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**BULLETIN OF THE
UNIVERSITY OF
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**GRADUATE SCHOOL
ISSUE**



University of
New Hampshire
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The Graduate School 1977-78



Map of New Hampshire	2
Graduate Degree Programs	3
Graduate Education at the University of New Hampshire	5
Teaching, Service, and Research	9
Admission, Financial Aid, and Academic Regulations	15
UNH and Graduate Life	31
Departmental Requirements and Course Descriptions	41
Trustees and Officers of the University	135
Faculty of the Graduate School	138
Campus Map and Key	150
Index	153
Graduate School Calendar 1977-78	156




SKIING 90 minute drive

BEACHES. . . 30 minute drive

BOSTON. . . . 90 minute drive

KEY

 *University System of N.H.*

 *Route Numbers*



Scale 1 inch = about 60 miles

Graduate Degree Programs

Master of Science

Animal Sciences
Biochemistry
Biology
Botany
Chemical Engineering
Chemistry
Civil Engineering
Electrical Engineering
Entomology
Genetics
Geology
Home Economics
Mathematics
Mechanical Engineering
Microbiology
Music Education
Natural and
 Environmental Resources
Physical Education
Physics
Plant Science
Zoology

Master of Arts

Economics
English
German
History
Music
Political Science
Psychology
Sociology
Spanish

Master of Arts in Teaching

Master of Science for Teachers

Biology
Chemistry
English
French
Mathematics
Physics
Spanish

Master of Occupational Education

Master of Business Administration

Master of Education

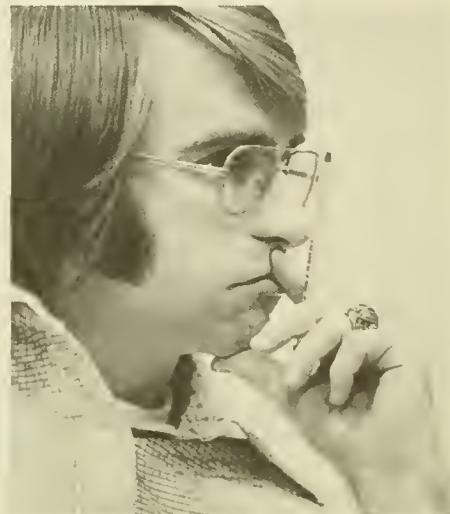
Administration and
 Supervision
Counseling and
 Personnel Services
Early Childhood
Elementary Education
Reading
Secondary Education

Master of Public Administration

Political Science

Doctor of Philosophy

Biochemistry
Botany
Chemistry
Economics
Engineering
English
Genetics
History
Mathematics
Mathematics Education
Microbiology
Physics
Plant Science
Psychology
Sociology
Zoology





Graduate Education At the University of New Hampshire

The University of New Hampshire awarded its first Ph.D. degree in 1896, placing it among the first American universities to award that degree. The doctoral programs in their present form began in the 1950s. The Graduate School has been a formal part of the University structure for over 50 years. The graduate faculty supervises graduate study at the University, and a Graduate Council, composed of elected faculty and student representatives, serves in an advisory capacity.

Guided by the quest for academic excellence, the University has followed a gradual, systematic approach in developing graduate programs. The goal has been to develop programs that are commensurate with institutional resources and the needs and opportunities found in New Hampshire and New England, to coordinate programming among the units of the University System of New Hampshire, and to avoid the pitfalls of overexpansion. The Graduate School cooperates with other graduate schools in New England to coordinate the further planning and development of graduate education in the New England region and participates in the New England Regional Student Program (see p. 16).

Master's Programs

The University offers master's degree programs in a wide variety of disciplines. The master's degree can serve either as a professional terminal degree or as an intermediate degree for those intending to pursue further graduate study. Master's programs at the University of New Hampshire have been carefully developed and are reviewed by the graduate dean and faculty to ensure their continuing quality. In most programs, students can elect options that will permit them either to study one aspect of a discipline in depth by preparing a thesis or to gain a broader mastery of a discipline by electing to take course work in lieu of a thesis. While master's programs are generally designed to be completed in a calendar year of full-time study, it is also possible to pursue many programs on a part-time basis. Recipients of the University of New Hampshire's master's degrees have found employment in education, government, and business organizations in the state and nation, while others have been successful in further graduate study.

Doctoral Programs

The University offers programs leading to the Doctor of Philosophy in those disciplines where it has both faculty and facilities to support advanced graduate education of high quality. Care has also been taken to ensure that the programs will make a significant contribution to the opportunities for doctoral education in the New England region. Doctoral education properly focuses upon preparing the student to contribute to the growth of knowledge through research. However, since a large percentage of doctoral students find employment in higher education, most doctoral

programs provide opportunities for students to work as teaching assistants and to participate in seminars in teaching led by experienced faculty members. This preparation for the student's future role as both developer and communicator of knowledge has enabled recipients of the doctoral degree from the University of New Hampshire to obtain attractive teaching and research positions.

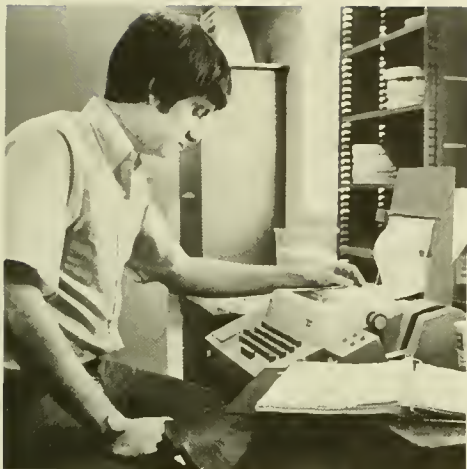
Interdisciplinary Programs



Many of the problems faced by modern society demand that students be trained in more than one of the traditional academic disciplines. Consequently, the Graduate School encourages programs which involve the faculty of more than one discipline or department. This may be done through such formal organizations as the Genetics Program, which involves geneticists from many departments in both master's and doctoral programs; or the Institute of Natural and Environmental Resources, which brings together resource economists, foresters, wildlife specialists, hydrologists, and soil scientists to address the problems of our environment; or the Intercollegiate Biological Sciences Organization, which makes the resources of the biological science departments available to students in master's programs designed for secondary and junior college teachers. Several options for interdisciplinary study also exist under the Marine Program (see p. 10). To encourage the development of additional interdisciplinary opportunities, the graduate faculty recently adopted procedures which permit establishment of interdisciplinary options within established doctoral programs.

Other forms of cooperation are less formal, as when students from one department work with faculty from other departments to develop a program, thus combining the strengths of several disciplines. An example of this is the Soil and Water-Chemistry Program, which involves faculty in soils and hydrology cooperating with faculty in chemistry. Students in zoology frequently work with faculty in such other departments as animal sciences and entomology to broaden their scope in their graduate programs. In the social sciences, the psychology and sociology departments cooperate in a social-psychology doctoral program. The Engineering Ph.D. Program is a cooperative, interdisciplinary effort of the electrical engineering, civil engineering, mechanical engineering, and chemical engineering departments.

Students in all programs are encouraged to identify, with their advisers, courses outside of their disciplines that are appropriate to their professional goals.





Teaching, Service, and Research

Research is an essential part of graduate education; it sustains a continuing transfusion of knowledge that enhances the level of instruction, extends the frontiers of understanding, and makes human progress possible. It provides an opportunity for graduate students to learn by working with instructors on independent projects or as part of research teams. Ultimately, the goal is to share discoveries and applications with others in the state, region, and world. To ensure that the University's research efforts are closely tied to its educational efforts, the dean of the Graduate School is also director of research.

