberti, (4) la vision totale: a combination of all the above. Each may be repeated up to six hours. Threehours. T. Geno. Alternate years, 1980-81.

**285 FRENCH CANADIAN LITERATURE** A study of fiction and poetry from 1835 to 1940. Three hours. Senecal. Alternate years, 1980-81.

**286 FRENCH CANADIAN LITERATURE** A continuation of 285, encompassing fiction, poetry and theatre from 1940 to 1975. Three hours. Senecal. Alternate years, 1980-81.

**289 AFRICAN LITERATURE OF FRENCH EXPRESSION** A study in La Francophonie drawing our attention to Africa by way of the Antilles and the USA. A survey of oral literature, poetic expression, theatrical expression and the novel seen through the culture and civilization of Africa's past and present and through the influence of France's colonial empire. Authors studied will include Senghor, Damas, Cesaire, Fanon, Diop, Oyono, Kane. Three hours. T. Geno. Alternate years, 1980-81

**291 CIVILIZATION OF FRANCE** A study of the geographical, political, social, economic and intellectual development of France from the Middle Ages to the present. Three hours. M. Geno.

**293 FRENCH CANADIAN CIVILIZATION** A sociocultural study of the French civilization of Canada. Three hours. Senecal. Alternate years, 1981-82.

**295, 296 ADVANCED SPECIAL TOPICS**

**297, 298 ADVANCED READINGS AND RESEARCH**

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

## GEOGRAPHY

*Professors Gade, Miles, and VanderMeer (Chairperson); Associate Professors Barnum, Lind, and Meeks; Assistant Professors Bodman, and Ryerson.*

Faculty research interests include most systematic aspects of geography, especially from an historical perspective. Technique interests are in cartography, remote sensing, and quantitative methods. Regional interests and field experiences are almost world-wide in scope.

## 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 aptitude portion of the Graduate Record Examination.

## MINIMUM DEGREE REQUIREMENTS

Twenty-one hours in approved geography courses including six hours of work on

a thesis or two research papers; nine additional hours in geography or related fields; a thesis or two research papers. For additional information, please write to The Graduate Program Coordinator, Department of Geography.

The Department also offers a program leading to the degree of Master of Arts in Teaching: See p. 9.

## 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 three additional hours in geography, history, or other social science. Three hours. Miles.

**202, 203 HISTORICAL GEOGRAPHY OF EUROPE** (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:* Six hours in geography or history. Three hours. Barnum.

**211 FIELD GEOGRAPHY** Field studies using the state and local area as an outdoor laboratory to indicate lines of geographic inquiry and demonstrate methods and techniques of investigation into the human use of the earth. *Prerequisite:* Six 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. *Prerequisite:* Nine hours in geography or biology. Three hours. Gade.

**221 SPECIAL TOPICS IN REGIONAL GEOGRAPHY** Specialized study of a particular region or parts thereof. *Prerequisites:* Twelve hours in the social sciences including three in geography and departmental permission. Three hours. Staff.

**231 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 resource significance. *Prerequisite:* Six hours in geography including Geography 12. Three hours. Meeks.

**233 REGIONAL PLANNING** See Resource Economics 233.

**241 ADVANCED PHYSICAL GEOGRAPHY** Patterns and processes in the interactions between the earth, atmosphere, hydrosphere and biosphere; effects of human intervention in environmental systems. *Prerequisites:* 12 or 151, and advanced courses in geography, geology, or biological sciences, or permission of instructor. Three hours. Lind.

**243 SPATIAL ANALYSIS I** (Same as Resource Economics 243) Analysis of spatial pattern and interaction through quantitative models; introduction to measurement, sampling and covariation in a spatial framework. *Prerequisite:* Six hours in geography or other social sciences. Three hours. Bodman.

**244 SPATIAL ANALYSIS II** Probabilistic, normative and multivariate

models in analyzing problems of spatial structure and process; emphasis upon spatial diffusion, regional classification, spatial forecasting. *Prerequisite:* 243. Three hours. Bodman.

**246 URBAN GEOGRAPHY** Analysis of the morphology and function of cities. Consideration of urban growth and development, methods of classification, distribution, and theories of location. *Prerequisites:* 11; three additional hours in the social sciences. Three hours. Barnum, Bodman.

**247 TRANSPORTATION FLOWS AND NETWORKS** Growth, location, and structure of transportation networks; study of spatial flows and linkage patterns, development, and connectivity through analytical, descriptive, and theoretical models. *Prerequisite:* Six hours in geography or other social sciences. Three hours. Bodman.

**248 INDUSTRIAL LOCATION AND REGIONAL DEVELOPMENT** Classical and contemporary theories of location and measurement of spatial change; locational planning in developed and developing areas; problems of regional disequilibrium and growth strategies. *Prerequisite:* Six hours in geography or other social sciences. Three hours. Bodman.

**249 AGRICULTURAL GEOGRAPHY** World, national, and local rural land use patterns; landscape elements as they reflect prevailing and historic agricultural patterns; ecologic and social problems of agriculture. *Prerequisite:* Six hours in geography or other social sciences. Three hours. Meeks, VanderMeer.

**251 ADVANCED CLIMATOLOGY** Analysis of regional and local climatic data with special reference to climatic controls; special laboratory projects. *Prerequisite:* 151. Three hours. Lind, Ryerson.

**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 human factors as they bear on the structure and functioning of the modern political unit; the relationship between geopolitics and political geography. *Prerequisite:* Six hours in geography and political science. Three hours. Miles.

**261 REMOTE SENSING AND ENVIRONMENTAL PROBLEMS** (Same as Geology 219) Research projects in remote sensing; application of multispectral data for environmental studies. *Prerequisite:* 161 or permission of instructor. Three hours. Lind.

**262 CULTURAL GEOGRAPHY** (Same as Anthropology 262). Concepts and theories of cultural ecology, culture area, culture history and the cultural landscape. *Prerequisites:* 11 and six additional hours in geography, anthropology or other social sciences. Three hours. 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:* Three hours of geography. Three hours. Gade.

**271 ADVANCED CARTOGRAPHY** *Prerequisites:* 171 and permission. Three hours. Barnum, Ryerson.

**281 THE NATURE OF GEOGRAPHY** The history, philosophy and structure of modern geography. *Prerequisite:* Twelve hours in geography. Three hours. Staff.

295, 296 SEMINAR Selected topics in geography. *Prerequisite:* Six hours in geography. Three hours. Staff.

297, 298 SPECIAL TOPICS

381 ADVANCED READINGS AND RESEARCH Credit as arranged.

391 MASTER'S THESIS RESEARCH Credit as arranged.

## GEOLOGY

*Professors Hunt, and Stanley; Associate Professor Drake (Acting Chairperson); Assistant Professors Bucke, and Doolan; Visiting Assistant Professor Rahmanian; Adjunct Professors Ratte, and Hatch.*

Research programs are oriented in the following areas: Selected problems in mineralogy; crystal chemistry of amphiboles; petrogenesis of mafic schists and ultramafic intrusions in Vermont; metamorphic and structural evolution of Vermont, with emphasis on Northern Vermont; structural geology of sedimentary and metamorphic 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; sedimentary geology of western Vermont; glacial geology of Green Mountains and Champlain Lowland; problems in environmental geology. Interdisciplinary studies are available. Thesis topics should be in accord with faculty interests.

### **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 Calculus. Open to undergraduate majors in physics, chemistry, biology, engineering or mathematics who have accumulated 12 semester hours in geology. Satisfactory scores on Graduate Record Examination.

### **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. All students must complete successfully a course in field geology before graduation. This can be satisfied by Geology 238, a comparable course at another institution, recognized experience with a state survey, U.S. Geological Survey, and oceanographic institute, a geolimnological group or industry. Satisfactory completion will be determined by the Departmental Studies Committee.

### **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 SCIENCE IN TEACHING (GEOLOGY)

Thirty hours of course work that will strengthen the student's 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 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, See p. 9.

## COURSES OFFERED

**211 SEMINAR IN SEDIMENTARY PROCESSES** Selected readings and field studies emphasizing the interpretation of sedimentary deposits including transportation and geomorphology of ancient and recent sedimentary environments. *Prerequisite:* 155. Three hours. Rahmanian.

**212 SEMINAR IN SEDIMENTARY PROCESSES** Paleoenvironmental analysis of carbonate rocks including selected readings, field investigations, and petrographic studies. *Prerequisite:* 155. Three hours. Bucke.

**216 GLACIAL GEOLOGY** Quaternary history of North America with emphasis on the origin, mechanics and effects of past and present glaciations. *Prerequisite:* Geology 105; junior standing or above. Three hours.

**218 HYDROGEOLOGY** The origin, occurrence, movement, and character of ground water with particular emphasis on pump test methods. *Prerequisite:* Junior standing or above. Three hours.

**219 SPECIAL TOPICS IN REMOTE SENSING OF THE ENVIRONMENT** See Geography 261. Three hours. Lind.

**221 SOIL CLASSIFICATION AND LAND USE** See Plant and Soil Science 261. Three hours. Bartlett.

**235 ADVANCED STRUCTURAL GEOLOGY** Selected topics in analytical structure. *Prerequisite:* 166. Three hours. Stanley.

**237 STRUCTURAL ANALYSIS OF DEFORMED ROCKS** Elastic and ductile behavior of rocks. Fracture phenomena and analysis. Fold generation analysis. Stress and strain interpretation of deformational features in rocks and minerals. *Field work. Prerequisites:* 145, 166. Four hours. Stanley.

**238 FIELD GEOLOGY** Field mapping in Vermont. Methods of analysis of field data. Geological reports. Held in late summer. *Prerequisite:* 166 or departmental permission of instructor. Three hours. Stanley.

**240 PLATE TECTONICS** Development and current status of plate-tectonic concepts with applications to selected parts of the globe. *Prerequisites:* 156 or 166, permission of instructor. Three hours. Stanley.

**242a, b REGIONAL GEOLOGY** (a) Discussion of the geology of a selected

region of North America; (b) A 4 week summer field trip to the area in question. *Prerequisites:* 105, 111; 242a for 242b. Four hours.

**245 GEOLOGY OF THE APPALACHIANS** Origin of mountain belts; Appalachian mountain system discussed in terms of sedimentation stratigraphic, structural, tectonic and petrologic processes active in modern continental margins. *Prerequisites:* 105, 111, Junior standing. Three hours. Doolan.

**250 ADVANCED MINERALOGY** Crystallographic, chemical, and physical properties of the common rock forming minerals. Laboratory stresses technique of mineral identification and analysis of mineral assemblages. *Prerequisite:* 111. Three hours. Doolan.

**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. Bucke.

**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. *Prerequisite:* 250, 155 or 156 or permission of instructor. Three hours. Drake.

**262, 263 SEMINAR IN PETROLOGY** Modern concepts of the evolution of igneous and metamorphic rocks. Emphasis directed toward application of petrologic concepts to interpretations of earth history and tectonophysics. *Prerequisite:* 156 or equivalent. Three hours. Doolan.

**270 INVERTEBRATE PALEONTOLOGY** Classification, geological distribution, evolution, paleoecology and morphology of major invertebrate fossil groups. *Prerequisite:* 121, or permission. Three hours. 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. *Prerequisites:* 155 or 42 and permission of instructor. Three hours. Hunt.

**275 GEOLOGY OF OIL AND GAS** Origin, migration and entrapment of petroleum. Geology and classification of source and reservoir rocks and traps. Methods of subsurface analysis of sedimentary rocks and basin analysis. *Prerequisite:* 155 or permission. Three hours. Rahmanian.

**277 STRATIGRAPHY** Study and interpretation of development and distribution of the sedimentary rocks. *Prerequisite:* 155. Three hours. Bucke.

**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 Mieder (Chairperson); Associate Professors Richel, and Scrase; Assistant Professors Doane, and Mahoney.*

Current research interests include East German literature; history of the German language; medieval literature; literature of the eighteenth, nineteenth and twentieth centuries; and folklore.

### 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

Thirty hours of graduate level courses including German 281, 282; 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: See p. 9. 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. *Prerequisites:* 101, 102 or the equivalent. Three hours. Mieder. Alternate years.

**203 DEVELOPMENT OF GERMAN INTELLECTUAL MOVEMENTS** A comprehensive survey of the history of ideas as a framework for the study of German literature. *Prerequisites:* 101, 102 or the equivalent. Three hours. Mahoney. Alternate years.

**204 COURTLY EPIC AND MINNESANG** Cultural background and major works of medieval classicism. *Prerequisite:* 101, 102 or the equivalent. Three hours. Mieder. Alternate years.

**205, 206 GOETHE AND SCHILLER AND THEIR TIME** Origin, development, characteristics and criticism of German Classicism. *Prerequisites:* 101, 102 or the equivalent. Three hours. Mahoney, Richel, Scrase. Alternate years.

**207 NINETEENTH CENTURY PROSE** Masterpieces of narrative prose by representative authors such as Kleist, Droste-Hulshoff, Stifter, Storm and Keller. *Prerequisite:* 101, 102 or the equivalent. Three hours. Mieder. Alternate years.

**208 NINETEENTH CENTURY DRAMA** Works by Kleist, Buchner, Grillparzer, Hebbel, Wagner and the early Hauptmann. *Prerequisites:* 101, 102 or the equivalent. Three hours. Richel. Alternate years.

**209, 210 THE TWENTIETH CENTURY** Selected works in poetry, prose

and drama by Brecht, George, Hauptmann, Hofmannsthal, Kafka, Thomas Mann, Rilke, and others. *Prerequisites:* 101, 102 or the equivalent. Three hours. Doane, Scrase. Alternate years.

221, 222 **ADVANCED COMPOSITION AND CONVERSATION** Guided version, 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. *Prerequisites:* 121, 122 or equivalent. Three hours. Doane, Mieder

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. *Prerequisites:* 121, 122 or the equivalent. Three hours. Mieder. Alternate years.

281, 282 **SEMINAR** Special readings and research. Three hours. Staff.

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

## HISTORIC PRESERVATION

*Chester H. Liebs, (Director); Professors Conrad, Hand, Haviland, Janson, Lipke, Sargent, Stout; Associate Professor True; Assistant Professor Power; Peter Thomas (UVM Contract Archeologist); Distinguished Visiting Faculty Eric N. DeLony, Maximilian L. Ferro, Margaret Garland, Kathlyn Hatch, Edmund Kellogg, Roger Lang, and Philip Marshall.*

An interdisciplinary graduate program leading to a Master of Science in Historic Preservation is offered by the History Department in partnership with the Department of Art, and with the cooperation of the Departments of Anthropology and Agricultural and Resource Economics, and the Environmental Studies Program. Enrollment is limited to a small number of qualified participants who are seeking an intensive, community-oriented educational experience which effects a balance between academic and professional training. As its underlying philosophy, the program recognizes the diverse contributions, both high-style and vernacular, that every generation has made to the built environment and views historic preservation as a form of management which keeps these contributions in balance. The program is designed to develop future leaders to help foster economic growth through the stewardship of historic resources and to provide a focus within northern New England for research on and public awareness of the region's outstanding built environment. The program publishes a news journal, *Possibilities*, on the built environment of Vermont and New Hampshire, is headquarters of the Society for Commercial Archeology, and cosponsors numerous special training workshops and a Historic Preservation Summer Institute.

### PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE IN HISTORIC PRESERVATION

1) A baccalaureate degree with a major in a preservation-related field such as architecture, architectural history, history, planning, business administration,

economics, engineering, interior design, law, or environmental studies. 2) Applicants must take the graduate record examination, the advanced test, if one exists, in their field of specialization, and submit a sample independent research paper, design project, or other evidence of preservation-related professional ability.

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

1) Thirty-six credit hours of course work. A minimum of eighteen credit hours (including an internship or thesis) must be taken in historic preservation. Participants are urged to choose electives that will fill in gaps in their previous training. 2) A comprehensive examination given during the third semester. 3) An internship in a preservation agency, or a written thesis. This may be undertaken upon completion of two or three semesters of concentrated course work. At the conclusion of the internship, an oral presentation describing work accomplished will be given before a jury of practicing professionals for evaluation. 4) Historic Preservation 201, 301, 302 and 303 or 304 are required courses for the degree. Students will also normally take History 351 (Proseminar in American Cultural History) and Art 207 (History of American Architecture) unless they have had sufficient backgrounds in these areas.

### **COURSES OFFERED**

**201 ARCHITECTURE AND THE ENVIRONMENT** (Same as Art 223) An introduction to the basic concepts and skills necessary to identify, document, and manage the nation's historic resources. Three hours. Liebs.

**202 SPECIAL TOPICS** Courses are offered yearly by visiting faculty under this number, in specialized areas of historic preservation, through the Division for Continuing Education. Current offerings include:

**CONSERVATION TECHNIQUES FOR HISTORIC STRUCTURES** An examination of the structural systems and materials most frequently found in historic resources and methods for their conservation. Techniques for the preservation of brick, stone, wood, plaster, metals, paints, etc., will be demonstrated. The problem of introducing new mechanical, electrical, and safety systems into existing structures without violating historical integrity will also be addressed. Three hours. Ferro.

**HISTORIC PRESERVATION: DEVELOPMENT ECONOMICS** A survey of the economic and financial aspects of real estate development which pertain to preservation and adaptive use including market studies and proformas. Course includes field trips and actual proposal development for underutilized historic properties. Three hours. Lang.

**HISTORIC PRESERVATION LAW** This course acquaints students with legal issues in the conservation of the built environment. Basic legal techniques for the protection of historic structures will be discussed including historic districts, protective legislation, easements and covenants. Participants will study the histories of court decisions significant in the development of American Historic Preservation Law. Three hours. Kellogg.

**HISTORIC PRESERVATION: COMMERCIAL ARCHEOLOGY** An ex-

ploration of the origin and evolution of the structures, signs and symbols of the recent past and techniques for their documentation and selective conservation. Field trips and a class project will supplement course work for a comprehensive look at the mid-20th-century built environment. Three hours. Liebs.

**301 HISTORIC PRESERVATION CONTEMPORARY PRACTICE** A detailed study of current historic preservation practice through field trips, seminars, with practicing professionals, and technical training in architectural taxonomy, environmental impact review, funding solicitation, and preservation agency administration. Six hours. Liebs, Hatch, and distinguished visiting lecturers.

**302 PRESERVATION ADVOCACY PROJECT** Third-semester graduate students apply developed professional skills to actual community preservation problems. Projects include strategy development, securing and allocating funds, research, advocacy, and implementation. Three hours. Liebs.

**303 INTERNSHIP** Participants will devote a semester to preservation within an appropriate institution or agency. Three hours. Liebs and Stout.

**304 MASTER'S THESIS RESEARCH** Credit as arranged.

**305 SPECIAL TOPICS** Credit as arranged.

**306 SPECIAL READINGS AND RESEARCH** Credit as arranged.

## HISTORY

*Professors Daniels, Davison, Evans (Emeritus), J. Felt, Hand, Metcalfe, (Chairperson), Schmokel, Schultz, Seybolt, Spinner, Steffens, and Stout (Director of graduate studies); Associate Professors Andrea, Hutton, Overfield, Stoler, and True; Assistant Professors Kenny, and Liebs (Director, Historic Preservation Program); Adjunct Professor Morrissey.*

Research interests include American history of the colonial, early federal, Civil War, and twentieth-century periods; American social and legal history; American foreign relations; American military history; Medieval Europe; the Renaissance and the Reformation; French history; English history (Tudor-Stuart and recent); twentieth-century German, Russian and Chinese history; the Communist movement and Soviet foreign policy; East European nationalism; Canadian history (including French Canada); Latin American history; African history; music history; history of science; and historic preservation. Two scholarly journals (*The American Review of Canadian Studies*, and *Chinese Education*) are edited by members of the History Department. For ancient history, see Greek and Latin.

## 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 ad-

vanced 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**

**Plan A:** Twenty-four hours in History, including thesis research (six hours), and History 301; six additional hours in History or a related field.

**Plan B:** Offered in cooperation with the Department of Art, the Cultural History/Museology option is a separate curriculum with different admissions and degree requirements leading to the degree of M.A. in History. It consists of a two year, thirty-six hour program, with the student usually electing an internship instead of writing a thesis.

The Department also offers a program leading to the degree of Master of Arts in Teaching (See p. 23). Satisfactory scores on the Graduate Record Examination are prerequisite for acceptance to candidacy for this degree.

### **COURSES OFFERED**

**201 HISTORICAL GEOGRAPHY OF THE UNITED STATES** Same as Geography 201.

**202 HISTORICAL GEOGRAPHY OF EUROPE** Same as Geography 202.

**210, 211 SEMINAR IN HISTORY OF TRADITIONAL SOCIETIES** Three hours.

**220, 221 SEMINAR IN HISTORICAL METHODS, HISTORIOGRAPHY, HISTORY OF IDEAS** Three hours.

**222 SEMINAR IN COMPARATIVE HISTORY** Three hours.

**230, 231 SEMINAR IN THIRD WORLD HISTORY** Three hours.

**250, 251 SEMINAR IN MODERN EUROPE** Three hours.

**261 SEMINAR IN VERMONT HISTORY** A topical approach to the Vermont experience through original research utilizing primary sources available at the University of Vermont, the Vermont Historical Society and the Vermont State Library. *Prerequisites:* History 71 and permission of instructor. Three hours. Hand.

**270, 271 SEMINAR IN AMERICAN STATESMEN** Thought and practical politics of American statesmen. First semester: 1783-1865; second semester: since 1865. Three hours. Schultz.