Research and Service Facilities

The University has many diversified research projects, ranging from highly specialized investigations in the physical and biological sciences to broad interdisciplinary marine studies. Graduate students are involved in this research as project assistants working on research leading to masters' theses and doctoral dissertations. These projects are conducted in individual departments, in University research centers, and in larger service units on the campus.

Among the centers are the Center for Industrial and Institutional Development, the Water Resources Research Center, and the Resources Development Center — all of which provide specialized research and service to New Hampshire business, industry, and government. The Marine Program, supported by an institutional Sea Grant Award and state funding, has facilities both on campus and at the Jackson Estuarine Laboratory. The Space Science Center and the Engineering Design and Analysis Laboratory provide highly specialized facilities for faculty groups and graduate students to participate in sophisticated engineering and science research projects.

The Public Administration Service acts as a consultant group for town and city officials. The Agricultural Experiment Station, one of the largest research and service units at the University, provides research, information, and testing for the state agricultural industry. The Ritzman Animal Nutrition Laboratory offers specialized research facilities. The recently established University Instrumentation Center coordinates the utilization of many highly specialized instruments and provides service to the many researchers on campus using instruments such as mass spectrometers, spectrophotometers, nuclear magnetic resonance spectrometers, amino acid analyzers, etc. The University Instrumentation Center has established a new electron microscope facility which houses a transmission electron microscope and electron microprobe and a scanning electron microscope. The DEC



10 system, the principal facility for the University Computer Center, is used by students from all disciplines on campus.

Marine Program: The University's central location on the northern New England coast near a variety of estuarine, coastal, insular, and continental shelf environments has fostered a broad range of marine educational and research activities for many years. These varied activities, which occur within all of the University's colleges, are coordinated and supported by the Marine Program. Both masters and Ph.D. degree programs are offered in the areas of marine life, physical, and social sciences; ocean engineering; and physical education on a departmental and interdisciplinary basis. Departments involved are animal science, biochemistry, botany, chemical engineering, civil engineering, earth sciences, electrical engineering, mathematics, mechanical engineering, microbiology, physical education, physics, and zoology. Also involved are the Institute of Natural and Environmental Resources and the Whittemore School of Business and Economics.

Marine research by faculty and students proceeds on both an intra- and interdisciplinary basis and is supported by University and private funds as well as by organizations such as the National Science Foundation, the Office of Naval Research, the National Institutes of Health, the U.S. Coast Guard, the Woods Hole Oceanographic Institution, Sanders Associates, and the National Sea Grant Program. UNH and the University of Maine together are a Sea Grant Institution.

Marine research activities are principally pursued in the neighboring environments of the Great Bay estuarine system, the coastal zone, the near-shore coastal zone, the Isles of Shoals, and the Gulf of Maine, but also in the more remote areas of the world such as the North Sea and the Arctic, Antarctic, and mid-Pacific Oceans. Some examples of research studies include those relating to marine food chains; marine biotoxins; trace metals; biological and thermal pollution; marine mineral resources; mariculture; marine resource management; marine law; environmental base-line studies; arctic under-ice systems; diving systems; submersibles, underwater habitats, and sealabs; and buoy systems and breakwaters.

Facilities specifically supporting graduate education and research include those on the University's campus — the Marine Program building, the Engineering Design and Analysis Laboratory, and the Mechanics Research Laboratory — and those off campus — the Jackson Estuarine Laboratory, the Diamond Island Ocean Engineering Station, the Shoals Marine Laboratory, a near-coast pier facility, and the R/V *Jere Chase* together with several smaller vessels and facilities used in cooperation with other institutions such as MIT and the Woods Hole Oceanographic Institution. In addition, the excellent University diving program directly supports research and annually qualifies numerous faculty and student divers.



The Marine Program building houses work spaces for ocean engineering, physical sciences, and other marine activities, as well as the Marine Program Office. The Engineering Design and Analysis Laboratory serves faculty and students from the four engineering departments and others associated with its activities supporting projects and applied research in the marine environment. The Mechanics Research Laboratory, an entity within the Department of Mechanical Engineering, emphasizes both theoretical and applied engineering research in the ocean environment. The Jackson Estuarine Laboratory, located on Great Bay about five miles from the campus and fourteen miles from the ocean via the Piscataqua River, supports the research of the marine life sciences and earth sciences departments. Research vessels dock at the adjacent pier. The Diamond Island Ocean Engineering Station,



located about forty miles from Durham on Diamond Island in Lake Winnepesaukee, furnishes an excellent fresh-water testing site for ocean systems. The Shoals Marine Laboratory, located about seven miles off the New Hampshire coast on Appledore Island of the Isles of Shoals, is a joint facility of UNH, Cornell, and the State University of New York/Stonybrook and is principally concerned with marine life sciences educational and research activities. A near-coast pier facility, situated about ten miles from Durham in Portsmouth, New Hampshire, and two miles from the ocean on the Piscataqua River, serves research vessels up to approximately 50 feet in length and commercial fishing boats of the area. The R/V *Jere Chase* is a 45-foot research vessel equipped for a wide variety of marine research activities in the estuarine and near-coast waters.

The New England Center for Continuing Education is adjacent to campus. This architecturally striking complex was built with a gift from the Kellogg Foundation and is supported by the six New England state universities. The center provides residence and conference facilities for a wide variety of adult education programs. A closed circuit TV system permits conference programs to be reviewed in the participants' rooms.

Library

The University Library houses over 700,000 volumes, 5,700 periodicals, and substantial microform and audio-tape collections. Specialized subject collections are housed in four branches: chemistry in Parsons Hall, engineering and mathematics in Kingsbury Hall, biological sciences in Kendall Hall, and physics in DeMeritt Hall. The branches are administered by a physical sciences librarian and a biological sciences librarian. Media Services, a department of the library, offers a large film collection, equipment loans including projectors and portable TV cameras and monitors, photographic and graphic design assistance, and audiovisual project consultation.

Special services offered to graduate students include graduate study areas, with assignable locked book trucks. Graduate students may use the Interlibrary Loan System to supplement material available in the University Library. The library is a U.S. government document depository, and a full-time documents librarian is available. On-line data base search services are offered at cost through the Reference and Branch Departments.

The library serves the University and the town of Durham. A graduate student's spouse and children may use the facilities, which include a professionally staffed children's room.

During the regular academic year, the library is open seven days a week. On vacations and during the summer, a more limited schedule is in effect.





Admission, Financial Aid, Academic Regulations

Admission

Requirements

Admission to the Graduate School may be granted to graduates of all colleges and universities of approved standing, provided the applicant's undergraduate record is satisfactory. It is the policy of the University of New Hampshire not to discriminate on the basis of sex, race, color, religion, national origin, or handicap in its recruitment and admission of students or awarding of financial aid, in accordance with all relevant federal and state laws and regulations.

Applicants for admission must present evidence that they have had the necessary academic preparation to enable them to pursue the graduate program for which they are applying. Candidates for admission must have a superior undergraduate record. An applicant who has undertaken graduate work at another institution should have completed the courses or program attempted with a record equivalent to that required for graduate students to remain in good academic standing at the University of New Hampshire.

Individual programs may designate specific requirements that applicants must meet; such requirements may include the scores achieved on the aptitude and appropriate advanced sections of the Graduate Record Examination or the Graduate Management Admission Test, or specific undergraduate preparation. The program descriptions listed in this catalog and the information sheet supplied with the application forms should be consulted for these special requirements.

Applicants seeking admission to programs leading to the Master of Science for Teachers degree must meet, in addition to the normal requirements, one of the following admission requirements: 1) completion of education courses sufficient for certification, 2) three years of teaching experience, or 3) a current full-time teaching position.