**278 SEMINAR IN FOREIGN POLICY OF THE USSR** (Same as Political Science 278) An historical topical study of Soviet foreign relations since 1917, including the international Communist movement and ideological, economic, and strategic aspects. Three hours. Daniels.

**280, 281 SEMINAR IN EARLY AMERICAN HISTORY** Three hours. Stout.

**282, 283 SEMINAR IN MODERN AMERICAN HISTORY** Three hours.

284 SEMINAR IN CANADIAN HISTORY Three hours.

285 SEMINAR IN FRENCH CANADA Three hours.

300 GRADUATE TUTORIAL Readings and research in a specific area; topics to be individually arranged; attendance in appropriate undergraduate courses may be required (see undergraduate catalog). *Prerequisite:* Permission of instructor. Variable credit. Staff.

301 INTRODUCTION TO GRADUATE STUDY IN HISTORY A pro-seminar required of all entering candidates for the M.A. in history. Study of historical method, philosophy of history, and the history of history writing. Each student will prepare and report on an individual research paper in the prospective area of his/her master's thesis, in consultation with a member of the department specializing in that area. Three hours. Staff.

351 PRO-SEMINAR IN AMERICAN CULTURAL HISTORY Intended mainly for students in Cultural History/Museology or Historic Preservation, but open to other graduate students. Three hours. Stout.

379 INTERPRETATIONS OF AMERICAN HISTORY An intensive reading course covering the major periods and events in America from the Revolution to the Cold War. Three hours. Hand and Staff.

380 INTERPRETATIONS OF EUROPEAN HISTORY An intensive reading course covering the major periods and events in Europe from the Renaissance to the Cold War. Three hours. Overfield and Staff.

391 MASTER'S THESIS RESEARCH Required of all candidates for the M.A., except Cultural History students. Normally arranged for two semesters at three hours each.

393 INTERNSHIP For students in the Cultural History program who opt for "Plan B", the non-thesis option for the M.A. in History. Supervised practicum in an appropriate agency or institution, to be individually arranged. Three or six hours. Liebs and Stout.

397 SPECIAL READINGS AND RESEARCH Directed individual study of areas not appropriately covered by existing courses. Variable credit.

## HUMAN NUTRITION AND FOODS

*Associate Professors Livak and Schlenker; (Acting Chairperson) Assistant Professors Ross, Soule, and Tyzbir; Instructor F. Emanuel; Lecturer Guild and Adjunct Assistant Professor Stowell.*

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

An undergraduate major in nutrition or a related field. Satisfactory scores on the Graduate Record Examination.

## MINIMUM DEGREE REQUIREMENTS

Thirty hours, of which twenty-one hours of graduate credit including thesis research (6-15 hours) must be earned in the field of specialization; nine hours may be selected from minor subjects of which a course in statistics is recommended.

## COURSES OFFERED

**235 RECENT ADVANCES IN FOODS AND NUTRITION** Interpretation, application and communication of trends in foods and nutrition as evidenced through literature and research. May be taken more than once for a maximum of twelve hours. *Prerequisites:* Twelve hours in foods and nutrition and permission of instructor. Three hours.

**236 INTRODUCTION TO FOOD RESEARCH** Independent laboratory study of problems in food analysis, preparation, processing or product development. *Prerequisites:* 135 and a course in biochemistry with laboratory. Three hours.

**237 READINGS IN FOOD** Critical survey of the literature on the recent developments in food research. *Prerequisite:* 135. Two or three hours.

**239 INSTITUTIONAL ORGANIZATION AND MANAGEMENT** Institutional organization and management; personnel policies; laws and regulations; promotion and advertising. *Prerequisites:* 138, 139, or equivalent. Three hours. Emanuel.

**240 METHODS IN NUTRITION EDUCATION** Problems common to nutrition education in schools hospitals, and community. Individual investigations selected to meet special needs. *Prerequisite:* 3 hours in nutrition. Three hours. Soule.

**241 NUTRITION AND AGING** Study of the physiologic, psychologic, sociologic and economic factors which influence the nutrient requirements, nutritional status and food habits of older people. *Prerequisite:* 144. Three hours. Schlenker.

**242 ADVANCED NUTRITION** A study of nutrients and their specific functions in metabolic processes integrating cellular physiology, biochemistry and nutrition. *Prerequisites:* 3 hours in nutrition and a course in biochemistry and physiology. Three hours. Tyzbit.

**245 NUTRITIONAL BIOCHEMISTRY I** Comprehensive study of metabolism of carbohydrates, lipids and protein with emphasis on hormonal control, nutritional and metabolic interrelationships and dietary abnormalities (e.g. starvation and obesity). *Prerequisites:* 242 and permission of instructor. Three hours. Tyzbit.

**247 DIET THERAPY** Adaptations of the normal diet in conditions affected by or affecting the utilization of food. *Prerequisites:* 130, 144 and 242. Four hours. Ross.

### Addendum

The following information was omitted inadvertently from pages 117 and 119 of the 1980-81 Graduate College Catalogue.

#### Page 117

The Master of Science degree in Home Economics with concentrations in Early Childhood and Human Development (ECHD), Home Economics Education (HEED), and Human Nutrition and Foods (HNF) is offered at the University of Vermont. As a result of administrative modifications, the ECHD concentration is presently affiliated with the College of Education and Social Services while the latter two concentrations are affiliated with the College of Agriculture.

The faculty associated with the ECHD concentration include Professor Grams; Associate Professors Barbour and Shelton (Acting Chairperson); Assistant Professors Edwards, Goldhaber, and Jameson; and Lecturer Michael.

The faculty associated with the HEED concentration include Professor Fuller (Chairperson); Associate Professors Bloom, Harris, and Kelly; Visiting Associate Professor Albright; Assistant Professor Ferreira; Lecturers Carr, Mohler, and Osborne.

#### Page 119

The following courses apply to the HEED concentration:

258 PERSONAL AND FAMILY FINANCE The role of money and its management in planning, controlling and evaluating income, expenditures, investments and debts. Alternatives in relation to goals. Prerequisites: 56, Economics 11. Three hours.

259 FIELD EXPERIENCE IN CONSUMER ECONOMICS Application of skills developed in the Consumer Economics Program to a community situation for the purpose of encouraging individual growth and clarifying career goals. Prerequisites: 56, 158, 258 or permission of instructor. Three hours.

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.

397 PROBLEMS IN EDUCATION See Education 397. Credit to be arranged.



**249 NUTRITION SEMINAR** A review of recent developments in nutrition research. *Prerequisite:* Advanced nutrition courses and permission of instructor. Two hours.

**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. One to six hours.

**294 HISTORY OF NUTRITION** Foremost investigators and methods involved in the development of present day nutritional knowledge. *Prerequisite:* Three hours in nutrition. One hour.

**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.

**307 ADVANCED CONCEPTS IN NUTRITION** See Animal Science 307. Three hours.

**308 EXPERIMENTAL TECHNIQUES IN NUTRITION** See Animal Science 308. Two hours.

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

#### **ADDITIONAL COURSES (Home Economics)**

**221 COSTUME DESIGN AND DRAPING** Draping techniques in creative fashion design. Handling of fabrics in relation to line in dress. Original projects. *Prerequisites:* Three hours. Webster.

**253 INTERIOR DESIGN II** Interior design; period furnishing, its present use and influence upon modern furnishing. *Prerequisite:* 153. Three hours. Caldwell.

**260 FAMILY ECOSYSTEM** The family will be viewed in and as an environment for human development. The family ecological approach will be applied to practical family concerns. *Prerequisite:* Senior standing or permission of instructor. Three hours. Edwards.

**263 ADVANCED CHILD DEVELOPMENT** A survey of the professional literature in child development throughout the life cycle. *Prerequisite:* 80-81 or equivalent. Three hours. Goldhaber.

**264 CONTEMPORARY ISSUES IN PARENTING** Contemporary cultural factors that influence adult life-styles and their relationship to successful parenting. *Prerequisite:* Nine hours in human development or permission of instructor. Three hours. Jameson and Goldhaber.

**265 TEACHING HUMAN DEVELOPMENT** Designed for individuals who teach or plan to teach human development. Emphasis on group-building skills and interpersonal relationships. *Prerequisite:* 6 hours in Human Development and permission. Three hours. Barbour.

**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. *Prerequisite:* Junior standing; nine hours of human development or equivalent. Three hours.

**281 INFANCY** Development and rearing from conception to eighteen months and the relationship to subsequent development. *Prerequisite:* Nine hours in human development, nutrition, and physiology or biology or permission of instructor. Three hours. Shelton.

**290 INTRODUCTION TO RESEARCH** Research procedures with lectures and discussions of problem selection, objective, bibliographical techniques, and analysis of data. Two hours. Tyzbir.

**370 ADVANCED HOME ECONOMICS EDUCATION** A study of recent trends, philosophy and objectives in methods of teaching homemaking. Opportunity will be provided for individuals to work on problems related to their own situations.

## MATHEMATICS

*Professors Chamberlain, Cooke, Izzo, Meserve, Moser (Chairman), Riggs, Schoonmaker, Sylwester and Wright; Associate Professors Ashikaga, Burgmeier, Dwork, and Haugh; Assistant Professors Dinitz, Kadas, Margolis and Pence; Lecturers Johansson, Kost, Lawlor, Morency, and Puterbaugh. Research Assistant Professor Costanza.*

Current research interests include algebra, real and complex analysis, differential equations, probability and statistics, computer science, numerical analysis and computational linear algebra.

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.

## 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 must already have, or must acquire a knowledge of the content of the following courses: Mathematics 251, 331, 333, and 252 or 274. Also, students must satisfactorily complete at least four 300-level Mathematics courses, at least one each semester, and the seminar 382.

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

A bachelor's degree from an accredited institution and certification as a teacher of mathematics. Three years of experience teaching secondary school mathematics. Satisfactory scores on the Graduate Record Examination (aptitude portions.)

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

Thirty hours of course work in Mathematics, Statistics and Computer Science which will broaden and balance the undergraduate work in the mathematical sciences. Each student, in conference with his faculty advisor, will develop a program suited to his needs and background. Up to twelve hours of 100-level courses may be chosen if applicable. No thesis is required; each degree recipient must pass a written or oral comprehensive examination.

## **REQUIREMENTS FOR THE DEGREE MASTER OF ARTS IN TEACHING**

The department offers a program leading to the degree of Master of Arts in Teaching: (see page 9)

## **COURSES OFFERED**

207 a,b PROBABILITY THEORY See Statistics 251 a,b.

217 INTRODUCTION TO THE THEORY OF COMPUTING See Computer Science 241.

218 AUTOMATA THEORY Capabilities and limitations of finite state automata. Minimization, control and identification of machines. State-identification and fault detection experiments. Finite state recognizers and regular expressions. *Prerequisite:* 104. Three hours.

**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, Godel numbers, recursive undecidability, axiomatic set theory, ordinal numbers, the axiom of choice, effective computability, undecidable problems. *Prerequisites:* 102 or 104; 219 for 220. Three hours. Staff.

**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. Alternate years, 1980-81. Staff.

**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. *Prerequisites:* 151 or 207; 221. Three hours. Alternate years, 1980-81. Staff.

**223 INTRODUCTION TO FORMAL LANGUAGE THEORY** Introduction to the theory and applications of context-free languages. Phrase structure and context free grammars, normal forms, pushdown automata, decision problems, power series in non-commuting variable, applications to parsing. *Prerequisites:* 104, 217 and/or 218 highly recommended. Three hours. Staff.

**224 ANALYSIS OF ALGORITHMS** Models of computation, design of efficient algorithms. Integer and polynomial arithmetic. Sorting, binary search trees and adaptive merging. NP-complete problems. Parallel processing. *Prerequisites:* 104, 121 and CS 103. Three hours. Staff. Alternate years, 1981-82.

**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.

**236 CALCULUS OF VARIATIONS** Necessary conditions of Euler, Legendre, Weierstrass and Jacobi for minimizing integrals. Sufficiency proofs. Variation and eigenvalue problems. Hamilton-Jacobi equations. *Prerequisite:* 230. Three hours. Alternate years, 1981-82. Staff.

**237 NUMERICAL METHODS I** Concept of error, polynomial approximation, summation techniques, solution of equations, linear systems, eigenvalues. *Prerequisites:* 121, 124 and knowledge of computer programming. Three hours. Staff.

**238 NUMERICAL METHODS II** Finite differences, differentiation and integration, ordinary and partial differential equations, linear programming. *Prerequisite:* 237. Three hours. Staff.

**240 OPERATIONAL MATHEMATICS** Orthogonal functions, transforms and boundary value problems. *Prerequisite:* 230 or 271. Three hours. Staff.

**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 ALGEBRA** Fundamental concepts of Abstract Algebra. Sets, mappings, groups, rings, integral domains, fields, homomorphisms and isomorphisms. *Prerequisites:* 22; 102 or 104 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. *Prerequisites:* 124; 251 desirable. Three hours. Staff. Alternate years, 1981-82.

**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:* 104; 253 for 254. Three hours. Staff. Alternate years, 1981-82.

**255 ELEMENTARY NUMBER THEORY** Divisibility, prime numbers, Diophantine equations, congruence of numbers, and methods of solving congruences. *Prerequisite:* One year of calculus. Three hours. Staff.

**257 THEORY OF GROUPS** The study of the various kinds and structures of groups. *Prerequisite:* 251. Three hours. Staff. Alternate years, 1981-82.

**258 GALOIS THEORY** The study of Galois theory leading to the insolubility of general quintic equations by radicals and theorems on constructions with straightedge and compass. *Prerequisite:* 257. Three hours. Staff. Alternate years, 1981-82.

**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:* One year of calculus. Three hours. Izzo, Meserve.

**261 THE DEVELOPMENT OF MATHEMATICS** The historical development of the mathematical sciences is considered with an emphasis upon the interrelations among these sciences. Individual students are expected to emphasize the specific aspects of mathematics that are of interest to them at the level of abstraction that is compatible with their previous experience. *Prerequisite:* Nine hours of college mathematics. 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. Alternate years, 1981-82. 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:* 121. 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:* 230 or 271. Three hours. Staff.

**273 INTRODUCTION TO COMBINATORICS** Combinatorial relations, elementary problems of existence, enumerative combinatorics; generating functions and graphs. Applications to problems in probability, mathematics of computers, graph theory and number theory. No graduate credit for mathematics majors. *Prerequisite:* 104. Three hours. Staff.

**274 COMPUTATIONAL LINEAR ALGEBRA** Implementation on digital computers is stressed. Topics include examples of "real" problems leading to formulation of linear computational problems; efficient algorithms for Gauss elimination, Householder upper triangular and tridiagonal reduction, stable least-squares computations, eigenvalue computations, determination of conditioning and stability, solution of under and over-determined systems. *Prerequisite:* 124 or 271, modest experience with digital computer programming. Three hours. Staff. Alternate years, 1980-81.

**276 MATHEMATICS OF SPACE FLIGHT** Topics include orbit determination and prediction of natural and artificial satellites and projectiles. Astrodynamic coordinate systems and their transformations. Integration schemes and perturbation theory. Attitude determination. *Prerequisites:* 237 and modest experience with digital computer programming. Three hours. Alternate years, 1980-81. Riggs.

**295 SPECIAL TOPICS** Lectures, reports and directed readings on advanced topics as announced. *Prerequisite:* permission of instructor. Credit as arranged. Offered as occasion warrants. Staff.

**325 ADVANCED AUTOMATA THEORY** Algebraic structure theory of automata, monoids, semigroups and semiautomata; homomorphisms, simulation and realization. Decomposition theory, including permutation and reset machines. Topics of current interest in complexity of automata. *Prerequisite:* 218. Three hours. Alternate years, 1980-81.

**330 ADVANCED ORDINARY DIFFERENTIAL EQUATIONS** Linear and non-linear systems, approximate solutions, existence, uniqueness, dependence on initial conditions, stability, asymptotic behavior, singularities, self-adjoint problems. *Prerequisite:* 230. Three hours. Alternate years, 1980-81. Wright.

**331 THEORY OF FUNCTIONS OF COMPLEX VARIABLES** Differentiation, integration, Cauchy-Riemann equations, infinite series, properties of analytic continuation, Laurent series, calculus of residues, contour integration, meromorphic functions, conformal mappings, Riemann surfaces. *Prerequisite:* 242. Four hours. Staff. Alternate years, 1980-81.

**332 APPROXIMATION THEORY** Interpolation and approximation by interpolation, uniform approximation in normed linear space, spline function, orthogonal polynomials. Least square, Chebychev approximations, rational functions. *Prerequisites:* 124, 238. Three hours. Staff. Alternate years, 1980-81

**333 THEORY OF FUNCTIONS OF REAL VARIABLES** The theory of Lebesgue integration, Lebesgue measure, sequences of functions, absolute continuity, properties of  $L^p$  spaces. *Prerequisite:* 242. Four hours. Staff. Alternate years, 1981-82.

**335, 336 ADVANCED REAL 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:* 333; 335 for 336. Three hours. Alternate years, 1980-81. Dwork.

**339 PARTIAL DIFFERENTIAL EQUATIONS** Classification of equations, linear equations, first order equations, second order elliptic, parabolic and hyperbolic equations, uniqueness and existence of solutions. *Prerequisites:* 230, 242. Three hours. Alternate years, 1981-82. Staff.

**382 SEMINAR** Topical discussions with assigned reading. Required of MS degree candidates. One hour. Staff.

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

## MECHANICAL ENGINEERING

*Professor Emeritus Duchacek, and Martinek; Professors Francis, Hundal, (Acting Chairperson), Marshall, McLay, Outwater, Tuthill, and von Turkovich; Research Professor Pope; Associate Professor Carpenter; Adjunct Professor Liu; Adjunct Assistant Professor Taff.*

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; 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. Satisfactory scores on the Graduate Record Examination.

### **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 dissertation research. At least 40 credit hours must be earned in courses and seminars and a minimum of 25 credit hours must be earned in dissertation 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 dissertation 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. *Prerequisite:* 133. Three hours. Hundal.

**206 APPLICATION OF COMPUTERS IN ENGINEERING** Utilization of analog, digital and hybrid computers as an engineering tool for the solution of complex engineering problems. Three hours. Hundal.

**208 BIOMECHANICS** Application of principles of mechanics to biological systems with emphasis on human body. Mechanics of soft tissues, bones, muscles and biofluids. Kinematics and whole body dynamics. Biomaterials. Prosthetic devices. *Prerequisite:* Permission of instructor. Three hours. Pope, Hundal.

**211 ADVANCED MECHANICAL STRUCTURES I** Energy methods; topics in solid mechanics, introduction to elasticity. Three hours. McLay.

**222 ADVANCED MECHANICAL STRUCTURES II** Elasticity; matrix methods. Three hours. McLay.

**231 MATERIALS PROCESSING II** Fundamental theory of selected mechanical and thermal processing techniques with applications. *Prerequisites:* 131 or equivalent. Three hours. von Turkovich.

**232 MICROMANUFACTURING TECHNOLOGIES** Crystal growth, defects, diffusion mechanisms, theory and practice. Thin film processes, vacuum, chemical vapor deposition; selection of integrated circuit materials and processes; photolithography, interconnection technologies and packaging. Manufacturing engineering for semiconductors, plant and equipment aspects. Three hours. von Turkovich.

**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. *Prerequisites:* 142 and Mathematics 271. Three hours. Martinek.

**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 ratio phenomena as applied to boundary layer; transition and separation on various shapes; compressibility phenomena; the optimum airfoil; performance. *Prerequisite:* 142. Three hours. Martinek.

**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. *Prerequisite:* 135. Three hours. 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. *Prerequisite:* 261. Three hours. Tuthill.

**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. von Turkovich.

**281, 282 SEMINAR** Presentation and discussion of advanced mechanical engineering problems and current developments. *Prerequisite:* Graduate engineering enrollment. One hour. Staff.

**297 NUCLEAR ENGINEERING** Fission and fusion chain reactions; criti-

cality; neutron diffusion; fast and breeder reactors; design considerations and accident delineation; high pressure and boiling heat transfer; liquid metals; fuel-coolant interaction; transient phenomena; safety. *Prerequisite:* Senior or graduate standing. Three hours. Martinek, von Turkovich.

**301 ADVANCED ENGINEERING DESIGN ANALYSIS AND SYNTHESIS** Application of the fundamental concepts and principles of advanced mathematics, physics, mechanics, electricity, thermodynamics, fluid dynamics and heat transfer combined with decision-making processes to the design, analysis and synthesis of complex engineering systems. Four hours. von Turkovich.

**302 ENGINEERING ELASTICITY** Tensors, complex variables, variational methods. Four hours. 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. Four hours. 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 non-linear systems. *Prerequisite:* 202. Three hours. Hundal.

**309 ADVANCED ENGINEERING THERMODYNAMICS** Microscopic thermodynamics; Maxwell-Boltzmann, Bose-Einstein, Fermi-Dirac statistics; kinetic theory of gases; transport properties, compressed gases, liquids and solid states; chemical systems; irreversible processes; fluctuations. Three hours. 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. Three hours. 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. Three hours. Martinek.

**320 SPECIAL PROBLEMS IN ELASTICITY** Advanced topics in the theory of elasticity in which there is a particular student and staff interest. Three hours. McLay.

**322 SPECIAL PROBLEMS IN DYNAMICS** Advanced topics in dynamics in which there is a particular student and staff interest. Three hours. Martinek, von Turkovich.

**323 SPECIAL PROBLEMS IN THERMODYNAMICS** Advanced topics in thermodynamics in which there is a particular student and staff interest. Three hours. von Turkovich.