The number of applicants to some graduate programs annually exceeds the number that can be accommodated by the University faculty and facilities. Thus, in some instances, qualified applicants may be denied admission because of these constraints.

Application Procedures

An applicant for admission must submit directly to the Graduate School, Social Science Center, University of New Hampshire, Durham, New Hampshire 03824, the following materials:

1. The official application forms for admission to graduate study (available from the Graduate School).
2. Two official transcripts showing the grades earned in all of the applicant's previous academic work (graduate and undergraduate).
3. Three letters of recommendation (on the Graduate School's recommendation form) from persons in a position to judge the applicant's preparation for and ability to undertake graduate study, e.g., previous instructors or coworkers of the applicant.



Letters must be forwarded directly by the writer to the Graduate School. Material from college placement offices must have been prepared within the last twelve months.

4. A \$10 application fee. This fee is nonrefundable.

5. Any additional materials, such as the official report of scores achieved on the Graduate Record Examination or Graduate Management Admission Test, which are required by the department or program to which the applicant is applying. Such scores must be forwarded directly from the testing agency and must be from tests taken within five years of the date of application.

6. Completed "Statement on Residence for Applicants to Graduate School at UNH." This form will be included with application forms.

All application material becomes part of the permanent records of the University of New Hampshire and will not be returned.

When the application and all of the required supporting material has been received, the application is reviewed by faculty members of the appropriate programs. This review normally is conducted by an admissions committee composed of graduate faculty members, which makes recommendations to the Graduate School concerning the admission of applicants to the program. Upon receipt of the committee's recommendation, the Graduate School carefully reviews the applicant's file. After making the final decision, the Graduate School will inform all applicants of the action taken.

Since the specific criteria for admission differ from program to program, it is impossible to itemize all of the factors that are weighed in the admission process. Because of this, the Graduate School has not established such specific criteria as minimum acceptable scores on standardized tests such as the GRE or GMAT. Rather, all of the material that is submitted as part of an application receives careful consideration.

A student who wishes to pursue a degree or program other than the one to which admission was granted originally should file an application for a change in degree with the Graduate School. The dean of the Graduate School will notify the student of the decision after consulting with the appropriate departments.

Master's candidates who intend to go on to the Ph.D. in the same department in which they were admitted for the master's degree should submit to the dean of the Graduate School an application for a change in degree program. This application will be reviewed by the Graduate School, which will notify the student of the decision. A student who has already received the master's degree will be required to submit a new application for admission to study for the Ph.D. degree.

A New England resident enrolling in a graduate program offered at one of the New England state universities but not at the state university in the student's home state

is eligible for in-state tuition rates under the New England Regional Student Program. Application procedures are contained in the New England Regional Student Program Graduate Level booklet, available from the New England Board of Higher Education, 40 Grove Street, Wellesley, MA 02181.

Applicants from Foreign Countries

In addition to the material noted above, all applicants from non-English-speaking countries must furnish proof of their proficiency in English by submitting scores achieved on the Test of English as a Foreign Language administered by Educational Testing Service. Arrangements for taking this examination should be made directly with the Educational Testing Service, Box 899, Princeton, New Jersey, USA, 08540.

Because of the time involved in processing applications from residents of foreign countries, completed applications and supporting documents should be received at the Graduate School four months prior to the semester for which the admission is desired.

Application Dates

Completed applications and supporting documents should be submitted before July 15 for the first semester, before December 15 for the second semester, and before April 1 for the summer session. There is no guarantee that applications submitted after these deadlines can be acted upon in time to permit registration in the desired semester. Applicants for financial aid must submit completed applications and supporting documents for admission and financial aid prior to February 15.

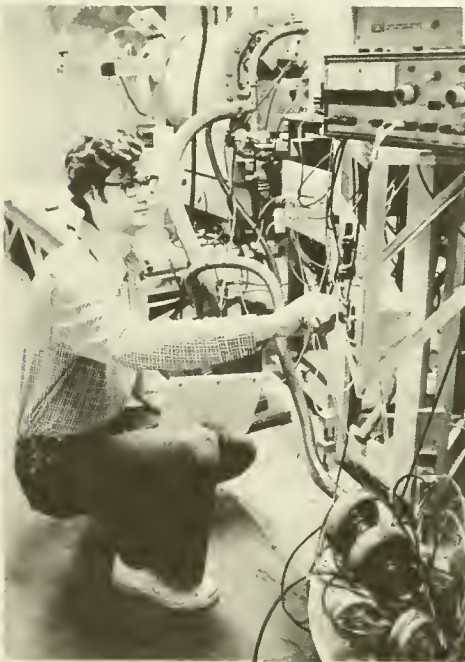
Types of Admission

Regular Admission: Regular admission may be granted to those applicants whose academic records and supporting documents indicate that they are fully qualified to undertake graduate study in their chosen field.

Conditional Admission: Conditional admission may be granted to those applicants whose academic records indicate deficiencies but suggest some promise of success in graduate study. Students granted conditional admission must meet the specific requirements stated at the time of their admission. Conditional admission will not be granted to applicants who reside in foreign countries.

Special Students: Individuals holding baccalaureate degrees who wish to register for courses may do so with the approval of the instructor and dean of the Graduate School. Such students are not admitted to the Graduate School and are not candidates for a graduate degree. Special students register with the Division of Continuing Education in Verrette House on campus. Special students are not required to file an application for admission to the Graduate School.

If a special student is subsequently admitted to a degree program, a maximum of nine credits earned in the University System of New Hampshire as a special student may, upon recommendation of the program faculty, be applied to a student's degree



program. The nine credit limitation applies to all courses completed or in process on the date when the official letter of admission is written.

Applicants Not Admitted: Applicants who are denied admission may have their applications reconsidered only if they furnish significant additional material that was not available at the time of the original decision, such as evidence of further academic achievement, or more recent and significantly improved GRE or GMAT scores.

University of New Hampshire Seniors: Qualified senior students in the University of New Hampshire may be admitted to the Graduate School and must have been admitted before enrolling in courses for graduate credit. Such seniors should follow the application procedures outlined on page 15 and should file their applications by the specified dates.

Upon recommendation of the department, superior University of New Hampshire senior students may petition the Graduate School to be allowed to count credits for a maximum of two 800-level courses toward both a bachelor's and master's degree, provided the student has been admitted to the master's program.

Students wishing to enroll in the five-year combined bachelor/Master of Business Administration programs should consult their advisers concerning the regulations relevant to them.

University of New Hampshire Employees: Members of the University of New Hampshire faculty with the rank of assistant professor or above will not be admitted to the graduate programs. Full-time staff employees of the University who do not hold academic rank will not ordinarily be admitted to doctoral programs in the department in which they are employed. The above regulations pertain even to individuals who resign their positions.

Honorary Fellows: Qualified scholars who may temporarily desire the privilege of using the library and research facilities of the University and who are not candidates for a degree may, upon recommendation of the dean of the Graduate School and the approval of the president of the University, be appointed honorary fellows without stipend. Honorary fellows shall not be required to pay any charges except the cost of unusually expensive supplies or equipment.

Financial Information

Course Charges and Fees



Tuition/course charges vary depending on the number of credits for which a graduate student registers.

9-16 Credits per Semester: Full tuition is charged. New Hampshire residents — \$1,000 per academic year (\$500 per semester); nonresidents of New Hampshire — \$2,990 per academic year (\$1,495 per semester).

1-8 Credits per Semester: Students are charged according to the number of credits for which they register. Residents — \$50 per credit, nonresidents — \$130 per credit.