- 324 **SPECIAL PROBLEMS IN HEAT TRANSFER** Advanced topics in heat transfer in which there is a particular student and staff interest. Three hours. Martinek.
- 325 **SPECIAL PROBLEMS IN MATERIALS** Advanced topics in behavior of materials in which there is a particular student and staff interest Three hours. Outwater, von Turkovich.
- 330 **MATRIX METHODS IN STRUCTURAL DYNAMICS** · Matrices, eigenvalue problems, forced vibration, wave propagation. *Prerequisite:* 203. Three hours. McLay.
- 391 **MASTER'S THESIS RESEARCH** Credit as arranged.
- 491 **DOCTORAL DISSERTATION RESEARCH** Credit as arranged.

The following courses are offered infrequently but may be taught where sufficient student interest is demonstrated.

- 251 **TECHNOLOGY AND SOCIETY SEMINAR** Three hours.
- 303 **STRESS ANALYSIS (THEORY AND EXPERIMENT)** Three hours.
- 306 **CONTINUUM MECHANICS** Three hours,
- 321 **SPECIAL PROBLEMS IN FLUID MECHANICS** Three hours.

## MEDICAL MICROBIOLOGY

*Professors Johnstone, T. Moehring, Schaeffer (Chairperson), and Stinebring; Associate Professors Albertini, Boraker, Fives-Taylor, Gump, and Novotny; Research Associate Professor J. Moehring; Adjunct Professor Chapple; Adjunct Associate Professor Smith.*

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; T-lymphocyte antigen recognition; enzyme-antibody immunoassays; mechanisms of transmission of bacterial DNA; studies of infectious hepatitis and other viruses; studies of *in vitro* carcinogenesis; mechanisms involved in assembly of bacterial surface structures; the role of bacteria, fungi and viruses in pulmonary hypersensitivity diseases and chronic bronchitis; somatic cell genetics studies; studies of immunocompetence and tumor immunity in cancer bearing patients and isolation of fungal genes controlling incompatibility and development of recombinant DNA techniques.

## **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 15 and 16 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 381-384, Thesis Research; approved selected courses from among Medical Microbiology 203, 211, 220, 223, 302, 305, 325; Biochemistry 301-302, 303; passage of a comprehensive examination in Medical Microbiology and related subjects. Twenty-four hours of course credits and six hours of research credits are required. Chemistry 140 (Physical Chemistry for Biological Science Students) would be helpful but is not required.

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

Two years of biology; chemistry through physical chemistry (equivalent to Chemistry 1, 2, 123, 131, 132, 140 or 141, 142) mathematics through calculus; one year of physics (Physics 15 and 16 equivalent); additional courses required by the Department depending on the aims of the student.

## **MINIMUM DEGREE REQUIREMENTS**

Participation in seminars offered by the Department during residency of students; Biochemistry 301-302, 303; approved selected courses from programs in medical microbiology, biochemistry, microbiology and 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 dissertation research will be allowed for the degree.

**COURSES OFFERED**

**203 THE MAMMALIAN CELL IN BIOMEDICAL RESEARCH** Cellular and molecular biology of vertebrate cells in culture; principles and techniques of vertebrate cell, tissue and organ culture and their application to problems of current interest in cell biology and medicine, including: cell regulation, differentiation, senescence, cytogenetics and cell genetics, carcinogenesis, virology, and mechanisms of pathogenesis. Laboratory exercises provide practical experience in technique and methods of analysis as a foundation for the lectures. Application of techniques to one's own research is possible. Designed for biology students of varied training. *Prerequisite:* Permission of instructors. Four hours. T. Moehring, Schaeffer.

**211 MOLECULAR GENETICS I** Analysis of organization, replication, and expression of genetic material in procaryotes. The standard methods of bacterial and bacteriophage genetics, including the fundamentals of recombinant DNA technology are presented. *Prerequisite:* Permission of instructor. Three hours. Novotny.

**220 CLINICAL MICROBIOLOGY** A comprehensive study of human pathogenic micro-organisms and their disease states in man. The course deals with collecting and handling specimens, pathogenic bacteriology, medical mycology and virology. Laboratory sessions provide practical experience in handling and identifying these pathogens. *Prerequisite:* Microbiology 55 or its equivalent. Immunology recommended but not required. Four hours. Fives-Taylor.

**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. *Prerequisite:* Permission of 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. Primarily for medical students. *Prerequisite:* Departmental permission. Four hours. Staff.

**303 SPECIAL PROBLEMS IN MEDICAL MICROBIOLOGY** Supervised investigations in microbiology. Credit as arranged. Staff.

**305 PATHOGENIC BACTERIOLOGY** Studies of major species of pathogenic bacteria with emphasis on mechanisms of disease production, epidemiology, control measures and diagnosis. Designed for graduate students interested in the phenomenon of parasitism. *Prerequisite:* Permission of the instructor. Four hours. Stinebring.

**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. *Prerequisite:* Permission of department chairman. Three hours. Staff. Alternate years.

**330 SPECIAL TOPICS IN CELL TISSUE AND ORGAN CULTURE** This course is offered in association with the W. Alton Jones Cell Science Center located in Lake Placid, New York. It is designed for students enrolled in courses offered by the Center for which they wish to obtain graduate credit. Credits are variable but a maximum is placed at three credit hours.

**381 SEMINAR** Current problems in medical microbiology. One hour. Staff.

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

**491 DOCTORAL DISSERTATION RESEARCH** Credit as arranged.

## MEDICAL TECHNOLOGY

*Associate Professors Breen, Lachapelle (Chairperson), and Sullivan; Assistant Professors Fike, Page, and Reed; Instructors Czerniawski and Russell.*

The Department of Medical Technology offers a Master of Science degree with emphasis in the preparation of medical technology educators. The student may also concentrate in administration, clinical chemistry, clinical microbiology or the student may design a program which fulfills his/her needs.

Areas of research and interest: clinical enzymology; anaerobes; streptococcus identification; mycological techniques; hematological techniques; admission criteria; curriculum design.

In addition, various departments and facilities in the College of Medicine and Medical Center Hospital of Vermont offer other opportunities for research.

### 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

Medical Technology 381 (2 credits), thesis research (6 credits); six credits biochemistry lecture, such as Biochemistry 301, 302; six credits clinically related sciences; additional approved courses. In addition, a noncredit teaching practicum is required.

**COURSES OFFERED**

**381 SPECIAL TOPICS** Review and discussion of current areas of importance to students in medical technology. The seminar will emphasize administration, clinical pathophysiology and education. Selected topics are presented by the student with occasional supplemental discussions led by faculty members or guests. One hour per semester. Staff.

**391 MASTER'S THESIS RESEARCH** Credits as arranged. Staff.

**MICROBIOLOGY AND BIOCHEMISTRY**

*Professors Racusen (Chairperson), and Weller; Associate Professors Foote, and Sjogren; Assistant Professor Currier; Teaching Associate Husted.*

Research currently involves the identification and metabolism of plant proteins, the isolation and characterization of ribosomes, chemotaxis and root nodulation, the synthesis and regulation of isozymes in the glyoxylate bypass of fungi, and the role of microorganisms in aquatic environments. Members of our faculty participate in the interdisciplinary Cell Biology Program (see separate listing in this catalogue).

**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. Courses in microbiology and physical chemistry are 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**

One year each of a laboratory course in organic chemistry, physical chemistry, and biology, 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 Medicine).

**MINIMUM DEGREE REQUIREMENTS**

Biochemistry 301, 302, 303; satisfactory participation in biochemistry seminars during residency; advanced courses in chemistry (9 hours); 10 hours of courses other than biochemistry and chemistry; balance of course work from microbiology and biochemistry; and doctoral dissertation research (30 hours).

## MICROBIOLOGY PROGRAM

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

An undergraduate major in biological science, including several courses in microbiology and one year of organic chemistry. A course in biochemistry is strongly recommended.

### MINIMUM DEGREE REQUIREMENTS

Medical Microbiology 205, Microbiology and Biochemistry 381-384; thesis research (10-15 hours).

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

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 dissertation research twenty to thirty-five hours. This program is co-sponsored with Medical Microbiology.

### COURSES OFFERED

**201 GENERAL BIOCHEMISTRY** Broad coverage of biochemistry including principles of analytical biochemistry. *Prerequisite:* Chemistry 41 or 141. Four hours. Foote. Also offered each spring.

**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. Racusen.

**203 MOLECULAR BIOLOGY** The structure and biological function of nucleic acids, proteins, and enzymes. Emphasis is on optical, electrophoretic, and ultracentrifugal methods. *Prerequisite:* A semester of physical chemistry or permission of instructor. Four hours. Carrier.

**220 ENVIRONMENTAL MICROBIOLOGY** The activities of microorganisms, primarily bacteria, in air, soil, and water. *Prerequisite:* A previous course in microbiology. Four hours. Sjogren. Alternate years, 1981-82.

**254 MICROBIAL BIOCHEMISTRY** The chemical composition and metabolism of microbial cells. *Prerequisites:* 55, 201, or permission of instructor. Four hours. Sjogren. Alternate years, 1980-81.

**295 SPECIAL TOPICS** Lectures, readings, laboratory studies, or field trips. Format and subject matter at the instructor's discretion. Spring, summer, and fall. *Prerequisite:* Departmental permission. Credit to be arranged. Staff.

**301 SPECIAL PROBLEMS** *Prerequisite:* Departmental permission. Credit as arranged. Staff.

**381-384 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 DISSERTATION RESEARCH** Credit as arranged.

## MUSIC

*Professors Chapman, Lidral, T. Read, and Pappoutsakis (Emeritus); Associate Professors D. Kinsey, Schultz, and Wigness; Assistant Professors Ambrose, Brown, and Weinrich; Instructors Bigelow, Boyer, Dahl, Fleming, Karstens, E. Metcalfe, E. Read, Scoones and Storandt.*

### No Graduate Program Offered

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.

### COURSES OFFERED

**203, 204 ORCHESTRATION** Instrumental characteristics, arranging for orchestra; second semester: advanced orchestral scoring. *Prerequisites:* 116, 203 for 204. Three hours.

**205, 206 COUNTERPOINT** First semester: Tonal counterpoint; second semester: canon and fugue. *Prerequisite:* 116. Three hours.

**208, 209 FORM AND ANALYSIS** Creative approach to aural and sight analysis of musical construction. *Prerequisites:* 116; 205 recommended. Three hours.

**211, 212 CONDUCTING** Baton technique, score reading, laboratory practice; second semester: preparation and performance of selected scores, including score reading at the piano and rehearsal procedures. *Prerequisites:* 16; 211 for 212. Three hours.

**215, 216 COMPOSITION** Creative work in free composition according to the needs and capabilities of the individual student. *Prerequisites:* 205 and 208 or permission of instructor. May be repeated for credit. Three hours.

**245, 246 CHAMBER MUSIC LITERATURE** Study through analysis and performance of masterworks for small groups leading to public performance. *Prerequisites:* Twelve hours or the equivalent in performance field and permission of instructor. May be repeated for credit. One hour.

**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.

## NATURAL RESOURCES

Two Master of Science degree programs, one in the Department of Forestry and the other through the interdisciplinary Natural Resource Planning Program, are offered within the School of Natural Resources.

### FORESTRY

*Professors Hannah, John (Director), Reidel, and Whitmore; Associate Professors Armstrong, Donnelly, Forcier, and Newton; Assistant Professors Bergdahl and DeHayes; Lecturer Turner; Extension Assistant Professor Bousquet.*

The goal of this Master of Science Program is to provide graduate students with initial training as forest scientists or the opportunity to further their knowledge and proficiency in some specialized aspect of forest resource management. The faculty has research interests which span the broad areas of biometry, ecology and silvics, genetics, economics and management, pathology, policy and administration, silviculture, and utilization. A student's thesis research is often an integral part of on-going research projects in the Department.

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

Successful completion of a four-year forestry curriculum or a strong background of specified (by the Department) undergraduate forestry courses. Satisfactory scores on the Graduate Record Examination.

### MINIMUM DEGREE REQUIREMENTS

Advanced forestry and related courses (15-24 hours); thesis research (6-15 hours), and oral defense.

### NATURAL RESOURCE PLANNING

*Professors Cassell, John (Director), Reidel, and Sargent; Associate Professors Forcier, Hirth, Gilbert, LaBar, Lapping, and Lindsay; Assistant Professors Capen, Fuller, and Manning; Lecturer Flinn; Extension Instructor Marek.*

This interdisciplinary program prepares students for professional careers with public and private organizations engaged in various aspects of natural resource planning. Theoretical and practical education is offered in planning the location, development, and coordination of resource uses, services, and related facilities.

In addition to faculty members from the School of Natural Resources there is participation by faculty members from other departments, including Agricultural and Resource Economics, Civil Engineering, Geography and Sociology.

### PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE IN NATURAL RESOURCE PLANNING

Undergraduate degree in an appropriate field and satisfactory scores on the Graduate Record Examination.

## MINIMUM DEGREE REQUIREMENTS

**Plan A:** At least 24 hours in individually prescribed courses numbered above the 200 level and six hours of thesis research, for a total of 30 hours. Thesis preparation and defense required.

**Plan B:** Completion of 36 hours of advanced courses and independent study prescribed by the candidate's faculty studies committee. A planning project which must be defended is included in the 36 hours.

Irrespective of the plan chosen, students in the Natural Resource Planning Program usually are in residence for two years.

## COURSES OFFERED

### FORESTRY

**205 MINERAL NUTRITION OF PLANTS** See Plant and Soil Science.

**207 WATER RELATIONS OF PLANTS** Soil-plant water relations. Absorption, transport, and transpiration by plants. Effects of water excesses and deficits. *Prerequisite:* Permission of instructor. Three hours. Donelly, Botany and Plant and Soil science staff. Alternate years, 1981-82.

**221 SITE RELATIONS AND PRODUCTION DYNAMICS IN FORESTS** ory of site relations, methods of study, discussion of current research and its application; total site concepts; dynamics of dry matter production. *Prerequisite:* Permission of instructor. Three hours. Hannah. Alternate years, 1980-81.

**222 ADVANCED SILVICULTURE** Scientific bases for selected silvicultural practices. *Prerequisite:* Permission of instructor. Three hours. Hannah.

**242 ADVANCED FOREST BIOMETRY** Advanced principles of estimation, prediction, inventory and evaluation of forest resources. Use of system analysis techniques in natural resource management. *Prerequisite:* 144 or permission of instructor. Three hours. Newton. Alternate years, 1980-81.

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

**282 SEMINAR** Review and discussion of selected topics and forestry research. *Prerequisites:* Graduate standing and permission of instructor. One hour.

**285 ADVANCED SPECIAL TOPICS** Advanced special topics courses or seminars in forestry beyond the scope of existing formal courses. *Prerequisites:* Graduate or advanced undergraduate standing and permission of instructor. Credit as arranged.

**381 SELECTED PROBLEMS IN FORESTRY** Advanced readings, or a

special investigation dealing with a topic beyond the scope of existing formal courses. *Prerequisite:* Graduate standing and permission of instructor. Credit as arranged.

391 MASTER'S THESIS RESEARCH Credit as arranged.

### NATURAL RESOURCES

235 LEGAL ASPECTS OF PLANNING AND ZONING Comparison of Vermont planning and zoning law with that of other states. Case studies in planning, zoning and land use controls. *Prerequisite:* Senior standing. Three hours.

272 ENVIRONMENTAL IMPACT ASSESSMENT Comprehensive perspective on methods and problems of assessing environmental and social impacts arising from natural resource management. *Prerequisite:* Permission of instructor. Three hours. Lapping.

275 NATURAL RESOURCES PLANNING THEORY AND TECHNIQUES Consideration of historical and theoretical roots of resource planning. Development of some skills mandated of natural resource planners. Three hours. Lapping.

278 WATER RESOURCES: ANALYSIS, PLANNING AND MANAGEMENT Study of the physical, chemical and biological phenomena in rivers, streams and lakes. Concepts of water resources modeling, planning and management. *Prerequisite:* Permission of instructor. Three hours. Cassell.

391 MASTER'S THESIS/PROJECT RESEARCH Credit as arranged.

### RECREATION MANAGEMENT

225 ECONOMICS OF OUTDOOR RECREATION AND TOURISM A socioeconomic analysis of recreation and tourism as an industry. Emphasis on regional, state and community impact. *Prerequisites:* Economics 11, 12 or Resource Economics 61. Three hours. Bevins.

235 OUTDOOR RECREATION PLANNING The planning of large wildland areas for outdoor recreation use. *Prerequisites:* 150 or Forestry 140; PSS 161 or Geol. 1. Three hours. Lindsay.

240 PARK PROTECTION AND MANAGEMENT Methods to direct public use and control environmental impacts in outdoor recreation areas. *Prerequisites:* 135 and 137. Three hours. Manning.

### WILDLIFE BIOLOGY

232 ICTHYOLOGY Biology of fishes. Study of the structure and function of systems; behavior and ecology of modern fishes. *Prerequisites:* Zoology 104 or 219 or equivalent, Wildlife Biology 161. Three hours. LaBar.

264 NONGAME WILDLIFE MANAGEMENT Selected topics which emphasize nongame birds and mammals: endangered species, vertebrate pests, urban wildlife, specialized survey and management practices. *Prerequisite:* Wildlife Biology 174. Three hours. Capen.

**271 WETLANDS WILDLIFE ECOLOGY** Life histories and management emphasizing North American waterfowl and furbearers: Integration of aesthetic, ecological, recreational, and socioeconomic values with contemporary uses of land and water. Field studies and one weekend trip. *Prerequisites:* Courses in ornithology and mammalogy, Wildlife Biology 174. Four hours. Fuller.

**272 UPLANDS WILDLIFE ECOLOGY** Integration of ecological principles, wildlife biology, land use, and human dimensions in wildlife. Emphasis on development and maintenance of wildlife habitat, and population regulation of uplands species. *Prerequisites:* Courses in ornithology and mammalogy, Wildlife Biology 151, 174. Four hours. Hirth.

**285, 286 ADVANCED SPECIAL TOPICS** Credit variable.

### **SELECTED RELEVANT COURSES IN OTHER COLLEGES**

**AREC 222 NATURAL RESOURCES EVALUATION**

**AREC 233 REGIONAL PLANNING**

**AREC 24 ADVANCED REGIONAL PLANNING**

**CE 210 AIRPHOTO INTERPRETATION**

**CE 230 URBAN PLANNING TECHNIQUES**

**CE 231 URBAN PLANNING ANALYSIS**

**CE 232 COMMUNITY DESIGN**

**GEOG 243 SPATIAL ANALYSIS I**

**SOC 205 RURAL COMMUNITIES IN MODERN SOCIETY**

**SOC 207 COMMUNITY ORGANIZATION AND DEVELOPMENT**

## **PATHOLOGY**

*Professors Clemmons, Craighead (Chairman), Korson, Stark, and Trainer; Associate Professors Howard, Perl, Tindle, and Winn; Assistant Professors Hardin, Lapenas, Lee, Little, MacPherson, McQuillen, Massman, and Ukena; Research Assistant Professor Adler.*

Research interests are in the fields of anatomic, clinical, and experimental pathology. Current studies include histochemistry, connective tissue pathology and biochemistry, electron microscopy, neoplasia, teratology, immunopathology, virology, and lung diseases.

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

Satisfactory undergraduate or graduate course work in chemistry and the biological sciences. Microbiology and immunology are also recommended but not required. Satisfactory scores on the Graduate Record Examination. Persons interested in a Ph.D. program may wish to consider the interdisciplinary program in Cell Biology in which Pathology participates.

**MINIMUM DEGREE REQUIREMENTS**

Anatomy 311 (3 hours), Pathology 301 (3 hours), Biochemistry 301-302 (6 hours); additional approved courses; thesis research (6-15 hours).

**COURSES OFFERED**

**301 GENERAL PATHOLOGY** A study of the processes of injury, repair, neoplasia, degeneration, etc., as they affect cells, tissues, and the human patient. *Prerequisite:* Departmental permission. 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 departmental permission. Eight hours. Staff.

**310 ADVANCED PATHOLOGY** Supervised practical experience in handling, processing and analysis of pathologic materials using light and electron microscopy, morphometrics, X-ray spectrometry. Participation in departmental seminars and conferences. *Prerequisites:* 301 and departmental permission. Credit as arranged. 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.

**PHARMACOLOGY**

*Professors Gans, Jaffe, Krakoff, McCormack, and Soyka (Chairperson); Associate Professor Reit; Assistant Professors Hacker, Newman, Redmond and (part-time) Scollins; Visiting Professor Maxwell.*

Research interests of the staff include: pharmacokinetics and pharmacodynamics of antiparasitic and anticancer drugs; synthesis, properties and structure-activity relationships of biologically active nitroheterocyclic compounds; cardiovascular effects of methylxanthines; mechanisms of adaptation to chemical injury in mammalian liver; influences of *in utero* exposure on perinatal sensitivity to carcinogens; interaction of the immune system and hepatic mixed-function oxidases; functions of neurohumoral substances in synaptic transmission and microcirculatory regulation; hormonal influences on drug metabolism and effects of drugs on neuroendocrine regulation of growth.

A pre- and post-doctoral training program in clinical pharmacology is offered in cooperation with the Department of Pediatrics: pharmacotherapy of developmental and endocrine disorders. Another pre- and post-doctoral training program in the clinical pharmacology of anticancer drugs is offered in cooperation with the Vermont Regional Cancer Center.

## **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 and/or a reading knowledge of one foreign language may be additional prerequisites, depending on the requirements of the research supervisor; acceptable scores on the verbal, quantitative and advanced sections of the Graduate Record Examination.

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

Pharmacology 301, 302, 303, 372, 381, 391; supporting courses in Biochemistry and Physiology.

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

Physiology and Biophysics 301; Biochemistry 301, 302. Pharmacology 301, 302, 303, 328, 372, 381, 491; Biometrics and Applied Statistics 308.

## **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. Gans.

**301 MEDICAL PHARMACOLOGY** The chemical and biological properties of drugs. *Prerequisite:* Departmental permission. Six hours. Staff.

**302, 303 PHARMACOLOGICAL TECHNIQUES** Experiments conducted under supervision in the areas of drug metabolism, modes of drug action, physicochemical properties of drugs, bioassay; and toxicology. *Prerequisite:* departmental permission. Two hours, by arrangement. Staff.

**328 INTRODUCTION TO MEDICINAL CHEMISTRY** Important classes of drugs are surveyed. Emphasis is placed on relationships between physicochemical properties and pharmacologic activity; synthetic aspects are considered. *Prerequisites:* Chemistry 131-132. Open to undergraduates with permission of instructor. Three hours. 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:* Departmental permission. Credit variable one to three hours. Staff.

**373 READINGS IN PHARMACOLOGY** Intensive directed reading in one area of pharmacology. Students in the department must choose a topic outside

their area of thesis research. A term paper and a seminar on the selected topic are required. *Prerequisite:* Departmental permission. Two hours, by arrangement. Staff.

381 SEMINAR Current developments in pharmacology are presented for discussion by students. *Prerequisite:* Departmental permission. One hour. Staff.

391 MASTER'S THESIS RESEARCH Credit as arranged.

491 DOCTORAL THESIS RESEARCH Credit as arranged.

## PHILOSOPHY

*Professors Dykhuizen(Emeritus), Hall, Mann(Acting Chairperson), and Sher; Associate Professors Hansen, Kitcher, Kitcher, and Moneta; Assistant Professors Kornblith, Kuflik, and Miller; Adjunct Professor Cahn.*

Research interests of the Department include virtually every period in the history of philosophy and every major area of philosophical inquiry.

No Graduate Program Offered

## COURSES OFFERED

201 THEORY OF KNOWLEDGE A critical examination of the nature and sources of knowledge: belief, truth, evidence, perception, memory, and induction. *Prerequisite:* 102 or 112. Three hours. P.S. Kitcher, Sher.

202 METAPHYSICS A critical examination of such topics as the nature of space and time, the concept of change, the identity of the self, the nature of the world and man's place in it. *Prerequisite:* 101 or 102 or 110. Three hours. Mann, Moneta, Sher.

210 PHILOSOPHY OF MIND Major philosophical theories of the mind and its relation to the physical world, the nature of sensation, desire, and belief, and the relation between thought and action. *Prerequisite:* 102 or 110. Three hours. P.W. Kitcher, Sher.

212 PHILOSOPHY OF SCIENCE A thorough investigation of one or two problems in the philosophy of science. There will be emphasis on modern attempts to solve them. *Prerequisite:* 112 or any 100 level history of science course or Junior or Senior standing in a science major. Three hours. P.S. Kitcher.

213 MATHEMATICAL LOGIC A study of important advanced results in mathematical logic, including Godel's Incompleteness Theory and recursive function theory. *Prerequisite:* 113. Three hours. P.S. Kitcher.

**215- PHILOSOPHY OF MATHEMATICS** A study of the philosophical problems connected with mathematics. The course will attempt to answer the following questions. What (if anything) is mathematics about? How do we acquire our mathematical knowledge? Is there an important difference between mathematics and natural science? Could all our mathematical beliefs be false?

*Prerequisite:* 113 or 213 or extensive background in mathematics. Three hours. P.S. Kitcher.

**217 PHILOSOPHY OF LANGUAGE** A philosophical study of the nature of language. *Prerequisite:* 113 or linguistics 100 and 102. Three hours. Hansen, P.S. Kitcher, Sher.

**240 CONTEMPORARY ETHICAL THEORY** An analysis of the ideas of contemporary moral philosophers in normative ethics and metaethics. *Prerequisite:* Sher.

**260 PHENOMENOLOGY II** A critical and intensive investigation of the thought of a major twentieth century phenomenologist, e.g. Husserl, Heidegger, Merleau-Ponty, or Gadamer. *Prerequisite:* 160. Three hours. Moneta.

**262 EXISTENTIALISM** A study of existentialism as a philosophy, and an examination of its background, as displayed in the literary and philosophical writings of Pascal, Kierkegaard, Camus, Heidegger, and Sartre. *Prerequisites:* Any two of 101, 102, and 107. Three hours. Hall, P.W. Kitcher.

**265 AMERICAN PHILOSOPHY** The thought of such leading American philosophers as Peirce, James, Royce, Santayana, Dewey and Whitehead. *Prerequisites:* 101 and 102. Three hours. Miller.

**271, 272 SEMINAR: MAJOR PHILOSOPHICAL AUTHOR OR SCHOOL** A study of the major philosophical texts by a single author or school of thought. May be repeated for credit when different authors are studied. *Prerequisite:* An appropriate 100-level course in philosophy. Three hours. Staff.

**281, 282 SEMINAR: SELECTED TOPICS IN PHILOSOPHY.** *Prerequisite:* An appropriate 200-level course in philosophy. Three hours. Staff.

**297, 298 READINGS AND RESEARCH** Independent study with an instructor on a specific philosopher or philosophical problem. *Prerequisite:* An appropriate 200-level course in philosophy. Staff.

## PHYSICS

*Professors Arns, Brown, Crowell, Detenbeck, Juenker, Krizan, Lambert (Chairperson), Nyborg, and Scarfone; Associate Professors Rankin, and Sachs; Assistant Professor Spitalian; Research Assistant Professor Miller.*

The Department of Physics offers experimental opportunities for research in the fields of biological physics, solid state and the physics of materials; theoretical studies in these areas as well as others may be pursued. In the field of biophysics the experimental projects are mostly concerned with the applications of nonlinear ultrasonic techniques to the study of structures and processes in biological materials. Investigations are carried out both *in vivo* and *in vitro* and the specimens range from plant cells to human tissue of medical interest. There are theoretical research programs devoted to both the interpretation of the ultrasonic work and to the applications of statistical mechanics and quantum mechanics to fundamental properties of biomacromolecules and biomembranes.

In the fields of the physics of materials and solid state there are experimental programs concerned with the interaction of gas molecules with metal surfaces using ultra high vacuum, radiotracer, photoelectron emission, and thin film techniques. The mechanisms of photoelectron emission, and the general area of electromagnetic interactions in metals are being investigated using vector photoelectric methods in near and far ultraviolet regions of the spectrum. Also included here is research on the optical properties of solids and vapor streams as well as device physics. The properties of semiconductor-oxide or electrolytic interfaces are also being studied. There is theoretical work in metal physics concerned with lattice dynamics and electron densities of states in liquid metals, alloys, and other disordered systems.

Other research includes the scattering of laser light by microscopic particles and other inhomogeneities in fluids in a project which is particularly concerned with environmental pollution.

In addition, theoretical research in the statistical mechanics of plasmas, quantum field theory, relativity and many-body theory is carried out.

Some of the above projects are carried out with the active cooperation of faculty in other science departments and opportunities exist for collaborative research with such other departments and groups of the University as Chemistry, Physiology and Biophysics; Cell Biology, Electrical and Mechanical Engineering, Medical Radiology and the Academic Computer Center.

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

An undergraduate major in Science, Engineering or Mathematics; Physics 211, 213 and 273; 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, a least twelve of which shall be Physics courses

numbered above 300 and including thesis research.

The department also offers programs leading to the degrees of Master of Arts in Teaching and Master of Science for Teachers of Physical Science. Details are available elsewhere in the catalog and also from the Physics Department.

## COURSES OFFERED

**201, 202 EXPERIMENTAL PHYSICS** Experiments in classical and modern physics. Each student selects laboratory experiments appropriate to his background and interests. *Prerequisites:* 16 or 128, Mathematics 121 or 123; junior standing. Three hours per semester, four semesters maximum.

**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.

**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. *Prerequisites:* 16 or 25; Mathematics 121 or 123. Three hours.

**214 ELECTROMAGNETISM** An introduction to time dependent electromagnetic fields. Maxwell's equations in space and matter. Electromagnetic waves and radiation. *Prerequisite:* 213. Three hours. Alternate years, 1981-82.

**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; experience in applying differential equations. Departmental permission required. Four hours. Alternate years, 1980-81.

**242 INTRODUCTION TO SOLID STATE PHYSICS** Introduction to crystal structures, reciprocal lattices, lattice vibrations. Thermal properties of solids and free electron theory of metals and semi-conductors. Elementary band theory. *Prerequisite:* 128. Three hours. Alternate years, 1980-81.

**254 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. *Prerequisite:* 211. **Three hours.** Alternate years, 1981-82.

**258 RELATIVITY** Development of Einstein's theory of special relativity. Lorentz transformation, time dilation, length contraction, mass variation, relative velocities. Introduction to four dimensional space. Concepts of general relativity. Applications selected from astrophysics, elementary particles. *Prerequisite:* 128. Three hours. Alternate years, 1981-82.

**265 THERMAL PHYSICS** Basic concepts of thermodynamics including equilibrium conditions in homogeneous and heterogeneous systems. Introduction to kinetic theory and statistical mechanics. *Prerequisites:* 128 and Mathematics 121 or 123. Three hours. Alternate years, 1980-81.

**273 INTRODUCTORY QUANTUM MECHANICS** Introduction to non-relativistic quantum mechanics. Schroedinger equation and applications to simple systems. *Prerequisites:* 128 and 211. Three hours.

**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. *Prerequisites:* 211 and 214. Four hours. Alternate years, 1981-82.

**311 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. *Prerequisite:* 211. Four hours. Alternate years, 1980-81.

**313 ELECTROMAGNETIC THEORY** Development of Maxwell's theory of electromagnetism with emphasis on its physical basis and the modes of mathematical description. *Prerequisite:* 214. Four hours. Alternate years, 1980-81.

**321 SEMINAR IN THEORETICAL PHYSICS** For research students interested in pursuing topics of general and departmental research interest in theoretical physics. *Prerequisite:* Permission of instructor. Offered as occasion warrants. Credit as arranged.

**323 SEMINAR IN CONTEMPORARY PHYSICS** Topics of current interest in physics to be offered as student and faculty interest warrant. May be repeated for credit with departmental approval. *Prerequisite:* Permission of instructor. Credit as arranged.

**331 SEMINAR IN BIOLOGICAL PHYSICS** For research students in the field of biological physics. Lectures, reports and directed readings related to the research of the department and the field generally. May be repeated for credit with departmental approval. *Prerequisite:* Permission of instructor. Credit as arranged. Offered as occasion warrants.

**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 273 or their equivalents; permission of instructor. Three hours. Alternate years, 1981-82.

**351 SEMINAR IN PHYSICS OF MATERIALS** For research students in the field of the physics of materials. Lectures, reports and directed readings related to the research for the department and the field generally. May be repeated for credit with department approval. *Prerequisite:* Permission of instructor. Credit as arranged. Offered as occasion warrants.

**362 QUANTUM MECHANICS** Mathematical and physical foundations of non-relativistic quantum mechanics from the unifying point of view of Dirac. Symmetry operations and the algebraic structure of quantum mechanics are emphasized. *Prerequisite:* 273. Four hours. Alternate years, 1980-81.

**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, 273. Four hours. Alternate years, 1981-82.

391 MASTER'S THESIS RESEARCH Credit as arranged.

491 DOCTORAL DISSERTATION RESEARCH Credit as arranged.

The following courses are offered as the occasion warrants by members of the Department. For descriptions see the Department Chairperson.

314 CLASSICAL ELECTRODYNAMICS

343 ADVANCED SOLID STATE PHYSICS

373 ADVANCED QUANTUM MECHANICS

374 ADVANCED QUANTUM THEORY

376 STATISTICAL MECHANICS

## PHYSIOLOGY AND BIOPHYSICS

*Professors Alpert (Chairperson), Chambers, Gibbons, Low, McCrorey, and Parsons; Associate Professors Halpern, Hendley, Webb, and Whitehorn; Assistant Professor Hamrell; Research Assistant Professors Evans, Litten, Maughan, and Mulieri.*

Specific areas of interest include mechanics and energetics of cardiac and skeletal muscle; cochlear AC and DC potentials; respiration; properties of vascular and bronchial smooth muscle; cardiac electrophysiology and excitation-contraction coupling; molecular basis of contraction of skeletal and cardiac muscle; neurochemistry of brain function; protein turnover; synaptic physiology and pharmacology; cholinergic and adrenergic receptor function; cation transport; and electrophysiology of the central nervous system. Opportunities exist in the Department of Physiology and Biophysics for multi-disciplinary studies in neurobiology, cardiovascular biology, cell biology, and biological motility. For example, coordinated studies are underway on the biochemistry, mechanics, and excitation-contraction coupling of muscle from hypertrophied hearts, and on the neurochemistry, central nervous system regulation of the circulatory system, and vascular smooth muscle properties of hypertensive rats.

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. Graduate Record Examination 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 year of residency. A Master's degree is not a prerequisite for the Ph.D. degree. Graduate Record Examination 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; dissertation 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 department chairman. Eight hours. Staff.

**302 NEUROSCIENCE** A correlated presentation of the neuroanatomy and neurophysiology of mammalian CNS. Same course as Anatomy 302. *Prerequisite:* Permission of instructor. Four hours. Anatomy and Physiology Staff.

**303 SPECIAL PROBLEMS IN PHYSIOLOGY** Various problems are covered by means of lectures, reports and directed reading. *Prerequisites:* 301; permission of 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. *Prerequisites:* Math 110 or equivalent, and permission of instructor. Five hours. 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:* 301 and 302, Biochemistry 301, 302, permission of instructor. Three hours. Webb. Alternate years, 1979-80.

**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:* 301, 302, Biochemistry 301, 302, permission of instructor. Three hours. Alpert. Alternate years, 1980-81.

**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:* 301 or Endocrinology 271; Biochemistry 301-302; permission of instructor. Three hours. Low.

**317 ADVANCED NEUROSCIENCE** This course emphasizes current multidisciplinary approaches to the study of brain and behavior, particularly systems neurophysiology and transmitter neuropharmacology. Students pursue areas of special interest. *Prerequisite:* 302, Psych. 222, or permission. Three hours. Whitehorn and Hendley.

**323 PRINCIPLES AND ELEMENTS OF BIOMEDICAL INSTRUMENTATION** 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. *Prerequisite:* Permission of instructor. Five hours. Halpern, staff.

**381 SEMINAR** Presentation and discussion by advanced students and staff of current developments and research in the field. *Prerequisite:* Permission of department chairman. One hour per semester.

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

**491 DOCTORAL DISSERTATION RESEARCH** Credit as arranged.

## PLANT AND SOIL SCIENCE

*Professors Bartlett, Boyce, MacCollom, Wiggans (Chairperson), and Wood; Associate Professors Magdoff, Murphy, Parker, and Pellett; Extension Professor Way; Extension Associate Professor Flanagan; Extension Assistant Professors Costante, and Nielsen; Lecturers Flinn, Watson, and Whipkey; Extension Lecturer Desrosier.*

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 rhizosphere; behavior of nitrogen in the soil; nutrient availability to plants; agricultural waste management; temperature effects on soil water retention and transmission. 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, a written comprehensive examination, and satisfactory scores on the Graduate Recored Exam.

## MINIMUM DEGREE REQUIREMENTS

18-22 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 completion of a written and oral qualifying doctoral examination as prescribed by the Department and satisfactory scores on the Graduate Record Exam.

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.

## 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, Chemistry, 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

**202 MICROMETEOROLOGY** Theoretical and practical considerations of the micrometeorological factors that affect plant growth and agricultural practices. *Prerequisite:* 11. Three hours. Whipkey. Alternate years, 1981-82.

**204 PLANT RESEARCH TECHNIQUES** Methods of conducting research with plants including the organizing and planning of experiments. *Prerequisites:* 11, Botany 104. Three hours. Wiggans. Alternate years, 1981-82.

**205 MINERAL NUTRITION OF PLANTS** See Botany 205. Alternate years, 1981-82.

**207 WATER RELATIONS OF PLANTS** See Forestry 207. Alternate years, 1981-82.

**221 ADVANCED TREE FRUIT CULTURE** Theory and practice of modern commercial fruit science. Nutrition and cultural responses to various management practices. *Prerequisites:* 11 and 61. Three hours. Boyce.

**232 BIOLOGICAL CONTROL OF INSECT PESTS** A survey of the biological agents used in controlling insects and related arthropods, and their application and limitations. *Prerequisite:* An intermediate course in entomology. Three hours. MacCollom. Alternate years, 1981-82.

**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:* 161 or a total of six hours in ecology, geography, or geology. Three hours. Barlett, Watson. Alternate years, 1980-81.

- 264 SOIL CHEMISTRY** Chemistry and biology of soils affecting plant growth including the properties of clays and organic matter. *Prerequisites:* 161, two semesters chemistry. Four hours. Bartlett. Alternate years, 1979-80.
- 266 SOIL PHYSICS** Mathematical and physical principles of the soil-water-plant interaction and its relationship to production and management. *Prerequisites:* 161, Physics 5-6 or Chemistry 1-2. Three hours. Bartlett. Alternate years, 1980-81.
- 281 SEMINAR** Presentation and discussion of papers on selected topics of current interest by students and staff. *Prerequisite:* Senior standing. One hour. Staff.
- 301 PLANT SCIENCE COLLOQUIUM** Graduate student and staff discussion of current research topics in plant science. One hour. Staff.
- 302 SOIL SCIENCE COLLOQUIUM** Graduate student and staff discussion of current research topics in soil science. 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.
- 491 DOCTORAL DISSERTATION RESEARCH** Credit as arranged.

## POLITICAL SCIENCE

*Professors Hilberg, Kinnard, Little, Staron (Chairperson), and Wertheimer; Associate Professors Nelson, Pacy, and Simon; Assistant Professors Bann, Bryan, Hoffman, Holland, Johnson, Mahler, and Nivola; Visiting Assistant Professor Amen.*

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: Political thought of the 19th and 20th centuries with emphasis on socialist ideologies from Marx to Marcuse. *Prerequisite:* Six hours in political science. Three hours. 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. Wertheimer.

**216 AMERICAN POLITICAL THOUGHT** American political thought from the colonial period to recent times. *Prerequisite:* Six hours in political science. Three hours. Simon.

**221, 222 CONSTITUTIONAL LAW** First semester: emphasis on developing skills of legal analysis. Historical origins and general principles of constitutionalism. Second semester: selected topics in constitutional law. *Prerequisites:* Six hours in a social science; 221 for 222. Three hours. Hoffman.

**223 COMPARATIVE CRIMINAL POLICY** Research seminar focusing on the political bases of criminal law and law enforcement policy: conventional criminal behavior as well as repression of political activity and deprivation of human rights in cross-national perspective. *Prerequisite:* 121, 122, or permission of instructor. Three credits. Holland.

**227, 228 INTERNATIONAL LAW** Principles and applications of public international law. *Prerequisite:* Six hours in political science. Three hours. Little.

**231 THE LEGISLATIVE PROCESS** Organization, procedure, and behavior of legislative chambers with special attention to the U.S. Congress. *Prerequisite:* Six hours in political science. Three hours. Nelson.

**232 LAWMAKING AND PUBLIC POLICY** Influence of the executive and problems of congressional and parliamentary control. *Prerequisite:* Six hours in political science. Three hours. Nivola.

**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. Johnson.

**235 DEFENSE POLITICS** Civil-military relations, strategic policy, arms control, defense-industrial complex, defense budget in the post-Vietnam environment. *Prerequisite:* Six hours in political science. Three hours. Kinnard.

**239 AMERICAN POLITICS** The politics of decision-making in the American political system. *Prerequisite:* Six hours in political science. Three hours. Simon.

**241 PUBLIC ADMINISTRATION** The Federal government in action. *Prerequisite:* Six hours in political science. Three hours. Bryan.

**242 PROBLEMS OF BUREAUCRACY** Bureaucracy and bureau pathology, scientific management, human relations, decision making, and leadership in the context of public organization. *Prerequisite:* Six hours in political science. Three hours. Johnson.

**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. Pacy.

**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. Kinnard, Hilberg.

**256 INTERNATIONAL ORGANIZATION** Theory and practice in supranational institutions. *Prerequisite:* Six hours in political science. Three hours. Pacy.

**257 POLITICAL GEOGRAPHY** See Geography 257. Three hours. Miles.

**258 PROBLEMS OF COMMUNISM** See Economics 258. Three hours. Staff.

**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. Nivola.

**262 URBAN PUBLIC ORDER** Urban crime as a political issue. Institutions of crime control. Urban police systems and law enforcement. *Prerequisite:* Six hours in political science. Three hours. Holland.

**264 STATE ADMINISTRATION** Problems in planning, policy development, and program coordination. *Prerequisite:* Six hours in political science. Bryan.

**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. Nivola.

**273 COMPARATIVE POLITICAL ANALYSIS** An intensive examination of selected topics in comparative politics. *Prerequisite:* Sophomore standing. Three hours. Mahler.

**274 ETHNIC POLITICS** Theories of ethnic group identification, ethnic roots of political behavior, impact of ethnicity on the political structure. *Prerequisite:* Six hours in political science. Three hours. Staff.