More Than 16 Credits per Semester: Students are charged full tuition at the appropriate rate plus the appropriate course charge for each credit beyond 16 if registered for more than 16 credits 30 days after the semester has begun. (No refund will be made if a student subsequently drops a course lowering his/her load to 16 or fewer credits.)

The above charges will apply to admitted graduate students enrolling for courses at the University during the academic year. Admitted graduate students planning to enroll for courses at the Merrimack Valley Branch, through the School of Continuing Studies, or during the summer session should consult the relevant catalogs for information regarding fees. Any combination of courses taken at the Durham campus or the Merrimack Valley Branch totaling nine credits or more requires full tuition payment. Any student who registers separately at the Durham campus and the Merrimack Valley Branch and who pays the per-credit-hour charge at either will be subsequently billed, if any combination totals nine credits or more, an additional amount necessary to meet the full tuition charge.

Rules Governing Residence Classification: A student is classified as a resident or a nonresident for tuition purposes at the time of admission to the University. The decision is based upon information furnished by the student's application and any other relevant information.

All applicants living in New Hampshire are required to submit a notarized statement to the effect that they have been legally domiciled in New Hampshire continuously for at least twelve months immediately prior to registering for the term for which in-state status is claimed.

Students admitted from states other than New Hampshire or from foreign countries are considered nonresident throughout their entire attendance at the University unless they shall have acquired bona fide domicile in New Hampshire. Changes in residency will only occur if the student can clearly establish that his or her residence in New Hampshire is for some purpose other than the temporary one of obtaining an education at the University.

The burden of proof in all cases is upon the applicant. In all cases, the University reserves the right to make the final decision as to resident status for tuition purposes.

The University Rules Governing Tuition Rates are fully set forth on the application for admission, and all students are bound by them.

Thesis, In Absentia, and Other Fees

Master's Students: Master's students registering for thesis credits (course number 899) will be assessed tuition for their thesis according to the number of thesis credits for which they register in a specific semester until they have registered for the maximum number of thesis credits permitted in their specific program. Master's students who have previously registered for the maximum number of thesis credits and who are on campus completing their thesis will pay a *Continuing Enrollment Charge* of \$100 per semester.

Master's students who are not registered for on-campus work at the time they complete their degree requirements (i.e., examinations, theses) will be assessed an *In Absentia Charge* of \$25 one month prior to the conferral of their degree. This charge will not apply to students removing course incompletes.

Doctoral Students: Doctoral students who are in residence and engaged in dissertation research must register for Doctoral Research (course number 999). A minimum of two semesters of registration for 999 is required. However, doctoral students using University facilities while engaging in dissertation research must register for 999 each semester even if the minimum requirement has been met. The charge for this registration will be \$300 per semester or \$150 per summer session.

Doctoral candidates not in residence at the time they complete their degree requirements (i.e., examinations, submission of dissertation) will be assessed an *In Absentia Charge* of \$100 one month prior to the conferral of their degree.

A Memorial Union Fee of \$17.50 per semester and a Student Services Fee of \$5 per semester must be paid by all full-time admitted graduate students. Students registered for less than 9 credits pay a Memorial Union Fee of \$8.75 per semester, are not liable for the Student Services Fee, but are charged a registration fee of \$5 for New Hampshire residents or \$10 for nonresidents of New Hampshire.

Students may audit courses with the consent of their adviser and the instructor involved. *Charges for auditing a course are the same as taking it for credit.*

University supported graduate assistants and project assistants receiving the full stipend may be exempted from the payment of tuition/course charges and academic fees during the academic year of their appointment and the following summer session. University supported graduate assistants receiving half the normal stipend may be exempted from the payment of half of their tuition/course charges and academic fees in the academic year of their appointment and the following summer session.

Charges and Refunds for Changes: Three-fourths of tuition charges will be refunded to a student withdrawing from UNH within one week of registration;

one-half after one week and within thirty days; and none thereafter. (See University Calendar, page 156.) A \$10 fee must be paid by all students dropping a course after the first two weeks of classes. The \$10 fee will not be charged to students changing to a reduced load or students withdrawing; and in both cases, the regular tuition rebate policy will apply. A \$10 fee will also be assessed for courses added after the three-week add period. The occasional student who registers very late (after the add period) will be assessed the \$10 fee for each course in the late registration. A change of section (within the same course) is accomplished by a “drop” of one section and an “add” of another section. The fee will not be assessed for the add portion of a late section change; but the \$10 drop fee will still apply for the drop portion of a late section change.

There are no refunds of the Memorial Union Fee and Student Services Fee.

Financial Aid

Fellowships and Scholarships

The University reserves the right to adjust rates for tuition, course charges, and fees. Such adjustments will be announced as far in advance as possible.

University of New Hampshire Fellowships: A limited number of three-year “University of New Hampshire Fellowships” are awarded to outstanding doctoral students. Each recipient is given an opportunity to spend the first year in full-time study, the second year as a teaching assistant, and the third year as a research assistant. The stipends for this program are \$3,300 for the first academic year, \$3,500 for the second academic year, and \$3,700 for the third academic year. In addition, the award provides \$900 support for each of two summers and waiver of tuition. These awards are made by the Graduate School Student Fellowship Selection Committee from nominations from the various programs.

Tuition Scholarships: Up to 50 superior students may be granted academic-year tuition scholarships. These awards provide only for waiver of tuition charges and are subject to the maintenance of a high scholastic record in the Graduate School.

Up to 30 superior students may be granted tuition scholarships for the summer session. Applications may be obtained from the Graduate School Office.

Dissertation Fellowships: Dissertation Fellowships with stipends of up to \$3,300 for a maximum tenure of one academic year are available. These awards include a waiver of the doctoral research registration fee for the period of the award. Applications should be made to the dean of the Graduate School.

Martin Luther King Assistantships: Martin Luther King Assistantships provide support for qualified members of minority groups. Applications should be made to the Graduate School Office.

Assistantships



Approximately 340 graduate and project assistantships are awarded annually to superior students; appointments are for one academic year but may be renewable. These appointments involve half-time employment. The normal load for students holding appointments is three full courses per semester, or master's thesis, or doctoral research. All graduate students holding appointments as graduate or project assistants must be regularly admitted to the Graduate School and must register for two or more full courses or equivalent thesis credits or doctoral research during each semester in which they hold their appointments. Such students are considered full-time students.

Inquiries regarding assistantships should be addressed to the chairperson of the appropriate department or program.

Appointments are made in the following categories:

Graduate Assistants: Most assistants are involved in assisting faculty members in instructional activities. A limited number of appointments involve assisting in research activities in the Agricultural Experiment Station. Stipends for graduate assistants are \$3,300 per academic year. University supported graduate assistants receiving the full stipend may be exempted from the payment of tuition and course charges during the academic year of their appointment and the following summer session. University supported graduate assistants receiving half the normal stipend may be exempted from the payment of half of their course charges and academic fees in the academic year of their appointment and the following summer session.

Project Assistants: These assistants aid faculty members in externally funded research projects. Stipends for project assistants are \$3,300 per academic year. Project assistants receiving the full stipend may be exempted from the payment of tuition and course charges during the academic year of their appointment and the following summer session. Project assistants receiving half the normal stipend may be exempted from the payment of half of their course charges and academic fees in the academic year of their appointment and the following summer session.