**276 MASSES AND ELITES** Structural and attitudinal linkages between governors and governed. Modern as well as more traditional societies. *Prerequisite:* Permission of instructor. Three hours. Staff.

**278 FOREIGN POLICY OF THE U.S.S.R.** See History 278. Three hours. Daniels.

**281 POLITICAL PARTIES** Political parties with emphasis upon voting behavior and campaign techniques. *Prerequisite:* Six hours in political science. Three hours. Nelson.

**283 SCOPE AND METHODS OF POLITICAL SCIENCE** Approaches, sources of information, research methods and systematization in the study of political phenomena. *Prerequisite:* Graduate student or permission of instructor. Three hours. Bann.

291 through 293 **READING AND RESEARCH** For advanced undergraduates and graduate students. Three hours. Staff.

295, 296 **SEMINAR** Selected topics in political science. Three hours. Staff.

391 through 393 **MASTER'S THESIS RESEARCH** Credit as arranged.

## PSYCHOLOGY

*Professors: Achenbach, Albee, Ansbacher, J. Burchard, Forgays, Joffe, Lawson, Leitenberg and Musty (Chairperson); Associate Professors: Damkot, Gordon, Hasazi, Howell, Kapp, Kessler, Leff and Rolf; Assistant Professors: Bond, Edwards, Peyser and Rosen; Adjunct Assistant Professors: Dietzel and Thomson; Visiting Assistant Professors: Fitzhenry-Coor, Kirk, Koburger and Miller; Lecturer: Celani.*

The Ph.D. program in General and Experimental Psychology began in 1964, and now includes ongoing research in a variety of areas. Details of ongoing available on request from the Chairperson, Department of Psychology. Students in this program are involved early in independent research projects. Further information on specific program specialties can be obtained from the Chairperson, Department of Psychology.

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. The clinical program is fully accredited by the American Psychological Association. Further information on the types of clinical facilities and the research interests of the clinical faculty can be obtained from the Chairperson, Department of Psychology.

Applicants should apply for the Ph.D. degree only. Students whose goal is a terminal Master's degree are not accepted. The application deadline for admission is February 1. All supporting materials, including GRE scores, must be received by February 1.

In 1974, a small number of students were admitted to the Ph.D. programs on a part-time basis. The intention is to serve neglected Vermont constituencies such as full-time mental health workers with families, and persons with responsibilities at home. The part-time graduate program is not otherwise possible. A justification of the necessity to attend part-time must accompany the candidate's application. To be eligible for acceptance, applicants must have fulfilled prerequisites and minimum requirements listed below.

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

Undergraduate courses in statistics, experimental psychology and a major or its equivalent in undergraduate psychology; satisfactory scores on the Graduate Record Examination, including the Advanced Psychology sub-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, or equivalent; satisfactory performance on the departmental Ph.D. comprehensive examination.

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

The General/Experimental Program requires a minimum of 80 credit hours and the Clinical Program, 83 credit hours; 24 credits must be accumulated in dissertation research credits, and the remainder in course credits numbered in the 200 through the 400 sequences of the psychology curriculum, or acceptable courses at the 200 or 300 level from other curricula. Detailed information on courses of study is available from the Department. Satisfactory performance on the departmental final oral examination. There is no foreign language requirement.

### **COURSES OFFERED**

**205 LEARNING** Examination of classical and recent research on the learning process, including respondent and operant learning, discrimination learning, and human learning and memory. *Prerequisite:* 110. Three hours. Forgays, Musty.

**206 MOTIVATION** Research and theorizing on the nature and development of motives, emotions and their relation to other psychological processes. *Prerequisite:* 110. Three hours. Joffe, Musty, Forgays.

**207 THINKING** A critical review of the experimental investigation of thought processes. *Prerequisite:* 110. Three hours. Gordon, Howell.

**210 PRINCIPLES OF HUMAN PERCEPTION** Focuses upon basic sensory and perceptual mechanisms that support the acquisition and processing of information through the auditory, visual, chemical and hapticsomatic sensory systems of animals and humans. Topics include: basic systems, and environmental and evolutionary influences. *Prerequisite:* 109. Three hours. Kirk.

**220 ANIMAL BEHAVIOR** Behavior of animals under controlled experimental conditions and in their natural environments. Consideration of antecedents of behavior and of its adaptive significance, evolution and development. *Prerequisite:* 109 or 121. Three hours. Joffe.

**221 PHYSIOLOGICAL PSYCHOLOGY I** The structure and function of the mammalian nervous system, with emphasis upon neurological correlates of sensory experience and perception. Individual laboratory experience. Four hours. Musty.

**222 PHYSIOLOGICAL PSYCHOLOGY II** The study of the role of central nervous system mechanisms in the determination of sleep arousal, motivation, learning, and memory. Individual laboratory experience. *Prerequisite:* 221. Four hours. Musty.

**223 PSYCHOPHARMACOLOGY** An intensive analysis of the effects of drugs on behavior. Topics such as drug effects on learning, memory, motivation, perception, emotions, and aggression will be considered in both animal and man. *Prerequisites:* 110 and 121 or 222 or permission of instructor. Three hours. Musty.

**230 ADVANCED SOCIAL PSYCHOLOGY** Advanced survey covering current research in various fields of social psychology. *Prerequisite:* 110. Three hours. Leff.

**233 PSYCHOLOGY OF ENVIRONMENTAL EXPERIENCE** An intensive examination of different ways of thinking (and feeling) about environments, including cognitive theory and research as well as applications to design creativity, aesthetic experience, and various types of environmental awareness. *Prerequisite:* Advanced background in psychology or in environmental studies or education. Three hours. Leff.

**234 PSYCHOLOGY OF SOCIAL AND ENVIRONMENTAL CHANGE** An examination of how psychology can increase our understanding of potential social and environmental transformations, with special emphasis on (a) implications for the quality of human experience and (b) devising effective change strategies. *Prerequisite:* Advanced background in psychology or in environmental studies or a social science. Three hours. Leff.

**250 INTRODUCTION TO CLINICAL PSYCHOLOGY** Examination of some of the critical issues in clinical psychology; its scientific status, problems of research; and probable future trends. *Prerequisites:* 110, 119, 152. Three hours. Koburger.

**251 BEHAVIOR DISORDERS OF CHILDHOOD** A review of the empirical and theoretical literature regarding disorders of cognition, affect, and social behavior of children. Emphasis will be placed on etiological factors and therapeutic methods. *Prerequisites:* 1 and 151 or 122. Three hours. Hasazi.

**253 ADVANCED BEHAVIOR MODIFICATION** Application of technique for the manipulation and control of human behavior in a variety of educational and social situations involving the collection and analysis of behavioral data. *Prerequisites:* 153, 109. Burchard, Koburger.

**261 COGNITIVE DEVELOPMENT** Research and theory concerning developmental changes in modes of processing information, from infancy to adulthood. Topics include early concepts, language and thought, play and imitation, and cross-cultural issues, focusing on the theory of Jean Piaget. *Prerequisite:* 161 or 109 (concurrently), or permission of instructor. Three hours. Bond.

**262 SOCIAL DEVELOPMENT** Examination of theory and research concerning interpersonal development in humans from infancy through adulthood.

Topical areas include the development of person perception, social inference, role-taking, moral judgment, and ego development. Relationships between language and cognition and social development emphasized. *Prerequisite:* 161, or 109, 110 (concurrently), or permission of instructor. Three hours. Fitzhenry-Coor.

**281-282 SEMINAR** Review and discussion of current psychological research. One hour. Staff.

**295, 296 CONTEMPORARY TOPICS** Three hours. Staff.

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 FACULTY SEMINAR** 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. One to three hours. Staff.

**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. Musty, Damkot.

**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. Kapp, Musty.

**331 INTERPERSONAL PROCESSES: MODES OF INTERACTING** Examination of interpersonal conflict, cooperation, power relations, information transfer, and persuasion. *Prerequisite:* Permission of instructor. Three hours. Leff.

**332 INTERPERSONAL PROCESSES: COGNITION IN SOCIAL BEHAVIOR** Examination of social attribution, interpersonal set, problems of reciprocal perspectives in social encounter and the formulation of interpersonal strategies. *Prerequisite:* Permission of instructor. Three hours. Leff.

**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. 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:* 340. Three hours. Howell.

**344 EXPERIMENTAL DESIGN** Extended coverage of problems in the design and analysis of behavioral experiments to include repeated and non-

repeated 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. Howell, 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. *Prerequisites*: 340 and 341. Three hours. Gordon.

**349 SPECIAL TOPICS IN APLIED 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. Gordon and Howell.

**351 BEHAVIOR THERAPY** A review of the literature relating to theory, practice, and research. Emphasis will be placed on the evaluation as a variety of procedures applied to behavior disorders in adults and children. *Prerequisite*: Permission of the instructor. Three hours. 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. Rosen.

**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. 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 instructor. Three hours. Rolf.

**358 ANTISOCIAL BEHAVIOR** A review of the literature related to the development and modification of antisocial 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. Burchard.

**360 METHODS AND MODELS OF CLINICAL PREDICTION** A study of clinical versus actuarial problems in applied psychology. Historical antecedents, examples of problems of reliability, validity, and utility including models of intelligence and personality, will be discussed. Modern day solutions are covered. *Prerequisite*: 340 or permission of instructor. Three hours. Kessler.

**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 organism-operational-Adlerian type theory is favored. *Prerequisite:* Permission of instructor. Three hours. 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. Kessler.

**363 PSYCHOPATHOLOGY** An advanced course dealing with models, epidemiology, research approaches to disturbed behavior; major patterns of mental disturbances and interpersonal pathology are considered; an overview of intervention and primary prevention of mental disorders is covered. *Prerequisites:* Graduate standing, permission of instructor. Three hours. Albee.

**364 PROFESSIONAL AFFAIRS AND ETHICS** An examination of the historical origins of professions and of the profession of psychology in particular. A discussion of accreditation, laws affecting psychology, the organization of the professional association, licensing and certification, and a detailed consideration of the code of ethics for psychology. *Prerequisites:* Graduate standing, permission of instructor. Three hours. Albee.

**365 GROUP PROCESSES** A comprehensive review of encounter, training, and psychotherapy group issues. Discussions focus on group composition, leadership styles, group stages, group problems, ethical issues, and research questions. *Prerequisites:* Graduate standing or permission of instructor. Three hours. Deitzel.

**366 ISSUES IN ADVANCED DEVELOPMENTAL PSYCHOLOGY** A critical in-depth analysis of a topic or set of topics of current significance to Developmental Psychology. Topics subsume research, theoretical and professional issues in the field, for example, models of development, moral development, infancy, early conceptual development, written and oral analyses of developmental literature. *Prerequisites:* Graduate standing or permission. Three hours.

**370, 371 INTRODUCTORY PRACTICUM: ASSESSMENT AND THERAPY I & II** Overview of clinical evaluation and therapy. 370 emphasizes cognitive evaluation: intelligence, achievement, developmental skills, neuropsychology. 371 emphasizes assessment, interview, personality examination, behavioral assessment. Utilizing clinical facilities, supervision is given in test administration, report writing, basic counseling, and therapy planning. Cognitive dysfunction and psychopathology are reviewed. *Prerequisites:* Graduate standing and permission of instructor. Three hours. Rosen.

**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; Behavior Therapy

Center; Counseling Center. *Prerequisites:* Graduate standing in psychology and permission of instructor. Three hours. Leitenberg, Staff.

**380 CONTEMPORARY 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. Recent topics include: animal behavior, anxiety and behavior, behavioral pharmacology, biological bases of memory, depression, psycholinguistics, psychotherapy research, primate behavior, skilled human performance, issues in industrial psychology. 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. Forgaes.

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

**491 DOCTORAL DISSERTATION RESEARCH** Credit as arranged.

The following courses are offered infrequently but may be taught where sufficient student interest is demonstrated.

**305 SEMINAR IN LEARNING THEORY** Three hours.

**308 SEMINAR IN OPERANT CONDITIONING** Three hours.

**310 SEMINAR IN PERCEPTION** Three hours.

**333 INTERPERSONAL PROCESSES: MOTIVATION IN HUMAN INTERACTION** Three hours.

## RELIGION

*Associate Professors Andrews, Martin (Acting Chairman) and Paden; Assistant Professors Brenneman, Gussner, Sugarman and Yarian.*

No Graduate Program Offered

**291, 292 TOPICS IN THE HISTORY AND PHENOMENOLOGY OF RELIGION** *Prerequisites:* Nine hours in religion; junior standing. Three hours. Staff.

## SOCIOLOGY

*Professors Folta (Chairperson), Lewis, Mabry (Epidemiology and Environmental Health), Sampson, and Stanfield; Associate Professors Finney, Loewen, Nixon, Steffenhagen, and McCann; Assistant Professors Danigelis, Fengler, Mintz, Payne, Schmidt and Stedman.*

No Graduate Program Offered

Emphasis of the Department is on the development of sociological theory and research methods for application toward the resolution of major social problems. Current research activities include studies of population change, modernization and social structure; complex organizations and inter-organizational relations; changes in sex role relations and family values and structure; rural and urban community development; social inequality, poverty and cooperatives;

drug use and abuse; criminal deviance and corrections; race and ethnic relations; school desegregation; the social impact of death and dying; political mobilization and community social networks; the deinstitutionalization of human service delivery systems; medical sociology; small group processes; the role of leisure and sports in modern society; and methodological problems in applied sociology, theory construction and quantitative research methods.

## COURSES OFFERED

Courses numbered 200 to 299 generally require graduate standing or six hours of sociology. Sociology 100, Fundamentals of Social Research, or its equivalent is required as a prerequisite for many 200 level courses.

**202 POPULATION DYNAMICS** Analysis of the factors affecting human population growth and distribution, migration patterns, and the relationship between economic activity and population trends. *Prerequisites:* 10 or six hours of sociology. Three hours. McCann, Payne, Stedman.

**204 ECOLOGICAL PERSPECTIVE ON HUMAN COMMUNITIES** Relationships between forms of social organization especially communities and their environments, will be analyzed. Attention will be given to the impact on communities of the differential location of socio-economic, racial and cultural groups. Three hours. Mabry, Schmidt, Staff.

**205 RURAL COMMUNITIES IN MODERN SOCIETY** The changing structure and dynamics of urban social organization in the context of modernization and urbanization. Emphasis on rural communities in America. Three hours. Finney, Schmidt.

**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. Schmidt.

**209 SMALL GROUPS** An examination of the structure and dynamics of interpersonal relations and informal interactions in small groups. Three hours. Nixon, 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. Finney, Stanfield.

**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. Finney, Folta, Stanfield.

**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. Folta, McCann, Payne.

**215 CRIME** Analysis of the nature and types of adult behavior that violate law, the mechanism for defining such behavior as criminal, and the relationships between crime and the social situation of adult offenders. Three hours. Folta, McCann, Payne, 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. Folta, Payne, Stanfield,

**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. Stanfield.

**219 RACE RELATIONS** Examination of racial subordination in social and historical context. Analysis 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. Danigelis, Loewen, Payne.

**225 ORGANIZATIONS IN MODERN SOCIETY** 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. Finney, Nixon, 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. Nixon, Steffenhagen.

**228 ORGANIZATION DEVELOPMENT AND CHANGE** A sociological introduction to the new applied field of organization development and to related issues of innovation and change. Primary emphasis placed on the application of social science to the solution of organizational problems. *Prerequisite:* Six hours in sociology; one college course on organizations, or equivalent; or permission of instructor. Three hours, Finney, Sampson, Steffenhagen.

**229 THE FAMILY AS A SOCIAL INSTITUTION** Description and analysis of the family as one of the society's major social institutions; varying theoretical perspectives used in studying the family; the family in cross-cultural perspective; continuity and change in the American family. *Prerequisite:* 129 or six hours in sociology. Three hours. Fengler, Lewis, Mabry.

**230 SOCIAL VALUE PATTERNS IN AMERICAN FAMILY LIFE** Examination of similarities and differences in social value patterns value patterns of different segments of American family life, e.g., class, ethnic, religious. Continuity and change in family value patterns and their inter-relationship with the larger society. Three hours. Lewis.

**232 SOCIAL CLASS AND MOBILITY** Comparative analysis of social causes, structures and consequences of differential ranking of individuals and groups in society. Special attention will be given to criteria for social ranking, their measurement and association, and intergenerational social mobility. Three hours. Danigelis, Finney, Lewis, Mintz, Nixon, Schmidt, Stedman.

**237 OCCUPATIONS AND PROFESSIONS** Analysis of the social organization of economic roles in industrial society. Special attention given to the impact of the structure of work on the individual and the relationship of occupations and professions to other institutions. Three hours. Mabry, Mintz.

**240 POLITICAL SOCIOLOGY** Analysis of the social organization of political roles and associations in modern society. Special attention will be given to examination of changing structure of the political institution and its relationship to other institutions in society. Three hours. Danigelis, Loewen, Mintz, Nixon.

**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. Mintz.

**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. Three hours. Loewen, McCann, Sampson.

**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. Sampson.

**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. Folta, Mabry, Steffenhagen.

**255 SOCIOLOGY OF MENTAL HEALTH** The socio-cultural environment of mental well-being and illness. Special attention will be given to the role of socio-cultural factors in the etiology, identification, definition, and treatment of mental illness in society. Three hours. Folta, Mabry, Steffenhagen.

**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. Folta, Stanfield.

**273 METHODOLOGY OF SOCIAL RESEARCH** Basic issues in the construction of sociological concepts, descriptions, predictions and explanations. Consideration will be given to the philosophy and logic of social research; models, theories and verification; and the formalization of theories. Three hours. Danigelis, McCann, Sampson.

**274 METHODS OF DATA GATHERING IN SOCIAL RESEARCH** An examination of methods for studying social phenomena including laboratory and

field experiments, observational techniques, surveys, content analysis and cross-cultural comparisons. Problems in research design, sampling, measurement, and scaling are addressed. Three hours. Danigelis, Loewen, Mabry, McCann, Schmidt, Stedman.

**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. Danigelis, McCann, Payne, Stedman.

**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. Danigelis, Loewen, McCann, Payne, Sampson, Schmidt.

**279 CONTEMPORARY SOCIOLOGICAL THEORY** A detailed examination of selected major theoretical approaches and issues in modern sociology. *Prerequisite:* 278. Three hours. Loewen, McCann, Sampson, Schmidt, Stanfield.

**281, 282 SEMINAR** Presentation and discussion of advanced problems in contemporary sociological analysis. *Prerequisites:* Twelve hours in sociology and departmental permission. Three hours. Staff.

**288, 289 SEMINAR: RESEARCH AND METHODS OF TEACHING SOCIOLOGY** 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. *Prerequisites:* Twelve hours in sociology and departmental permission. Three hours. Danigelis, Finney, Loewen, McCann, Mintz, Nixon, Sampson.

**295, 296 SPECIAL TOPICS**

**297, 298 READINGS AND RESEARCH**

## SPANISH

*Professors Ugalde, Weiger, and Zarate; Associate Professors Wesseling, and Whatley (Chairperson); Assistant Professor Murad.*

### No Graduate Program Offered

Opportunities for research exist in Spanish literature of the 16th, 17th, 19th and 20th centuries and in Spanish-American literature of the 20th century,

## COURSES OFFERED

The following courses are available for graduate credit. In literature, the two-hundred 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. For more detailed information on specific courses, consult with department chairman and the course instructor.

For undergraduate courses see the undergraduate catalogue.

### SPANISH LANGUAGE

**209 ADVANCED GRAMMAR** An in-depth study of Spanish grammar, its rules and practices, going beyond conventional good usage into the reasons and theories for same. Three hours. Ugalde.

### SPANISH LITERATURE

**235, 236 GOLDEN AGE** The picaresque novel, the drama and poetry of the 16th and 17 centuries, with emphasis on Lope de Vega, Calderon, Quevedo, Tirso de Molina. Three hours each course. Weiger. Alternate years, 1980-81.

**245, 246 CERVANTES** *Don Quijote*, the *Novelas Ejemplares*, and the theatre of Cervantes. Three hours each course. Weiger, Alternate years, 1981-82.

**265 19th CENTURY SPANISH LITERATURE** Romanticism and realism: 1. Romantic theater, prose, poetry; 2. the realist and naturalist novelists: Galdos and Leopoldo Alas. Three hours. Wesseling. Alternate years, 1981-82.

**276 THE REAWAKENING IN THE 20th CENTURY** Origins and main aspects of the intellectual conflicts in modern Spain as reflected in the literary works from the "Generation of 1898" to the present. Three hours. Ugalde. Alternate years, 1981-82.

**285, 286 SPANISH-AMERICAN LITERATURE OF SOCIAL PROTEST** The literature of the Spanish-American peoples as a reflection of and contribution to the social problems of the area, following the various directions of social protest against the Spanish political system, local governments, and imperialism. 286 will stress the contemporary scene. Three hours each course. Zarate. Alternate years, 1980-81.

**291 CIVILIZATION OF SPAIN** Topical approach to the study of Spanish civilization, with emphasis on ideas, art, literature and music. Three hours. Ugalde. Alternate years, 1980-81.

**293 LATIN AMERICAN CIVILIZATION** A study of history and culture of Latin American people from the formation of the Indian civilization to the present ideals and problems. Pre-Hispanic civilization, colonization and modern states. Artistic, literary and musical manifestations of these periods will be covered. Three hours. Zarate. Alternate years, 1981-82.

**295, 296 ADVANCED SPECIAL TOPICS**

**297, 298 ADVANCED READINGS**

### STATISTICS

*Steering Committee Members: Professors McCrorey and Sylwester (Director); Associate Professors Ashikaga, Gordon, Haugh, Howell, Newton, and Tashman; Assistant Research Professors Aleong and Costanza; Adjunct Assistant Professors Dorsey and Whitmore.*

The Statistics Program was established July 1, 1973 and is responsible for offering statistics courses and degree programs to meet the needs of the University. The Director reports to the Dean of the College of Engineering, Mathematics and Business Administration. The Program Steering Committee is composed of professional statisticians plus other faculty with extensive training in statistics so that students have substantial opportunities to see and participate in the interaction between statistics and its applications. Departments represented are Mathematics, Psychology, Business Administration, Physiology, Forestry, the Agricultural Experiment Station, the Academic Computing Center and the College of Medicine Biometry Facility.

The Program offers the Master of Science Degree in Statistics with emphasis in applied statistics. The degree program is designed primarily for students who plan to work as statisticians in business, industry and government and for students who wish a graduate degree in statistics prior to advanced training in other disciplines. The Biostatistics Program (described elsewhere in this catalogue) is a separate but related program.

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

A baccalaureate degree. Three semesters of calculus, a course in linear algebra and one semester of statistics. Provisional acceptance can be given prior to the completion of all these requirements. Satisfactory scores on the aptitude portion of the Graduate Record Examination are required for students wishing to be considered for financial aid.

### **MINIMUM DEGREE REQUIREMENTS**

**Plan A:** Twenty-four semester hours of acceptable graduate credits in statistics, mathematics and allied fields and six semester hours of thesis research.

**Plan B:** Thirty semester hours of acceptable graduate credits in statistics, mathematics and allied fields with no thesis required.

Under Plan A and Plan B students must already have, or must acquire, a knowledge of the content of the following courses in statistics: Statistics 211, 221 (Statistical Methods I, II), 231 (Experimental Design), 251 (Probability Theory) and 261, 262 (Statistical Theory). The student is expected to participate in the Statistics Seminar series throughout his graduate studies. Under Plan B students must carry out a comprehensive data analysis culminating in both an oral and written report. This project may be done independently or by enrolling in 281 (Statistics Practicum).

### **COURSES OFFERED**

**211 STATISTICAL METHODS I** Fundamental ideas and techniques of statistics, with applications, used in experimental design and data analysis; descriptive and inferential statistics, including descriptive and inferential statistics, correlation, regression, and analysis of variance. *Prerequisite:* Junior standing, college algebra. Three hours.

**221 STATISTICAL METHODS II** Continuation of 211 concentrating on multiple regression, experimental design, analysis of variance and covariance, and non-parametric methods. Realistic data is used in projects, with calculations performed on UVM computer. *Prerequisite:* Any one of 141, 211, 241 or 262; Junior standing. Three hours. Aleong.

**225 APPLIED REGRESSION ANALYSIS** The nature and applications of basic regression-correlation models in investigating relationships, testing hypotheses and making predictions. Emphasis on developing appropriate models and evaluating existing research. Same as BSAD 244. *Prerequisite:* Any one of 111, 141, 211, 241, or 262. Three hours. Tashman.

**227 STATISTICAL METHODS FOR THE BEHAVIORAL SCIENCES** See Psychology 341 for course description.

**229 STATISTICAL METHODS FOR THE ENGINEERING SCIENCES** Multiple regression and response surface modeling, factorial design of experiments with statistical quality control. Probability distributions used in reliability and life testing. *Prerequisite:* Any one of 141, 211, 241 or 262. Three hours. Haugh.

**231 EXPERIMENTAL DESIGN** Basic experimental designs, complete and incomplete blocking, factorial designs; response surface method, fixed and random effects models. *Prerequisite:* Any one of 225 241, or 262 with permission of instructor; or any one of 221, 227, 229 or 313. Three hours. Aleong.

**233 SAMPLE SURVEY METHODS** Analysis, applications and comparisons of various sampling schemes: simple and stratified random, systematic, and cluster sampling. *Prerequisite:* Any one of 141, 211, 241, 261 or 313 plus any one of 51, 151 or 251. Three hours. Ashikaga. Alternate years, 1982-83.

**235 MULTIVARIATE METHODS** Properties and statistical methods, with applications, for the multivariate normal distribution including discriminant and factor analysis. *Prerequisites:* 241 or 261 plus any one of 221, 225, 227, 229, or 313. Three hours. Ashikaga. Alternate years, 1980-81.

**237 NONPARAMETRIC METHODS** Nonparametric procedures for hypothesis tests and confidence intervals, including rank and chi-square tests. *Prerequisite:* Any one of 141, 211, 241, or 261. Three hours. Alternate years, 1981-82.

**241 INTRODUCTION TO STATISTICAL INFERENCE** Introduction to statistical theory: parameter estimation, hypothesis testing, chi-square tests, regression analysis, and analysis of variance. *Prerequisites:* 251 or 12 hours of calculus and 3 hours of calculus-based probability. Three hours. Haugh.

**251 PROBABILITY THEORY** Non-measure theoretic course in probability, meeting for 11 weeks. Derivation of classical distributions, laws of large numbers and central limit theorems. *Prerequisite:* MATH 121. STAT 151 recommended. Three hours. Sylwester.

**252a, b, c STOCHASTIC PROCESSES AND TIME SERIES** Three one-credit mini-courses: 252a, Discrete processes: Random walks, Markov chains and discrete branching processes. *Prerequisite:* 151 or 251. 252b Continuous Processes Poisson, birth and death, and queueing processes. *Prerequisite:* 151 or

251. 252c Time Series Analysis Autoregressive-moving average models, auto and partial correlation functions, computer modeling. *Prerequisite:* Any one of 141, 211, 225, 241, or 262.

261, 262 STATISTICAL THEORY I,II Methods of point and interval estimation, hypothesis testing, and decision theory. Application of general principles to specific areas such as non-parametric tests, sequential analysis, and linear models. *Prerequisite:* For 261: 151 with instructor permission or 241 or 251. For 262: 241 with instructor permission or 261. Credits: 261: one hour, meeting last 4 weeks of Fall semester; 262: four hours. Sylwester.

281 STATISTICS PRACTICUM Intensive experience in carrying out a complete statistical analysis for a research project in a substantive area with close consultation with the project investigator. 1-4 credit hours. *Prerequisites:* One year of statistics and elementary computer programming.

295 SPECIAL TOPICS For advanced students. Lectures, reports and directed readings on advanced topics. *Prerequisite:* As listed in course schedule. 1-4 credit hours as arranged.

313 BIOMETRICS See Physiology 308 for course description.

391 MASTER'S THESIS RESEARCH Credit as arranged.

## VOCATIONAL EDUCATION AND TECHNOLOGY

*Professor Fuller (Chairperson); Associate Professors Bloom, Harris, Kelly, and Shimel; Assistant Professor Ferreira; Extension Associate Professor Moore; Extension Assistant Professors Patterson and Wells.*

The department offers two areas of concentration:

- (a) Occupational and Practical Arts Education — which leads to either an M.A.T. or an M.Ed. degree, and
- (b) Extension Education — which leads to a Master of Extension Education degree

Individuals seeking a maximum amount of flexibility in a program based upon both undergraduate and graduate courses are encouraged to consider the Fifth Year Certificate in Education. (See page of this bulletin.)

### OCCUPATIONAL AND PRACTICAL ARTS EDUCATION

#### *The Master of Arts in Teaching Degree Program*

The goal of this program is to strengthen an individual's background in a teaching field. The specialized areas of interest include agriculture and natural resource education, industrial arts and industrial education.

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

An undergraduate degree in an appropriate field of specialization. Completion of the necessary courses to meet the minimum requirements for a teaching certificate. Acceptable scores on the aptitude portion of the Graduate Record Examination.

Candidates who do not qualify for a teaching certificate, but have satisfactory teaching field preparation and Graduate Record Examination scores may be admitted. A professional field experience will need to be completed in addition to the minimum degree requirements.

### **MINIMUM DEGREE REQUIREMENTS**

See pages 24 and 23 for regulations of the Graduate College.

The Department expects a candidate to complete at least eighteen semester hours in professional education in his or her combined undergraduate and graduate programs, which includes preparation in the areas of Foundations of Education, methods for teaching, and learning and human development. Usually not more than six hours of independent study are allowed. A candidate is expected to complete at least one semester or two summers in residence on the University of Vermont campus in Burlington. Inquiries should be directed to Professor Gerald R. Fuller.

#### *The Master of Education Degree Program*

The goal of this program is to prepare the individual for professional leadership in occupational and practical arts education. Programs are planned jointly with the College of Education and Social Services in guidance and counseling, occupational education for the mentally retarded, or to meet individual goals as they relate to occupational and practical arts education.

The department expects each candidate to include study in one or more of the following areas as they relate to occupational and practical arts education: improvement of instruction, principles and problems involved in curriculum development, planning and managing educational programs, and/or research.

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

An undergraduate degree in an appropriate area. Eighteen hours of education courses or appropriate certification. Acceptable scores on the aptitude portion of the Graduate Record Examination.

### **MINIMUM DEGREE REQUIREMENTS**

See pages 24 and 25 for regulations of the Graduate College.

A candidate is expected to complete at least one semester or two summer sessions in residence on the University of Vermont camps in Burlington. Additional information on this degree program may be found on pages 79-83 of this bulletin. Inquiries should be directed to Professor Edward Ducharme, College of Education and Social Services, or Professor Gerald R. Fuller, College of Agriculture.

### **EXTENSION EDUCATION**

The goal of this program is to improve the knowledge and competencies of the student in a career field coupled with preparation for educational leadership

functions. Programs of study may be designed for educational responsibilities in one of the following specializations in the non-school based setting: agricultural or related agencies and organizations, business and industry, and youth programs and organizations.

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

An undergraduate degree with an acceptable major area of specialization. An acceptable score on the Miller Analogies Test. One year of satisfactory professional experience. A person may be admitted who does not have one year of appropriate professional experience, but it will be necessary to complete a field experience in addition to the minimum degree requirements.

### **MINIMUM DEGREE REQUIREMENTS**

See page for regulations of the Graduate College. A candidate is expected to complete at least six semester hours in the Vocational Education and Technology Department. Usually courses in political science, sociology, and/or research will be taken. Not more than six hours of independent study are allowed in a candidate's program. A candidate is expected to complete at least one semester or two summers in residence on the University of Vermont campus, Burlington, Vermont. Inquiries should be directed to Professor Gerald R. Fuller.

### **COURSES OFFERED**

**207, 208 UNDERSTANDING STUDENTS WITH SPECIAL NEEDS IN VOCATIONAL EDUCATION** Overview of special educational needs of handicapped and/or disadvantaged students; implications for planning and programming for special needs of youth in vocational, industrial and home economics education. (207 will focus on handicapped; 208 considers disadvantaged.) *Prerequisite:* Advanced standing in an approved VOTEC or Home Economics Teacher Certification concentration or permission of instructor. Two or three hours.

**253 TEACHING ADULTS** Needs, problems and objectives for the education of adults. *Prerequisite:* Senior standing, 12 or 52 and 104 or 251, or permission of instructor. Three hours. Kelly.

**271 TEACHING DIVERSIFIED OCCUPATIONS "HEAVY LAB" FOR STUDENTS WITH SPECIAL NEEDS** Objectives, procedures, materials, media and instructional strategies appropriate for teaching "heavy lab" activities to mentally retarded adolescents in Vermont's Diversified Occupations programs. *Prerequisites:* Acceptance into an acceptable teacher preparation concentration, and permission. Variable credit two or three hours offered by request.

**272 TEACHING DIVERSIFIED OCCUPATIONS "LIGHT LAB" FOR STUDENTS WITH SPECIAL NEEDS** Objectives, procedures, materials, media and instructional strategies appropriate for teaching "light lab" activities to mentally retarded adolescents in Vermont's Diversified Occupations pro-

grams. *Prerequisites:* Acceptance into an acceptable teacher preparation concentration, and permission. Variable credit two or three hours offered by request.

**275 DEVELOPING VOCATIONAL INSTRUCTION FOR STUDENTS WITH SPECIAL NEEDS** Curriculum content and instructional objectives appropriate for students with special needs in vocational, industrial and home economics education; consideration given to planning for individual student needs in regular and "special" vocational education settings. *Prerequisites:* Junior standing, 207 or 208 or equivalent and permission of instructor. (Admission to approved VOTEC or Home Economics teacher certification concentration.) Variable credit two or three hours. Offered by request.

**282 SEMINAR** Reports, discussions and investigations in selected fields. *Prerequisites:* Six VOTC hours 100 level and permission of instructor. One to three hours. I, II.

**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:* Six hours 100 level and Departmental permission. Credit as arranged. I, II. Staff

## ADDITIONAL GRADUATE COURSES

The following courses are also offered by the Vocational Education and Technology Department upon request, usually in the Summer Session and in the Evening Division.

**251 METHODS FOR TEACHING OCCUPATIONALLY ORIENTED SUBJECTS** Three hours.

**270 INTRODUCTION TO DIVERSIFIED OCCUPATIONS EDUCATION FOR SPECIAL NEEDS STUDENTS** Variable credit. Two or three hours.

**274 TEACHING VOCATIONAL RELATED ACADEMICS FOR STUDENTS WITH SPECIAL NEEDS** Variable credit. Two or three hours.

**276 RESOURCES AND PROCEDURES FOR TEACHING STUDENTS WITH SPECIAL NEEDS IN VOCATIONAL EDUCATION** Variable credit. Two or three hours.

**277 PRACTICUM IN DIVERSIFIED OCCUPATIONS EDUCATION** Variable credit. One hour per related course per semester.

## ZOOLOGY

*Professors Bell, Glade, Happ (Chairperson), Heinrich, Henson, and Potash; Associate Professors Davison, Kilpatrick, Landesman and Stevens; Assistant Professors Herbers, Pennypacker, Schall, and VanHouten; Research Assistant Professor Wilson.*

Faculty research interests fall within the general areas of environmental biology, developmental biology, genetics, evolutionary biology, physiology, and cell biology. Current ongoing projects include research in insect taxonomy and ecology, especially of the Carabidae; limnology; wetlands ecology; population ecology; ecology of parasites in lizards; evolutionary ecology; environmental controls of invertebrate development; endocrine control of insect development; developmental biology of amphibians, limb regeneration and pattern formation; immune response to cancer; physiological energetics of insects; foraging strategies; insect-plant coevolution; systematics and evolutionary genetics of vertebrates; genetics of behavioral and physiological mutants of *Paramecium*; membrane physiology; development genetics of *Drosophila*; biochemistry of cartilage formation. When applying, students are requested to indicate their general area of interest for research to the extent it is known. The Zoology Department also participates in the interdisciplinary Cell Biology Program.

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

An undergraduate major in zoology or its equivalent. Satisfactory scores on the Graduate Record Examination. Acceptability to the faculty member with whom the candidate wishes to do thesis research. Satisfactory completion of a qualifying examination.

### **MINIMUM DEGREE REQUIREMENTS**

Zoology Graduate Colloquia, 2 hours; 13-20 additional hours in zoology and related fields; thesis research (8-15 hours). Each candidate must participate in the teaching of at least one undergraduate course.

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

The department offers a program leading to the degree of Master of Arts in Teaching: See p. 23. 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 Departments 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 where approved by the advisor and the Dean. Appropriate courses in related science departments may be used 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

Satisfactory completion of: an academic year of graduate study at 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; satisfactory completion of a qualifying examination; satisfactory scores on the Graduate Record Examination; acceptability to the faculty member with whom the candidate wishes to do dissertation research. Students whose programs are to include physical chemistry should have had, or should take, mathematics through Mathematics 121 or its equivalent.

## 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 and must include 4 hours of Graduate Colloquia. The selection of courses will 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 dissertation research. Each candidate must participate in the teaching of at least one undergraduate course.

## COURSES OFFERED

**201 CONTROL OF GROWTH AND DIFFERENTIATION** Three hours.  
*Prerequisites:* Biology 101 and Chemistry 141, 142. Davison.

**202 QUANTITATIVE BIOLOGY** Mathematical concepts applied to biological problems such as growth, metabolism, temperature effects, kinetics, and

graphic interpretation of data. Statistics will not be treated. *Prerequisite:* An intermediate level course in biology, Mathematics 9, or permission of instructor. Three hours. Davison.

**203 POPULATION ECOLOGY** Analysis of growth, regulation, and interrelations of biological populations in theoretical, laboratory, and natural systems. *Prerequisite:* Biology 102. Three hours. Herbers.

**204 BIOLOGICAL ASPECTS OF WATER QUALITY MANAGEMENT** Designed to meet the needs of students who are developing careers in any of the various aspects of water resources. The biological and limnological viewpoints of the aquatic systems (lakes and streams); practical experience in methodology and interpretation in the field and laboratory. Credit will not be given for both Zoology 236 and this course. *Prerequisite:* Upperclass or graduate standing, a year of chemistry, two advanced courses in a related area, and permission of the instructor. Four hours. Henson.

**207 NATURAL HISTORY OF THE LOWER VERTEBRATES** Classification, ecology, behavior, evolution, and distribution of fish, amphibians, and reptiles. *Prerequisite:* 104. Three hours. Bell. Alternate years, 1980-81.

**208 GENERAL ENTOMOLOGY** Morphology, physiology, and evolution of insects. *Prerequisite:* 104 or Biology 102. Four hours. Bell. Alternate years, 1981-82.

**209 FIELD ZOOLOGY** Collection and identification; study of local habitats, their nature, and adaptations to them; factors governing distribution; methods of preparing study specimens. *Prerequisite:* 104 or Biology 102. Four hours. Bell.

**211 EMBRYOLOGY** Principles exemplified by typical invertebrate and vertebrate embryos. *Prerequisite:* 104. Four hours. 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. Glade.

**216 HUMAN GENETICS** Inheritance; population genetics; interaction of heredity and environment; application to human problems. *Prerequisite:* Biology 101. Three hours. Kilpatrick.

**219 COMPARATIVE AND FUNCTIONAL VERTEBRATE ANATOMY** Structure, function, and phylogeny; evolutionary and functional trends; investigation of the structure of all chordate groups. *Prerequisite:* 104. Four hours.

**222 EXPERIMENTAL EMBRYOLOGY** Theoretical approach based on research in embryology, genetics, physiology, bacteriology, and related fields. *Prerequisites:* 211 and permission of instructor. Four hours. Glade. Alternate years, 1980-81.

**223 BIOCHEMICAL EMBRYOLOGY** Biochemical and structural differentiation of cells and tissues during oogenesis and embryogenesis. *Prerequisites:*

Biology 101, 211; a course in biochemistry is recommended. Three hours. Landesman. Alternate years, 1981-82.

**225 ENVIRONMENTAL PHYSIOLOGY** Processes by which animals cope with moderate, changing, and extreme environments. *Prerequisites:* Biology 102 and 104. Four hours. Heinrich.

**231 CELL PHYSIOLOGY** Experimental techniques used to elucidate chemical and physical mechanisms within living cells. *Prerequisites:* Biology 103; Chemistry 141, 142 and permission of instructor. Four hours.

**236 LIMNOLOGY** The ecology of standing waters; the biota of lakes as related to the geological, physical, and chemical conditions of lakes. *Prerequisite:* Biology 102, chemistry. Four hours. Henson.

**237 ECOLOGY OF RUNNING WATERS** Stream and river environments, adaptations of organisms to varying physical, chemical, and biotic conditions. *Prerequisites:* Biology 102, chemistry. Four hours. Potash.

**250 INVERTEBRATE ZOOLOGY** Anatomy, physiology, and life histories of representatives of the more important phyla. Four hours. Henson.

**255 COMPARATIVE ANIMAL PHYSIOLOGY** General principles of function in invertebrates and vertebrates. *Prerequisites:* 104; Chemistry 141, 142; and permission of instructor. Four hours.

**262 BIOLOGICAL BASIS OF BEHAVIOR** The structure and function of neural and hormonal mechanisms involved in animal behavior with emphasis on phylogeny. *Prerequisite:* Biology 103 or permission of instructor. Three hours. Stevens.

**270 MODERN EVOLUTIONARY THEORY** Contributions of modern research in genetics, systematics, distribution, experimental embryology, serology, and related fields to problems of evolutionary change. *Prerequisite:* Biology 101 (102 recommended). Three hours. Kilpatrick.

**271 ADVANCED LIMNOLOGY** Analysis of current concepts and problems. *Prerequisite:* 236 Four hours. Henson.

**281 SEMINAR** Review and discussion of current zoological research. Graduate students and seniors in zoological research programs may enroll. Without credit.

## 295 SPECIAL TOPICS

**371 GRADUATE COLLOQUIA** Topics of current faculty and graduate student interest presented in a seminar-discussion format. Specific titles for colloquia will be listed in the course schedule. One hour.