Graduate Associates: A very limited number of highly qualified graduate students may be appointed to teaching or research positions as graduate associates. The academic load for students appointed to these positions will not exceed two full courses or doctoral research registration per semester. Stipends are negotiable up to \$5,500 per academic year according to the qualifications and duties of the student. Graduate associates whose positions are entirely funded from University funds may have one-half of the dissertation fee or course charge waived (at the appropriate resident/nonresident rate) upon recommendation of the employing department. Graduate associates whose positions are funded externally (e.g., research) will be assessed the full dissertation fee and course charges.

Summer Support: A limited number of Summer Fellowships are available for students who have held graduate assistantships involving teaching during a previous academic year. The stipend for summer study is \$900. Full-time summer employment may be available for project assistants or graduate assistants. Assistants employed during the summer are paid up to \$660 per month for a maximum of two and one-half months full-time employment. Students so employed are not normally permitted to register for summer session courses.

Federally Funded Traineeships and Fellowships

Subject to the availability of federal funds, a variety of federal fellowships and traineeships are available for outstanding graduate students. These awards are open to U.S. citizens only. The stipends for these awards vary somewhat but average \$3,900 for 12 months of study plus tuition waiver.

It is suggested that applicants contact the National Science Foundation, Fellowship Office, National Research Council, 2101 Constitution Avenue, N.W., Washington, D.C. 20418 and/or Career Development Review Branch, Division of Research Grant, National Institutes of Health, Public Health Service, Bethesda, Maryland 20014.

Loan and Work-Study Programs

National Direct Student Loans: To be eligible for consideration, a student must be an admitted degree candidate carrying at least one-half the full-time academic load as defined by the University, be a U.S. citizen or a permanent resident of the U.S., and establish need for a loan that is to be used for educational purposes only.

UNH Loans: To be eligible for consideration, a student must be a registered degree candidate. Financial need must be clearly established, and if approved, the loan may be used for educational purposes only. The maximum amount granted to a student is \$1,000 during his or her undergraduate and/or graduate work.

College Work-Study Program: With the aid of federal funds, the University is able to provide employment opportunities on campus or in various off-campus agencies. To be eligible for consideration, a student must be an admitted degree candidate carrying at least one-half the full-time academic load as defined by the University and demonstrate financial need as determined by the Financial Aid Office. Work during the academic year is usually on campus.

Applications for the above programs may be obtained from the Financial Aid Office, Thompson Hall, and must be returned not later than May 1.

Guaranteed Student Loan Program: Students may apply for as much as \$2,500 per year from a bank or other financial institution participating in the Guaranteed Student Loan Program. Qualified borrowers pay no interest while attending college. Repayment of principal and interest begins nine months after the student ceases a full-time course of study. Check with your local bank for further details and current interest charges.

Academic Regulations

Graduate Credits and Grades

Credits: Graduate credits may be earned in courses numbered from 700 through 898 and in the thesis. Graduate credits will not be given for any courses so numbered which are open to freshmen and sophomores. Under certain conditions, graduate credit may be allowed for 600-level courses in master's degree programs. (See general requirements for master's degrees.)

In many departments or programs it is possible for students to do part of their work during the summer session. Students should consult the Summer Session Office in Verrette House concerning the courses offered and course schedules. Students intending to graduate in September, 1977, must present dissertation or thesis to the Graduate School Office by August 12; the last day for final Ph.D. and master's examinations and completion of all degree requirements is August 19.

Grades: The following grades are used in the University: A, A-, B+, B, B-, C+, C, C-, D+, D, D-, F. Graduate credit is normally granted only for course work completed with a grade of B- or higher. Any grade below the B- level will normally not count for graduate credit and will count toward the accumulation of nine failing credits which will normally result in a student being required to withdraw from the Graduate School. The undergraduate pass/fail option is not available to graduate students taking graduate courses.

However, a student's advisory committee, or his/her adviser and appropriate departmental committee, may recommend to the dean of the Graduate School that up to eight credits of C or C+ be granted for graduate credit. When a student's advisory committee or his/her adviser in conjunction with the appropriate departmental committee wishes to recommend that credit be given for work completed with a C or C+, the advisory committee shall forward its recommendation with appropriate justification within one month of the conclusion of the course.

A grade of Credit (Cr.) will be given for complete and approved theses and dissertations.

With the permission of the instructor at the time of registration, a graduate student may elect to take independent study courses on a credit/fail basis. Students electing this option should ask the instructor to send written notification to the Graduate School and Registrar's Office that the graduate student is taking the course credit/fail.

An incomplete grade earned by a graduate student must be removed by the end of the semester following the one in which the incomplete grade was obtained. An incomplete grade automatically becomes an F if not removed within the allowed time period. It is the responsibility of the student to complete work required for the removal of the incomplete within the allotted time period. This rule does not apply to the completion of the thesis.

Requirements for Master's Degrees

General Requirements: A minimum of 30 graduate credits are required for all master's degrees. Many programs require substantially more than the minimum 30 credits. Consult the appropriate program description in this catalog. Graduate credits are normally earned in courses numbered 700-899. Master's candidates must earn at least eight credits in courses numbered 800-898 (thesis credits cannot be used to meet this requirement). Courses numbered 600-699 cannot be used toward master's degrees if the courses are given in the department awarding the degree. No more than 12 credits will be permitted in courses numbered 600-699. The major department will prescribe for its students the courses which make up the degree program. Somewhat different requirements obtain for the Master of Science for Teachers degree. Consult the appropriate program description in this catalog.

A student will normally spend at least one calendar year, or the equivalent, in satisfying the requirements for the degree. No more than 12 credits, not including thesis, may be earned off the Durham campus. A student may present for transfer credit a maximum of six credits earned at another graduate school, provided that these credits are of a grade of at least B or the equivalent. Credits transferred from another graduate school will count as part of the 12 credits which may be earned off the Durham campus. Transfer and off-campus credits will be applied toward the degree only if recommended by the major department and approved by the Graduate School.

All graduate work for any master's degree must be completed within six years of the time of registration for the first graduate work applied toward the degree. Progress toward the degree will be carefully monitored by the adviser and the Graduate School to ensure that adequate advancement is made toward the completion of the program and that any deficiencies noted at the time of admission are removed.

In any department or program requiring a final examination for the master's degree, the examination may be oral, written, or both. A candidate will be permitted only two opportunities to take the final examination for the master's degree. The time of final examinations will be at the convenience of the department concerned, except that all such examinations must be given at least two weeks before the Commencement date in the year in which the degree is to be conferred. Further regulations governing the final written examination, when required, will be made by the department concerned, subject to the approval of the dean of the Graduate School. Oral examining committees, when required and not otherwise provided for, are appointed by the dean of the Graduate School, upon the recommendation of the department concerned. The dean of the Graduate School is, *ex officio*, a member of all examining committees.

Master's Thesis: A thesis may be required of candidates for the master's degree. Consult the individual program descriptions for thesis requirements. A master's thesis must be approved by a committee composed of the faculty member under whose direction it was written and two other members of the graduate faculty nominated by the department chairperson and appointed by the dean of the Graduate School.

Each department will determine the date when the candidate must submit for approval a statement of the subject of the thesis and the date when the thesis must be completed.

From six to ten thesis credits may be applied toward a master's degree. The exact number of credits to be assigned will be determined by the faculty of the individual programs. No thesis credit shall be given until the completed thesis has been approved by the thesis committee. No letter grade shall be given for the thesis, but its satisfactory acceptance will be recorded with a Credit (Cr.).

Students writing theses should obtain from the Graduate School Office the latest regulations for the form and typing of theses.

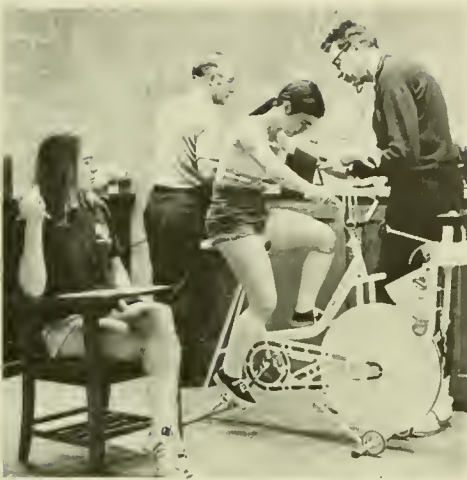
Whenever a thesis is published or otherwise reproduced, it must be designated as having been accepted as a master's thesis by the University of New Hampshire.

The original and one copy of the approved thesis, ready for binding, shall be submitted to the Graduate School Office as soon after approval as possible but not less than two weeks before Commencement, together with a receipt for the binding fee from the University Bookstore. Most programs require one copy of the thesis in addition to the above-mentioned two copies. Students should consult their advisers concerning thesis requirements.

Requirements for Doctor's Degrees

General Requirements: The degree of Doctor of Philosophy is conferred on qualified candidates who have passed an oral or written examination on the subject matter of their field of study, who have completed an original investigation in this field and have embodied the results in an acceptable dissertation, and who have passed an oral examination in defense of the dissertation. The degree of Doctor of Philosophy is essentially a research degree. It is not given merely for the completion of course credits. Programs leading to the degree of Doctor of Philosophy are offered in biochemistry, botany, chemistry, economics, English, engineering, genetics, history, mathematics, mathematics education, microbiology, physics, plant science, psychology, sociology, and zoology.

All doctoral students must be registered each semester that they use University facilities. A minimum of three academic years of graduate study is required for the doctorate. Resident graduate work done at other universities may be counted toward the minimum requirement upon approval of the guidance committee and the



dean of the Graduate School, but one full academic year must be in residence at the University of New Hampshire. In individual cases, the major department and the dean of the Graduate School may grant permission to pursue the research for the dissertation at another institution where access to special facilities is advantageous.

All graduate work for the doctorate must be completed by the end of the fifth academic year following that in which the student completes the requirements for advancement to candidacy.

Degree Candidacy: A guidance committee will be appointed by the dean of the Graduate School upon the recommendation of the program faculty as soon as possible after a student has begun study for the doctoral degree. The committee will have the responsibility of assisting the student in outlining a program and preparing for the qualifying examination and will administer the examination.

The qualifying examination may be written, oral, or both. This examination will test: 1) the student's general knowledge in the student's major and minor work and 2) the student's fitness for engaging in research, particularly in the subject proposed for the dissertation. The results of the examination will be communicated by the chairperson of the student's department or program to the dean of the Graduate School.

After the successful completion of the qualifying examination, a doctoral committee will be appointed to supervise and pass on the dissertation and administer the final examination. This committee will be nominated by the department of major concentration and appointed by the dean of the Graduate School. It shall consist of a minimum of five members, usually three from the major department and two from related departments. The dean of the Graduate School is an ex officio member of all doctoral committees.

The student may not be advanced to candidacy for the Ph.D. until he/she has passed the qualifying examination and met such language or proficiency requirements as are deemed desirable by the faculty of the student's program and/or guidance committee. The proposed subject of the student's dissertation must be declared at the time of advancement to candidacy.

Dissertation: The dissertation must be a contribution to scholarship in the student's discipline, embodying the results of significant and original research, and a mature and competent piece of writing.

A copy of the completed dissertation must be made available to the members of the examining committee two weeks before the final examination date. As soon after the examination as possible but not less than two weeks prior to Commencement, the original and one copy of the approved dissertation, ready for binding, shall be turned in to the Graduate Office, together with a receipt from the University Bookstore for the binding, microfilming, and copyright fees. Most departments

require one copy of the thesis in addition to the above-mentioned two copies. Students should consult their advisers concerning dissertation requirements.

Publication of the dissertation by University Microfilms will be required, and the cost will be assumed by the student. Students are urged to protect their research by copyrighting their dissertation at the time of microfilming. If the material presented in the dissertation is published, it should be designated as having been accepted as a doctoral dissertation by the University of New Hampshire.

The final oral examination is conducted by the doctoral committee and is intended to give the candidate an opportunity to defend his dissertation. A written final examination, on subject matter not covered in the qualifying examination, may also be required. This written examination is conducted by the major department. These final examinations must be completed at least two weeks prior to the date of receiving the degree. After consultation with the major department, the dean may appoint, for participation in the final oral examination, additional members of the faculty under whom the student has worked. The doctoral committee alone shall decide on the merits of the candidate's performance by a majority vote.

Registration Procedure

Students admitted to the Graduate School must have their programs approved by the chairperson of the department or the chairperson of the guidance committee and by the dean of the Graduate School. Registration is held the first Monday after classes begin each semester and on the first day of the summer session. All tuition and fees are payable at the time of registration. Consult the calendar in this catalog for the date of registration.

Preregistration for continuing students is at the option of the department; students required to preregister should do so at the Registrar's Office during the time designated in the calendar. A \$10 fee is charged for not preregistering if required. Registration information and Time and Room Schedules may be obtained from the Registrar's Office, Thompson Hall.

Students who find it necessary to interrupt their graduate programs may request a leave of absence by writing to the dean of the Graduate School stating the reasons for, and the anticipated length of, the interruption.

Students who do not register during a twelve-month period and have not notified the Graduate School of their intention to continue in their degree programs must reapply for admission in order to resume their graduate work.

Withdrawal Procedure: A student may withdraw from the Graduate School during any semester by obtaining a withdrawal form from the registrar. This form should be signed by the student's adviser, the dean of the Graduate School, and other appropriate University officials (e.g., the director of residences). When completed, the form should be filed with the registrar.



Full-time Graduate Students: Full-time graduate students are those students who have received either a conditional or regular admission to the Graduate School and are enrolled each semester for sufficient course or thesis (899) credits to be liable for full tuition. Students registered for Doctoral Research (course number 999) or paying a Master's Continuing Enrollment Charge are also classified as full-time students. Students holding appointments as graduate assistants or project assistants are considered full-time students and must be enrolled for a minimum of two full courses, equivalent thesis credits, or doctoral research each semester.

The maximum graduate load allowed is sixteen credits for a regular semester, four credits for a four-week summer session, and eight credits for an eight-week summer session. Only under unusual circumstances will a student be allowed to exceed these limits, and then only with the recommendation of the student's adviser and the approval of the dean of the Graduate School.





UNH and Graduate Life

The University is located in Durham — one of the oldest towns in northern New England. Durham is a small town located in a semirural area which still retains abundant traces of its colonial past. Easy accessibility to Boston's cultural opportunities (65 miles to the south); the unsurpassed skiing, hiking, and scenery of the White Mountains (60 miles northwest); and the sandy beaches and rocky coast of New Hampshire and Maine (10 miles east) make it an ideal location.

The campus, 156 acres in size, is surrounded by more than 3,000 acres of fields, farms, and woodlands owned by the University. A stream flowing through a large natural area in the middle of the campus enhances a sense of openness among the buildings — 35 for teaching, research, and admission, and 21 residence halls for men and women.

The University is composed of the College of Liberal Arts, College of Life Sciences and Agriculture, College of Engineering and Physical Sciences, Whittemore School of Business and Economics, School of Health Studies, Thompson School of Applied Science, Division of Continuing Education, and the Graduate School. In addition to these colleges and schools located on the University campus at Durham, the University System of New Hampshire includes Keene State College, Plymouth State College, the Merrimack Valley Branch at Manchester, and the School of Continuing Studies.