**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 DOCTOR'S DISSERTATION RESEARCH** Credit as arranged.

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DONALD CUSHING FOSS M.S. (Wisconsin), Ph.D. (Massachusetts)	<i>Professor of Animal Sciences</i>
WAYNE LENIS FOX Ph.D. (Arizona)	<i>Professor of Special Education, Social Work, and Social Services</i>
STEVEN LESLIE FREEDMAN Ph.D. (Rutgers)	<i>Associate Professor of Anatomy and Neurobiology</i>
GERALD ROSS FULLER M.Ed., Ed.D. (Cornell)	<i>Professor of Vocational Education and Technology</i>
DANIEL WAYNE GADE M.S., Ph.D. (Wisconsin)	<i>Professor of Geography</i>
JAMES FRANCIS GATTI M.A., Ph.D. (Cornell)	<i>Associate Professor of Business Administration</i>
WILLIAM E. GEIGER, JR. Ph.D. (Cornell)	<i>Associate Professor of Chemistry</i>
WALTER RAY GIBBONS Ph.D. (Washington)	<i>Professor of Physiology and Biophysics</i>
ALPHONSE HENRY GILBERT M.S. (Michigan), Ph.D. (Colorado)	<i>Associate Professor of Resource Economics</i>
BRADY BLACKFORD GILLELAND M.A. (Oklahoma), Ph.D. (North Carolina)	<i>Professor of Classical Languages</i>
RICHARD WILLIAM GLADE M.S., Ph.D. (Illinois)	<i>Professor of Zoology</i>
ROBERT JOHN GOBIN M.Ed. (Bowling Green), Ph.D. (Ohio State)	<i>Professor of Physical Education</i>
LAWRENCE RUSSELL GORDON M.A., Ph.D. (North Carolina)	<i>Associate Professor of Psychology</i>
ALAN A. GOTLIEB M.S., Ph.D. (Wisconsin)	<i>Extension Associate Professor of Botany</i>
ARMINE E. GRAMS M.A. (DePaul), Ph.D. (Northwestern)	<i>Professor of Human Development</i>
ROBERT S. GRIFFIN Ph.D. (Minnesota)	<i>Associate Professor of Professional Education and Curriculum Development</i>
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BARRY E. GUITAR M.A. (Western Michigan), Ph.D. (Wisconsin)	<i>Associate Professor of Communication Science and Disorders</i>
DIETER W. GUMP M.D. (John Hopkins)	<i>Professor of Medicine</i>
STANLEY T. GUTMAN M.A., Ph.D. (Duke)	<i>Associate Professor of English</i>
ROBERT WILLIAM HALL M.A., Ph.D. (Harvard)	<i>Professor of Philosophy and Religion</i>
WILLIAM HALPERN M.S. (Stanford), Ph.D. (Vermont)	<i>Associate Professor of Physiology and Biophysics</i>

SAMUEL B. HAND

Ph.D. (Syracuse)

Professor of History

MORRIS HANDELSMAN

M.E.E. (Ohio), Ph.D. (Syracuse)

Professor of Electrical Engineering

EDWARD MICHAEL HANLEY

M.A. (Syracuse), Ph.D. (Harvard)

Professor of Special Education, Social Work,

PETER ROBERT HANNAH

M.F. (Yale), Ph.D. (Syracuse)

and Social Services

CHAD D. HANSEN

Ph.D. (Michigan)

Professor of Forestry

BETH A. HART

M.S., Ph.D. (Cornell)

Associate Professor of Philosophy

SUSAN E. HASALET

M.Ed. (Vermont), Ed.D. (Boston)

Associate Professor of Special Education, Social Work,

LARRY D. HAUGH

M.A., M.S., Ph.D. (Wisconsin)

and Social Services

Associate Professor of Mathematics

WILLIAM A. HAVELAND

M.A., Ph.D. (Pennsylvania)

Professor of Anthropology

DAVID R. HEMENWAY

M.S., Ph.D. (North Carolina)

Associate Professor of Civil Engineering

EDITH D. HENDLEY

M.S. (Ohio State), Ph.D. (Illinois)

Associate Professor of Physiology and Biophysics

EARL BENNETT HENSON

M.S. (West Virginia), Ph.D. (Cornell)

Professor of Zoology

DAVID HAMMOND HIRTH

M.S. (Massachusetts), Ph.D. (Michigan)

Associate Professor of Wildlife Biology

DAVID R. HOLMES

M.A. (Columbia), Ph.D. (Denver)

Assistant Professor of Professional Education and

JAMES ROBINSON HOWE

M.A., Ph.D. (N.Y.U.)

Curriculum Development

DAVID CHARLES HOWELL

M.S., Ph.D. (Tulane)

Professor of English

DAVID HUDDLE

M.A. (Hollins), MPA (Columbia)

Associate Professor of English

MAHENDRA SINGH HUNDAL

M.S., Ph.D. (Wisconsin)

Professor of Mechanical Engineering

ALLEN STANDISH HUNT

M.S. (Michigan), Ph.D. (Harvard)

Professor of Geology

LYMAN CURTIS HUNT, JR.

M.A., Ed.D. (Syracuse)

Professor of Professional Education and

PATRICK H. HUTTON

M.A., Ph.D. (Wisconsin)

Curriculum Development

BEAL BAKER HYDE

A.M., Ph.D. (Harvard)

Associate Professor of History

JOSEPH ANTHONY IZZO, JR.

M.S. (Illinois), Ph.D. (Columbia)

Professor of Botany

JULIAN JOSEPH JAFFE

M.A., Ph.D. (Harvard)

Professor of Mathematics

JUSTIN MANFRED JOFFE

M.A. (U. of W. Waterland), Ph.D. (U. of London)

Professor of Pharmacology

Professor of Psychology

ROBERT D. BONES ARISTOTONE

M.S., Ph.D. (Rutgers)

LEONIDAS MONROE JONES

A.M., Ph.D. (Harvard)

BRUCE SHEPARD KAPP

M.S., Ph.D. (New York U.)

PHILIP C. KELLEHER

M.D. (Georgetown)

MARC Z. KESSELER

Ph.D. (Nebraska)

WILLIAM KILPATRICK

M.S. (Midwestern U.), Ph.D. (North Texas State U.)

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Ph.D. (Princeton)

PHILIP KITCHER

Ph.D. (Princeton)

RICHARD M. KLEIN

M.S., Ph.D. (Chicago)

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M.Ed. (Vermont), Ed.D. (Boston)

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M.A., Ph.D. (Harvard)

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Ph.D. (Temple)

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M.S., Ph.D. (Lehigh)

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Ph.D. (Hahnemann)

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Ph.D. (Maryland)

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M.B., Ph.D. (Syracuse)

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D. Eng. (Johns Hopkins)

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M.S. (Connecticut), Ph.D. (Cornell)

LLOYD MILTON LAMBERT, JR.

M.S.E.E., M.A., Ph.D. (California)

MERTON PHILIP LAMDEN

Ph.D. (M.I.T.)

RICHARD H. LANDESMAN

M.S. (N.Y.U.), Ph.D. (British Columbia)

HELENE WANDA LANG

M.Ed., Ed.D. (Boston U.)

MARK B. LAPPING

Ph.D. (Emory)

Professor of Mathematics and Statistics

Professor of English

Associate Professor of Mathematics

Associate Professor of Medicine

Associate Professor of Pathology

Associate Professor of Zoology

Associate Professor of Philosophy

Associate Professor of Philosophy

Professor of Botany

Assistant Professor of Special Education, Social

Work and Social Services

Professor of Chemistry

Assistant Professor of Anatomy and Neurobiology

Professor of English

Associate Professor of Anatomy and Neurobiology

Professor of Chemistry

Associate Professor of Wildlife Biology

Professor of Business Administration

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Professor of Physics

Professor of Biochemistry

Associate Professor of Zoology

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and Curriculum Development

Associate Professor, Environmental Programs  
and Natural Resources

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and Foundational Studies*  
M.Ed. (Brigewater), Ed.D. (Boston)
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M.A., Ph.D. (Delaware)
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Health, and Learning Studies*  
M.S. (St. John's), Ed.D. (Syracuse)
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M.A. (Northwestern), Ph.D. (Florida)
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M.A. (Wayne State), Ph.D. (Wisconsin)
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Work, and Social Services*  
Ph.D. (Arizona)
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M.S., Ph.D. (Wisconsin)

HAROLD AUSTIN MEEKS M.A., Ph.D. (Minnesota)	<i>Associate Professor of Geography</i>
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WILLIAM LAROS MEYER Ph.D. (U. of Washington)	<i>Associate Professor of Biochemistry</i>
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MARIAFRANCA MORSELLI Ph.D. (Milano)	<i>Research Associate of Botany</i>
BROOKE T. MOSSMAN M.S., Ph.D. (Vermont)	<i>Research Assistant Professor of Pathology</i>
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ROBERT A. NEWMAN M.S., Ph.D. (Connecticut)	<i>Assistant Professor of Pharmacology</i>
CARLTON M. NEWTON Ph.D. (SUNY at Syracuse)	<i>Associate Professor of Forestry</i>
KAY MILLIGAN NILSON M.S. (Utah), Ph.D. (Nebraska)	<i>Professor of Animal Sciences</i>
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CHARLES PRYOR NOVOTNY Ph.D. (Pittsburgh)	<i>Associate Professor of Medical Microbiology</i>
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- SUSAN D. PAGE** *Assistant Professor of Medical Technology*  
M.S. (Ohio State)
- PHYLLIS PAOLUCCI-WHITCOMB** *Assistant Professor in Special Education, Social Work and Social Services*  
M.Ed. (Vermont), Ed.D. (Boston)
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M.B.A. (Pennsylvania State), Ph.D. (Massachusetts)
- BRUCE L. PARKER** *Associate Professor of Plant and Soil Science.*  
M.S., Ph.D. (Cornell)
- RODNEY LAWRENCE PARSONS** *Professor of Anatomy and Neurobiology*  
Ph.D. (Stanford)
- NORMAN EUGENE PELLETT** *Associate Professor of Plant and Soil Science*  
M.S., Ph.D. (Minnesota)
- NEIL H. PELSUE, JR.** *Associate Professor of Agricultural and Resource Economics*  
M.S. (Massachusetts), Ph.D. (Purdue)
- DANIEL PETER PERL** *Associate Professor of Pathology*  
M.D. (SUNY)
- JAMES ALLAN PETERSON** *Professor of Organizational, Counseling, and Foundational Studies*  
M.Ed. (South Dakota State), Ed.D. (Boston U.)
- SIDNEY BORIS POGER** *Professor of English*  
M.A., Ph.D. (Columbia)
- MILTON POTASH** *Professor of Zoology*  
M.A. (Indiana), Ph.D. (Cornell)
- DAVID WILLIAM RACUSEN** *Professor of Microbiology and Biochemistry*  
Ph.D. (Iowa State)
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M.M. (N.E. Conservatory), D.M.A. (Peabody Conservatory)
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M.A. (Virginia), M.D. (Columbia)
- JOHN PATRICK MARTINDALE REED** *Assistant Professor of Medical Technology*  
M.S. (Vermont)
- JOE ERNEST REICHLE** *Visiting Assistant Professor of Special Education, Social Work and Social Services*  
M.A. (Kansas State), Ph.D. (Wisconsin)
- ERNEST REIT** *Associate Professor of Pharmacology*  
D.V.M. (Cornell), Ph.D. (Yale)
- S. ALEXANDER RIPPA** *Professor of Organizational, Counseling, and Foundational Studies*  
M.A. (Vanderbilt), Ed.D. (Harvard)
- ALTON O. ROBERTS** *Assistant Professor of Professional Education and Curriculum Development*  
M.S. (Syracuse & Canisius), Ph.D. (Syracuse)
- JON ERIK ROLF** *Associate Professor of Psychology*  
Ph.D. (Minnesota)
- ALFRED F. ROSA** *Professor of English*  
M.A., Ph.D. (Massachusetts)
- JAMES CARL ROSEN** *Assistant Professor of Psychology*  
Ph.D. (Nevada)
- JANE K. ROSS** *Assistant Professor of Human Nutrition and Foods*  
M.S. (Purdue), Ph.D. (Oregon State)
- WILFRED ROTH** *Professor of Electrical Engineering*  
Ph.D. (M.I.T.)
- KENNETH S. ROTHWELL** *Professor of English*  
M.A., Ph.D. (Columbia)

- STANLEY RUSH  
M.S., Ph.D. (Syracuse)  
*Professor of Electrical Engineering*
- SAMUEL F. SAMPSON  
M.A. (Oklahoma); Ph.D. (Cornell)  
*Professor of Sociology*
- KAREN WILEY SANDLER  
M.A. (Pennsylvania State), Ph.D. (Pennsylvania)  
*Assistant Professor of Romance Languages*
- FREDERIC OBERLIN SARGENT  
Ph.D. (Wisconsin)  
*Professor of Resource Economics*
- KENNETH P. SAURMAN  
M.A. (Kent State), Ed.D. (Loyola)  
*Professor of Organizational Counseling,  
and Foundational Studies*
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M.A. (Williams), Ph.D. (R.P.I.)  
*Professor of Physics*
- WARREN IRA SCHAEFFER  
M.S., Ph.D. (Rutgers)  
*Professor of Medical Microbiology*
- ELEANOR D. SCHLENKER  
M.S. (Drexel); Ph.D. (Michigan State)  
*Associate Professor of Human Nutrition*
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Ph.D. (Cincinnati)  
*Professor of Classics*
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M.S., Ph.D. (Cornell)  
*Assistant Professor of Sociology*
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M.A., Ph.D. (Yale)  
*Professor of History*
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M.A., Ed.D. (Columbia)  
*Associate Professor of Music*
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Ph.D. (Miami)  
*Assistant Professor of Anatomy and Neurobiology*
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Ph.D. (Indiana)  
*Associate Professor of German*
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Ph.D. (Harvard)  
*Professor of History*
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M.A. (Brown), Ph.D. (Pennsylvania)  
*Professor of English*
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Ph.D. (Columbia)  
*Professor of Philosophy*
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M.A., Ph.D. (California)  
*Professor of Organizational, Counseling, and  
Foundational Studies*
- LARRY E. SHIRLAND  
M.S., Ph.D. (Oregon State)  
*Associate Professor of Business Administration*
- KENNETH ROGERS SIMMONS  
M.S., Ph.D. (Cornell)  
*Associate Professor of Animal Sciences*
- R. THOMAS SIMONE  
M.A., Ph.D. (Claremont)  
*Assistant Professor of English*
- ROBERT ORVILLE SINCLAIR  
M.S. (Vermont), Ph.D. (Michigan State)  
*Professor of Agricultural and Resource Economics*
- ROBERT ERIK SJOGREN  
M.S., Ph.D. (Cincinnati)  
*Associate Professor of Microbiology and Biochemistry*
- ALBERT MATTHEW SMITH  
M.S., Ph.D. (Cornell)  
*Professor of Animal Sciences*
- CAROL J. SMITH  
Ph.D. (Vermont)  
*Research Assistant Professor of Medicine*

LESTER R. SOYKA M.S., M.D. (Illinois)	<i>Professor of Pharmacology</i>
KEVORK SPARTALIAN M.S., Ph.D. (Carnegie-Mellon)	<i>Assistant Professor of Physics</i>
THOMAS JOHN SPINNER M.A. (Columbia), Ph.D. (Rochester)	<i>Professor of History</i>
ROBERT EVERETT STANFIELD A.M., Ph.D. (Harvard)	<i>Professor of Sociology</i>
ROLFE SEATON STANLEY M.S., Ph.D. (Yale)	<i>Professor of Geology</i>
MICHAEL N. STANTON Ph.D. (Rochester)	<i>Associate Professor of English</i>
STANISLAW JAN STARON M.A., Ph.D. (U. St. Andrew's, Scotland)	<i>Professor of Political Science</i>
RONALD ALBERT STEFFENHAGEN M.S.A. (Wayne State), Ph.D. (SUNY Buffalo)	<i>Associate Professor of Sociology</i>
HENRY JOHN STEFFENS M.A., Ph.D. (Cornell)	<i>Professor of History</i>
WILLIAM A. STEPHANY M.A., Ph.D. (Delaware)	<i>Assistant Professor of English</i>
DEAN FINLEY STEVENS A.M. (Boston U.), Ph.D. (Clark)	<i>Associate Professor of Zoology</i>
WARREN R. STINEBRING M.S., Ph.D. (Pennsylvania)	<i>Professor of Medical Microbiology</i>
MARK A. STOLER M.A., Ph.D. (Wisconsin)	<i>Associate Professor of History</i>
NEIL RALPH STOUT M.S., Ph.D. (Wisconsin)	<i>Professor of History</i>
MICHAEL JOHN STRAUSS Ph.D. (California)	<i>Professor of Chemistry</i>
ANNE M. SULLIVAN M.S. (Vermont)	<i>Associate Professor of Medical Technology</i>
RICHARD SWETERLITSCH M.A. (Duquesne), Ph.D. (Indiana)	<i>Assistant Professor of English</i>
DAVID LUTHER SYLWESTER A.M. (Indiana), Ph.D. (Stanford)	<i>Professor of Mathematics and Community Medicine</i>
LEONARD J. TASHMAN Ph.D. (Brown)	<i>Associate Professor of Business Administration</i>
JOHN WALTER THANASSI Ph.D. (Yale)	<i>Professor of Biochemistry</i>
LEE B. THOMPSON M.A. (Manitoba), Ph.D. (Queen's)	<i>Associate Professor of English</i>
HELENE W. TOOLAN Ph.D. (Cornell)	<i>Associate Professor of Pathology</i>
RAYMOND HERMAN TREMBLAY M.S. (Vermont), Ph.D. (Cornell)	<i>Professor of Agricultural and Resource Economics</i>
ROBERT S. TYZBIR Ph.D. (Rhode Island)	<i>Assistant Professor of Human Nutrition</i>
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CANUTE VANDERMEER M.A., Ph.D. (Michigan)	<i>Professor of Geography</i>

- HUBERT WALTER VOGELMANN  
M.A., Ph.D. (Michigan) *Professor of Botany*
- ROSS TIMM VOGELSBERG  
M.S. (Utah), Ph.D. (Illinois) *Visiting Assistant Professor of Special Education,  
Social Work and Social Services*
- BRANIMIR F. VON TURKOVICH  
M.S. (U. of Madrid), Ph.D. (Illinois) *Professor of Mechanical Engineering*
- GEORGE DAYTON WEBB  
M.A.T. (Yale), Ph.D. (Colorado) *Associate Professor of Physiology and Biophysics*
- FRED CLARENCE WEBSTER  
M.S. (Vermont), Ph.D. (Cornell) *Professor of Agricultural and Resource Economics*
- JOHN GEORGE WEIGER  
M.A. (Colorado), Ph.D. (Indiana) *Professor of Romance Languages*
- JAMES GRAHAM WELCH  
M.S., Ph.D. (Wisconsin) *Professor of Animal Sciences*
- DAVID LLOYD WELLER  
Ph.D. (Iowa State) *Professor of Microbiology and Biochemistry*
- JOSEPH WELLS  
Ph.D. (Duke) *Associate Professor of Anatomy and Neurobiology*
- EUGEN EMMANUEL WELTIN  
Dipl.Sc.Nat., Dr.Sc.Nat. (E.T.H., Switzerland) *Associate Professor of Chemistry*
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Ph.D. (Case Western Reserve) *Professor of Political Science*
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Ph.D. (Vanderbilt) *Associate Professor of Romance Languages*
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M.A., Ph.D. (Harvard) *Professor of Chemistry*
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Ph.D. (Washington) *Associate Professor of Physiology and Biophysics*
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M.S., Ph.D. (Wisconsin) *Professor of Plant and Soil Science*
- RONALD W. WILLIAMS  
Ph.D. (Iowa State) *Professor of Electrical Engineering*
- WAYNE WESTON WILLIAMS  
M.A., Ph.D. (Wisconsin) *Assistant Professor of Special Education Social Work,  
and Social Services*
- MARY SWEIG WILSON  
M.A. (Emerson), Ph.D. (Northwestern) *Professor of Communication Science and Disorders*
- GLEN M. WOOD  
M.S., Ph.D. (Rutgers) *Professor of Plant and Soil Science*
- ROBERT CUMMINGS WOODWORTH  
Ph.D. (Penn State) *Professor of Biochemistry*
- ARNOLD PETER WOOLFSON  
M.A. (Toronto), Ph.D. (SUNY at Buffalo) *Associate Professor of Anthropology*
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M.S., Ph.D. (Syracuse) *Associate Professor of Communication*
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M.S. (Canterbury), Ph.D. (British Columbia) *Associate Professor of Botany*
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M.A., Ph.D. (Columbia) *Professor of Mathematics*
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Ph.D. (M.I.T.) *Professor of Chemistry*
- DHARAM PAUL YADAV  
M.A. (Delhi), Ph.D. (Michigan State) *Assistant Professor of Communication*