The University enrolls more than 10,000 students, has a full-time faculty of more than 500, and offers 80 undergraduate and 39 graduate programs. The student body includes 1,000 graduate students taught by a faculty of over 400.

The University of New Hampshire is one of 117 colleges made possible by federal land grants which aided states in developing institutions to serve all the people. The institution was founded as New Hampshire College of Agriculture and Mechanic Arts in 1866 to train young men and women for service to the state through agriculture and technology. In 1893, New Hampshire College (as it was called at that time) moved from Hanover to Durham, as the result of a bequest of lands and funds by Benjamin Thompson, and began to develop more rapidly. University status was conferred in 1923.

Graduate Student Life

Graduate students play an active role in the life of the University community. In most departments, students are consulted concerning issues affecting their programs and serve as full voting members on important departmental committees. Three graduate students are elected by the graduate student organization as full voting members of the Graduate Council — the body which advises the graduate dean on





all matters concerning Graduate School policy. Five graduate students, elected by districts, serve in the University Senate, which is the primary governing body in matters of undergraduate student conduct and academic decisions. Graduate students serve on such University-wide committees as the Research Council, the Teaching and Learning Council, and the University Academic Planning Committee.

Babcock House, the graduate student residence hall, has become a center for both academic and nonacademic graduate student activities. Events in the past year have included seminars on job opportunities, art exhibits, film series, evening gatherings, fishing trips, and trips to Boston Pops concerts. Most events at Babcock House are open to all graduate students. Graduate students are also invited to participate in most undergraduate clubs and social organizations.

Recreation and Cultural Activities

Graduate students may participate in a variety of recreational, social, and cultural programs that take place on the campus throughout the year.

Each year UNH's Celebrity Series brings a colorful array of professional talent to the University. Offerings include classical, modern, baroque, and jazz music, and programs centered on human communication, whether in song, dance, speech, or mime. A sampling of recent programs includes Ella Fitzgerald and the Tommy Flanagan Trio, the Hartford Ballet Company, National Theater of the Deaf, the New England Conservatory Ragtime Ensemble, the Royal Shakespeare Company, and the Buffalo Philharmonic Orchestra with Michael Tilson Thomas.

The Sidore Series brings provocative, well-known speakers and experimental programs throughout the year. Russell Baker, Moshe Dayan, Nicholas Johnson, and Viveca Lindfors lectured as guests of the series in 1976-77.

University students perform frequently in concerts, recitals, and theatrical productions. These programs originate in the music and speech and drama departments and are open to graduate students for participation. The Department of the Arts hosts exhibitions in the newly redesigned University Galleries. The University's two theaters and the art galleries are located in the Paul Creative Arts Center.

Student organizations bring folk and rock concerts to campus and provide a wide variety of social events including dances and gourmet dinners. The Memorial Union houses the student-operated AM-FM radio station, the student newspaper, offices for student organizations, and facilities for student film services.

The Memorial Union games area runs the length of the building's lower level and contains pool tables, ping pong, pinball machines, and candlepin bowling lanes. The area is open to all; no recreation passes are required.

The Memorial Union also offers craft courses. Other student and University organizations schedule lectures, concerts, plays, or films throughout the year. There is a charge for some events but many are free.

The University Library has music listening rooms and a collection of more than 5,500 tapes and records. New Hampshire's educational television station, WENH-TV, broadcasts in-school programs for 110,000 young people and, during evening hours, cultural and educational programs. Additional information is available through the offices of the Memorial Union and student activities.

Student Services

Graduate School Office

The Graduate School Office is available to assist graduate students in both academic and personal matters affecting their study at the University. The staff will assist graduate students with information and advice concerning such academic issues as admission, degree requirements, thesis and dissertation format, procedures for changing programs, interdisciplinary options, availability of fellowships and other forms of financial aid (both UNH and external), and part-time employment opportunities. The Graduate School supports graduate student organizations and assists in planning social, informational, and academic programs and events for both graduate students and faculty. Students are urged to contact the office concerning any questions about the availability or applicability of various University sponsored student services to graduate students.

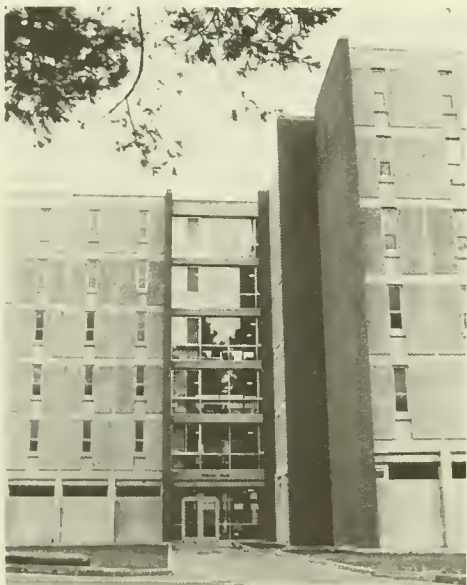
Graduate Student Residences

Babcock House: The graduate residence is designed to provide housing for single full-time graduate students and to provide quiet, dignified areas for graduate students to meet informally with one another and with members of the faculty.

Babcock House is located on McDaniel Drive within easy walking distance of a number of major classroom areas as well as the University Library, University theaters, and the Memorial Union Building. Parking is provided in areas convenient to the building.

The structure, consisting of two six-story towers connected at each floor by a common lounge, accommodates 180 men and women. The house also has a large main lounge with fireplace, two recreation rooms, a food vending room, coin-operated laundry, TV room, luggage storage, individual mailboxes, and optional private room telephones. All rooms are single occupancy, allowing complete privacy for consultation with students or faculty. Each room is furnished with a bed, mattress, easy chair, desk chair, and built-in desk-dresser-wardrobe unit with book shelves, mirror, medicine chest, and desk lamp. Residents provide their own bedding. An optional linen service is available which furnishes bed linen, towels, and blankets at a minimal cost.

A part-time resident director lives in the apartment on the ground floor and works in conjunction with a graduate student House Council to provide cultural and social programs for the graduate community. The resident director and four graduate



resident assistants carry out the administrative responsibilities of the house and are knowledgeable about University policies and available personal services.

The rental charge for Babcock House is \$830 per student per academic year with an option to remain during the summer months at a special rate of \$180. All rental fees are subject to revision by the Board of Trustees. Following acceptance to the Graduate School, a student interested in Babcock residence must return a completed Room and Board Agreement Card with \$50 prepayment to: Graduate Residence, c/o Residence Office, 7 Stoke Hall, UNH, Durham, N.H. 03824. There are usually more applicants than there are spaces available, so it is important that a student return the application and prepayment promptly. A waiting list is maintained.

Forest Park Apartments: The University owns and operates Forest Park, a complex of 154 studio (efficiency), one- and two-bedroom apartments for students, faculty, and staff with families. The development is composed of two- and three-story buildings located on the edge of campus, convenient to all University facilities and within walking distance of the Durham shopping area and schools. Residency is not limited to graduate student families, and the demand for these apartments is great. To be eligible for the University apartments, a graduate student must have been admitted to the University and be a full-time student as defined in this catalog. Students may apply for Forest Park before fulfilling the above requirements as long as they are met at the time of assignment.

Since the waiting time can approach one year from date of receipt of application until assignment, students should apply as early as possible. A brochure containing the application blank and information concerning Forest Park is available upon request from: Forest Park Resident Manager, Building 16, Forest Park, Durham, N.H. 03824.