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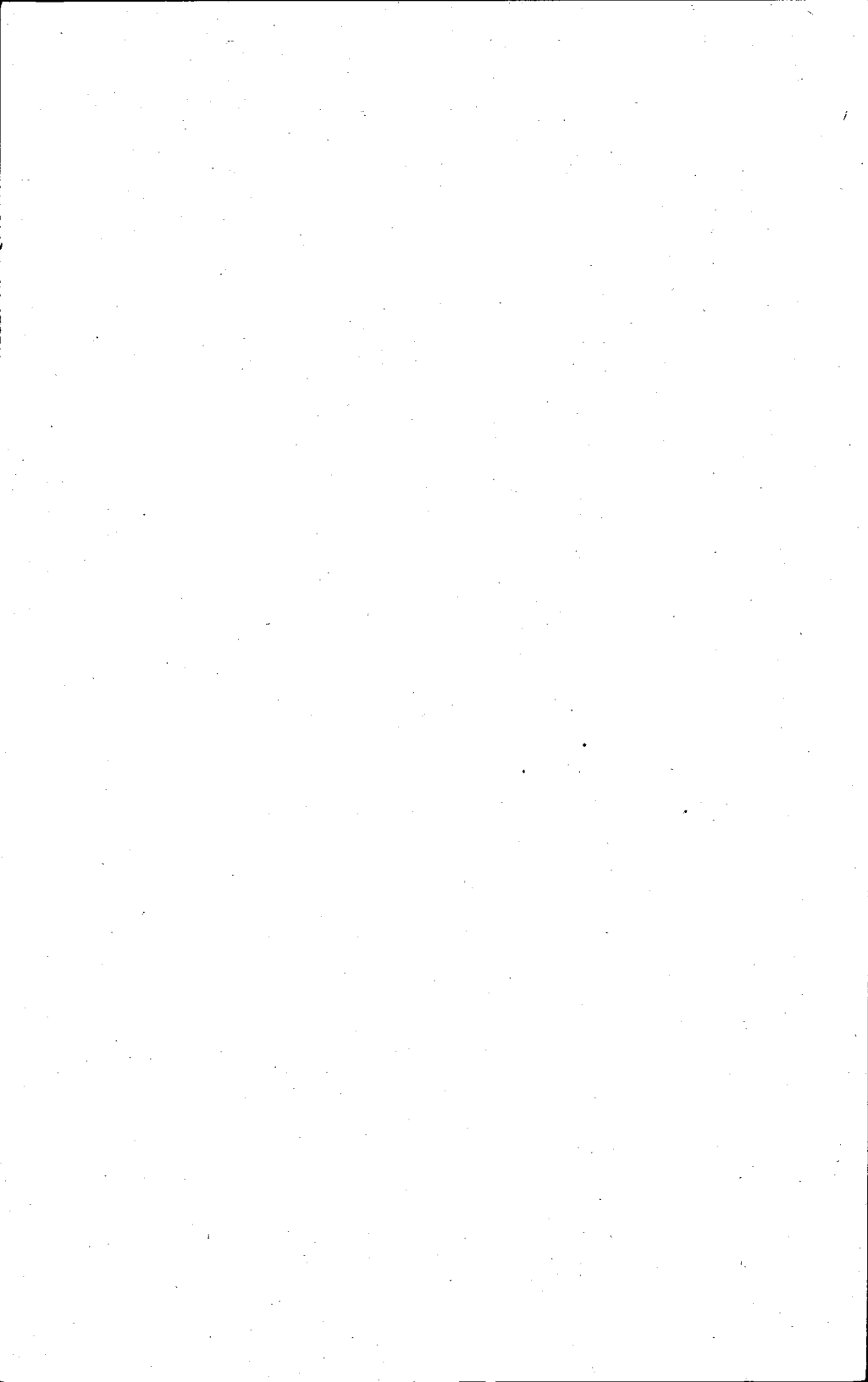
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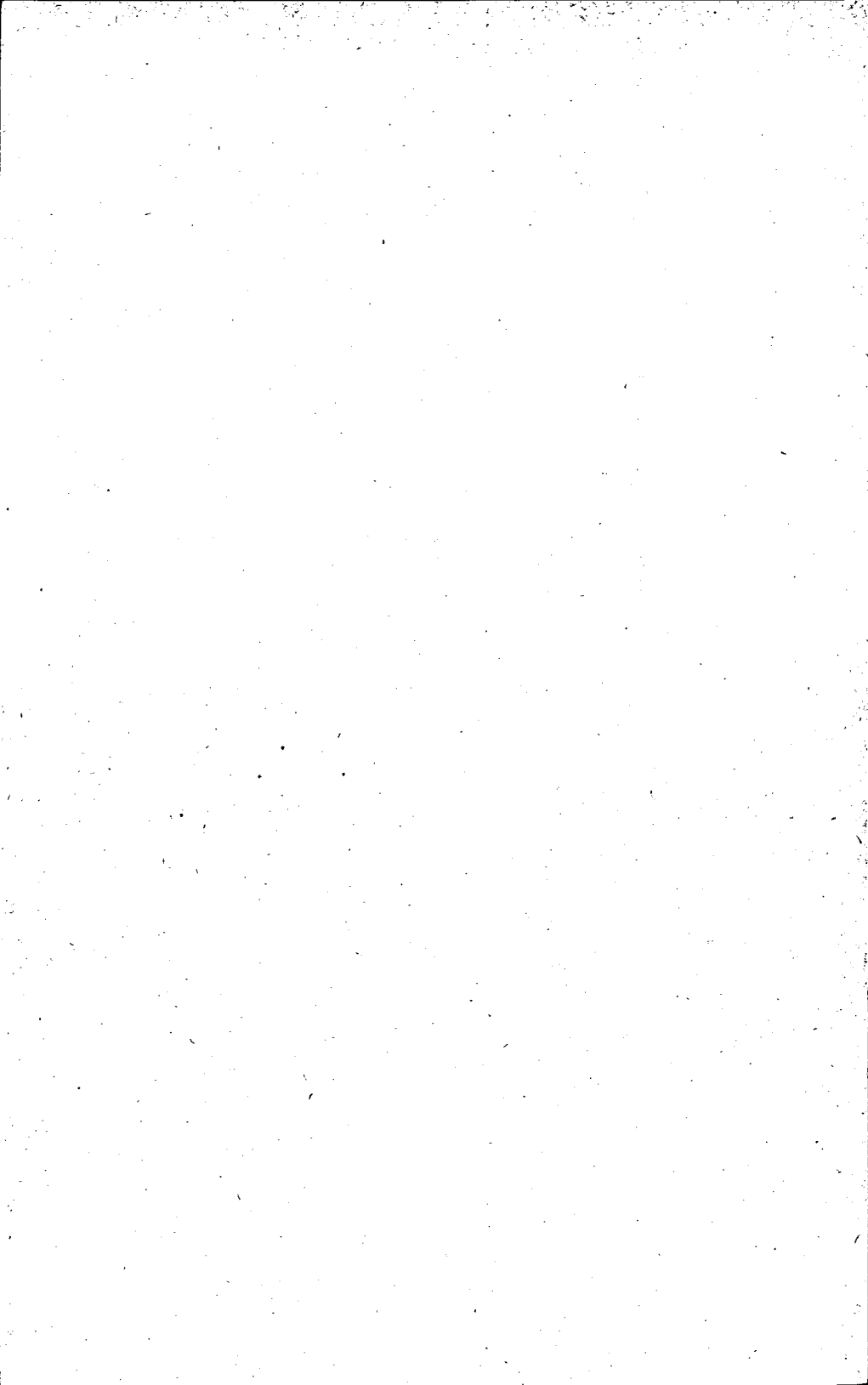
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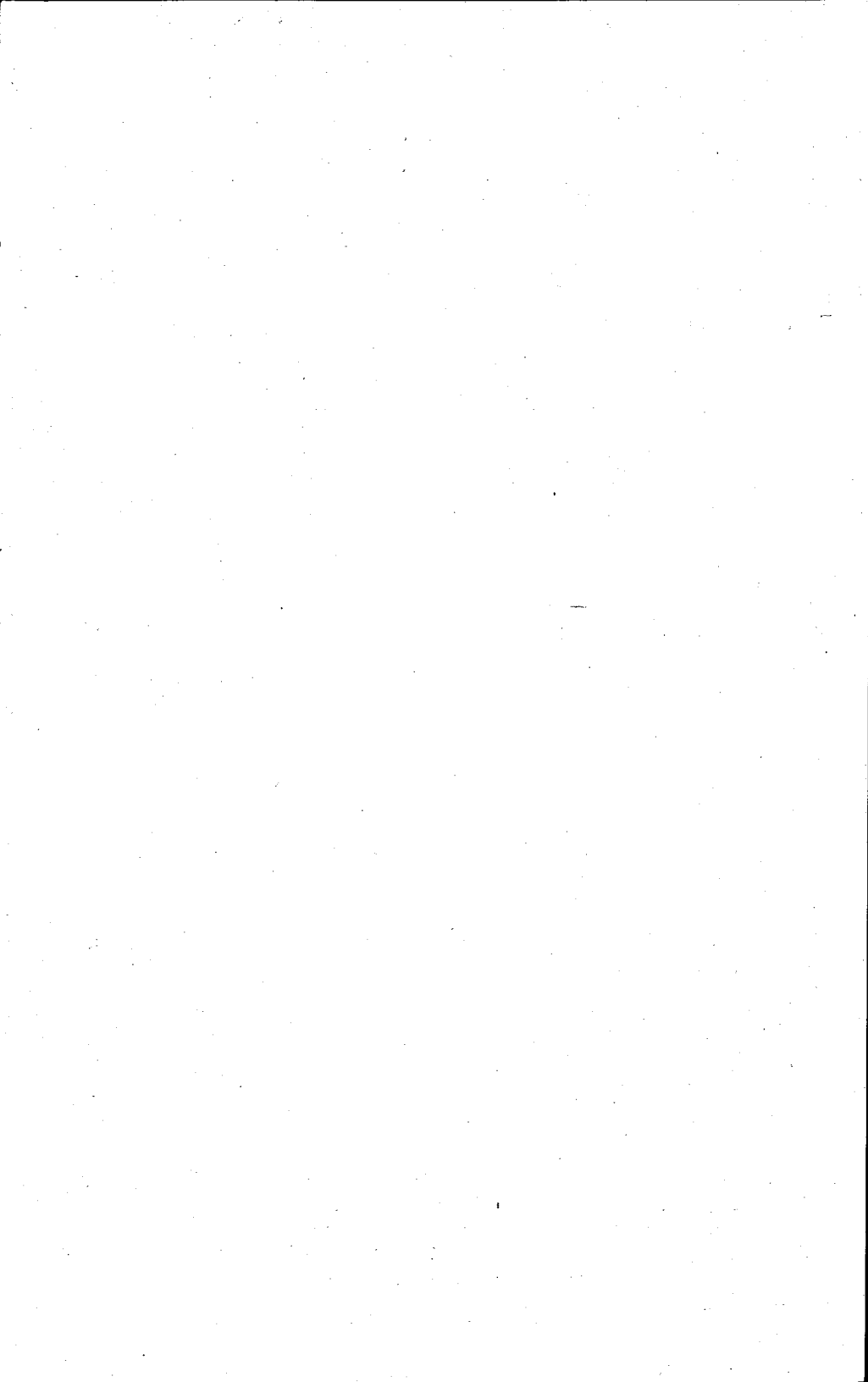
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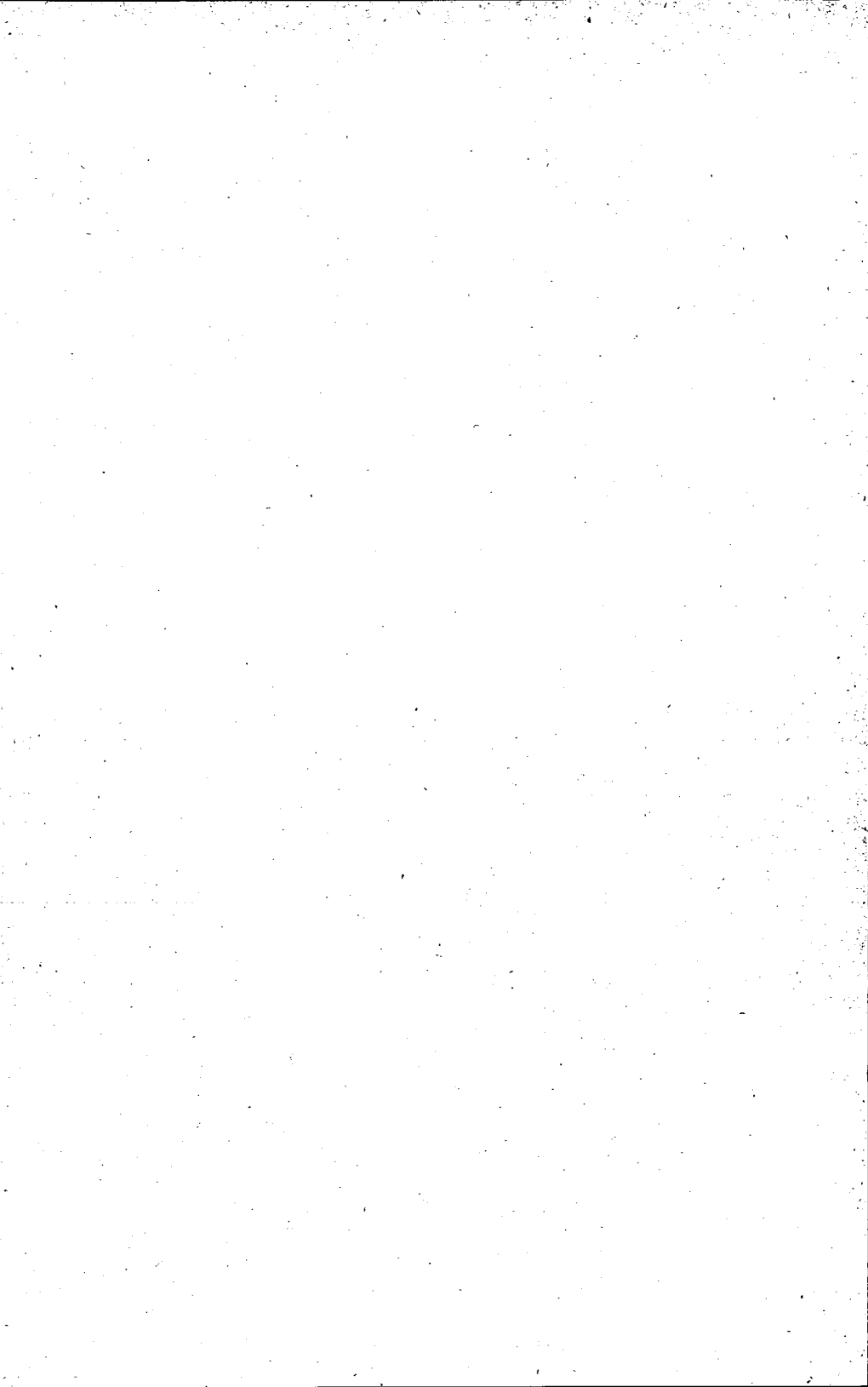
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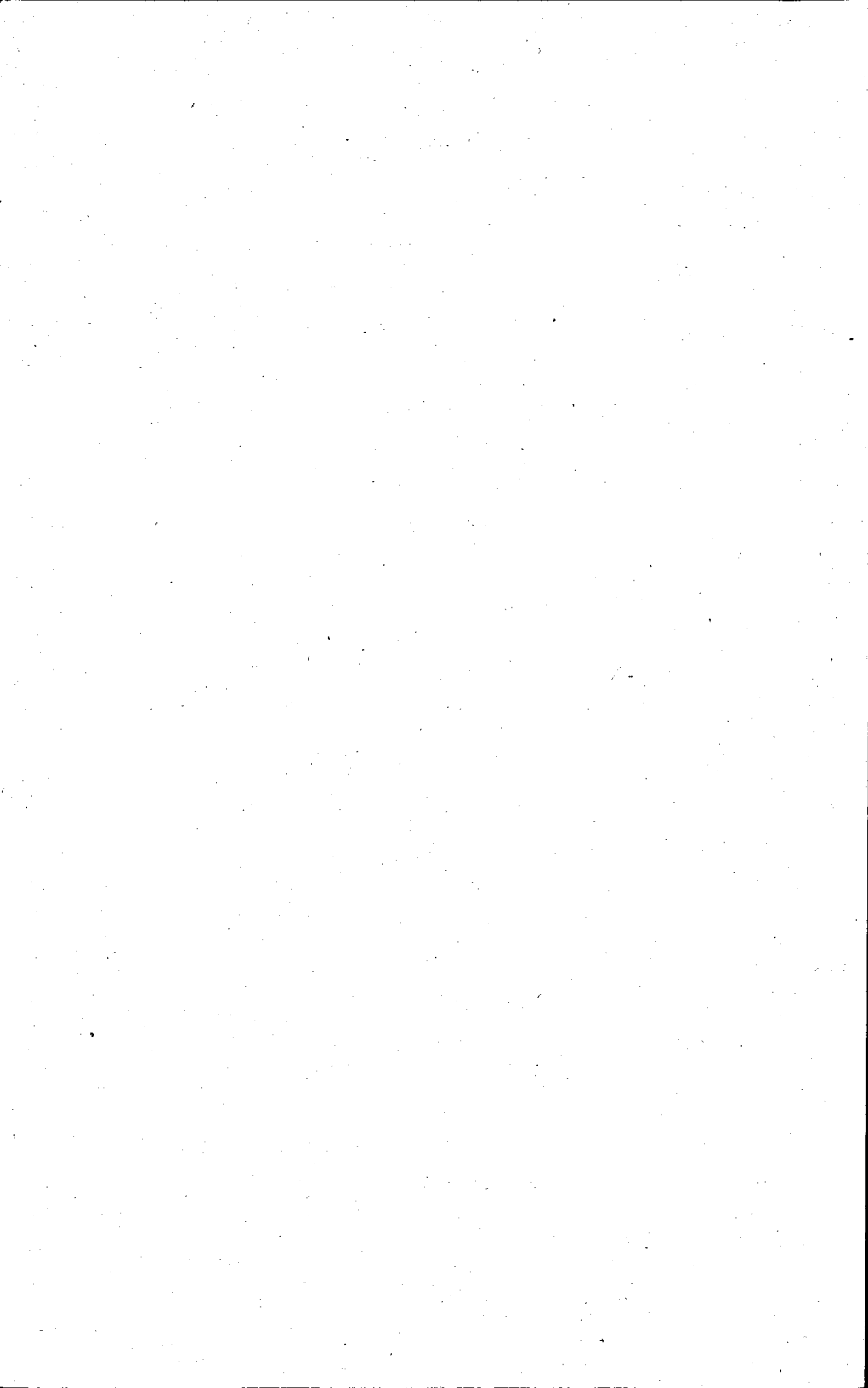
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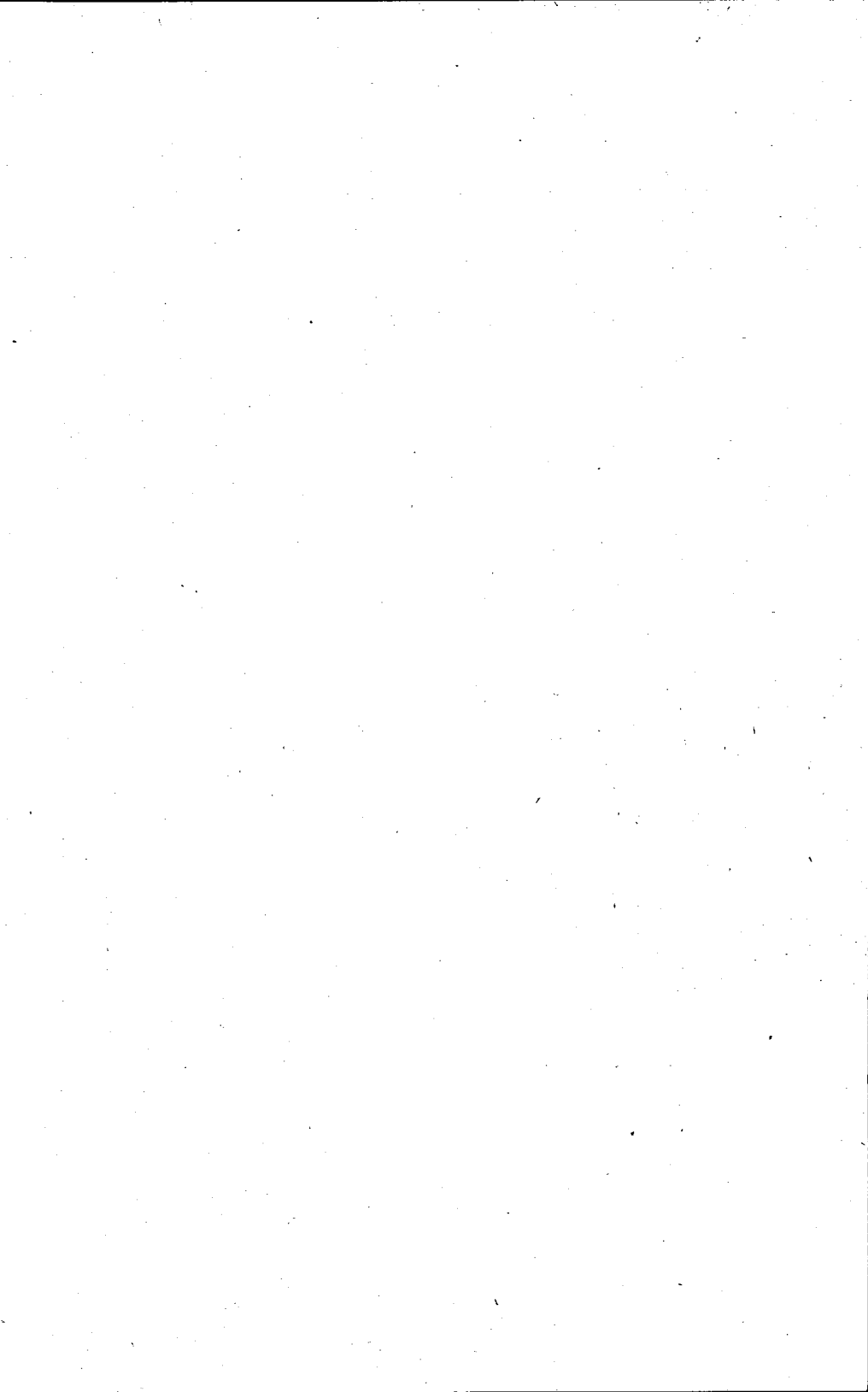












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