Summer Housing: A limited number of rooms in Babcock House are available to graduate students taking courses during the summer. Students interested in summer accommodations should contact the Summer Housing Office, University of New Hampshire, Durham, N.H. 03824.

Off-Campus Housing: The Residence Office operates an office to assist students in obtaining off-campus housing. As in most university communities, rents in the Durham area can be high and the supply limited. The office does have listings of off-campus rentals in Durham and the surrounding area which are updated weekly.

Students are encouraged to make every effort to come to campus so that the Off-Campus Housing Office will be able to assist in finding accommodations. The office is located near the commuter lounge of the Memorial Union Building and is open Monday through Friday.

Dining

Graduate students may elect to take their meals on a contractual basis with the University dining halls whether or not they live on campus. These meal tickets may be used in any of the three dining halls. There are limited cooking facilities in Babcock House; none are available in individual rooms.

Counseling and Health Services

University Health Service: This service, located in Hood House, contains a well-equipped clinic for initial diagnosis and treatment of student health problems. Services include: out- and in-patient care, laboratory tests, x-rays, limited mental health care, and routine medications. For serious medical problems students are generally referred to consultants and/or a local hospital. An emergency ambulance service is available.

During the regular academic year, Hood House is staffed by full-time physicians, nurses, and part-time consultants. Regular clinic hours are held and appointments may be made upon request. Nurses are available twenty-four hours a day and a duty doctor is always on call.

Hood House is closed during holidays and semester breaks and operates on a very limited basis during summer session. The spouses and children of students and University employees are not eligible for treatment at Hood House.

As a supplement to the Health Service program, an optional group accident and sickness insurance is available through the University Business Office.

Counseling and Testing Center: This agency, in collaboration with the Student Health Service at Hood House, is the primary mental health facility on campus. The center provides without charge, and through a professional staff, counseling to students who are experiencing personal difficulties or some disruption in their academic lives. Its services, which include individual and group counseling, are designed primarily to meet the typical needs of students who seek greater personal and academic effectiveness.

The full- and part-time staff includes psychologists, clinical associates, and interns. A psychiatrist is available through Hood House for students whose needs go beyond the scope of the center's facilities. Individual testing is also available to help students establish goals, sort out their strengths and weaknesses, and develop academic and career plans.

All information about students' visits to the center is confidential and is not released without permission.

During vacations and the summer, the center is only open on a limited basis.



Career Planning and Placement Service

The Career Planning and Placement Service assists students in planning for professional careers following completion of their degree work. The assistance available to students includes an on-campus interview program, which brings recruiting personnel to the campus between November and May; a library of information on employers and career opportunities; vocational counseling; and placement techniques workshops.

The service will update student's records and provide assistance to alumni.

Campus Minister and Churches

The Ecumenical Ministry to the University of New Hampshire is a cooperative endeavor involving a full-time on-campus minister; concerned administrators, faculty, and students; the designated denominational chaplains; and Durham residents. The Ecumenical Ministry focuses on issue-oriented programs, teaching, involvement in the needs and concerns of various members in the University, and counseling. In addition there are specific organizations such as Hillel for Jewish students, the Inter-Varsity Christian Fellowship, the Fellowship of Christian Athletes, the Christian Science and Latter Day Saints groups, and the Durham Unitarian Universalist Fellowship, which provides religious activities. In Dover are the Greek Orthodox Church and a Friends Meeting; Protestant, Catholic, and Episcopal churches are located in Durham.

The Alumni Association

All recipients of a graduate degree from the University are considered members of the Alumni Association. It organizes alumni activities including social and educational programs both on and off the campus. The *New Hampshire Alumnus* contains news of alumni, the University, students, staff, and faculty.





Departmental Requirements and Course Descriptions

Key

When two course numbers precede a course title and are connected by a hyphen, the first semester of the course, or its equivalent, is a prerequisite to the second semester. If the course numbers are separated by a comma, qualified students may take the second semester without having had the first.

The notation "Lab" indicates that laboratory sessions are a part of the course.

Each prerequisite for a course is separated from the other prerequisites by a semicolon.

Prereq: Educ 601; Psyc 635

If permission (of the instructor, department, or a committee) is a prerequisite for all students, it is listed among the prerequisites.

Prereq: Educ 601; Psyc 635; permission

If, on the other hand, permission may be substituted for one or more of the listed prerequisites, it follows the other prerequisites and is separated from them by a slash mark.

Prereq: Educ 601; Psyc 635; /or permission

If permission may be substituted for only one of the prerequisite courses, it is listed with the course for which it may be substituted.

Prereq: Educ 601 or permission; Psyc 635

CR/F following the description indicates that no letter grade is given but that the course is graded credit/fail.

For up-to-date information about when a course is offered; who teaches the course; the number of recitations, lectures, labs, and such, students are referred to each semester's *Time and Room Schedule*, which carries a complete schedule of course offerings for the semester.

DEPARTMENT ABBREVIATIONS

The following department abbreviations are used.

College of Liberal Arts

Anth	Anthropology	Ling	Linguistics Program
Arts	Arts	Micr	Microbiology
Biol	Biology	Musi	Music
Clas	Classics	MuEd	Music Education
Educ	Education	Phil	Philosophy
Engl	English	Polt	Political Science
Fren	French	Psyc	Psychology
Geog	Geography	ScSc	Social Science
Germ	German	S S	Social Service
Gre	Greek	Soc	Sociology
Hist	History	Span	Spanish
Huma	Humanities	ThCo	Theater and Communication
Ital	Italian	Zool	Zoology
Latn	Latin		

School of Health Studies

Comm	Communications Disorders
SHS	Health Studies
MedT	Medical Technology
Nurs	Nursing
OT	Occupational Therapy
PhEd	Physical Education
RecP	Recreation and Parks

Whittemore School of Business and Economics

Admn	Administration
Econ	Economics
Hotl	Hotel Administration
Secr	Secretarial Studies

College of Life Sciences and Agriculture

AnSc	Animal Science
Bchm	Biochemistry
Bot	Botany and Plant Pathology
Ento	Entomology
FoRs	Forest Resources (INER)
HEC	Home Economics
Hydr	Hydrology
INER	Institute of Nat. & Envir. Resources (INER)
OcEd	Occupational Education
PISc	Plant Science
REco	Resource Economics (INER)
Soil	Soil Science (INER)

College of Engineering and Physical Sciences

ChE	Chemical Engineering
Chem	Chemistry
CiE	Civil Engineering
ESci	Earth Science
E E	Electrical Engineering
E T	Engineering Technology
Math	Mathematics
M E	Mechanical Engineering

Phys	Physics
Engr	Ph.D. Engineering
Tech	Technology nondepartmental

Separate Departments and Programs

Aero	Aerospace Studies
DCE	Division of Continuing Education (all courses)
Gen	Genetics Program
Inco	Intercollege
Milt	Military Science
TSAS	Thompson School of Applied Science

Ancient and Modern Languages and Literatures

Ancient and Modern Languages and Literatures

Chairperson: Grover E. Marshall

PROFESSORS: R. Alberto Casás; Warren H. Held, Jr.; Louis J. Hudon; Charles H. Leighton

ASSOCIATE PROFESSORS: Rose T. Antosiewicz, Richard J. Callan, F. William Forbes, Marron C. Fort, Helmut F. Pfanner, Michael J. Rosenbush, John C. Rouman, Jack R. Vrooman

ASSISTANT PROFESSORS: Thomas J. Acquario, Roger S. Brown, Lydia Crowson, Richard V. Desrosiers, Lois S. Grossman, Bernadette Komonchak, Grover E. Marshall, James L. Sherman

French (Fren)

The French section offers courses leading to the degree of Master of Science for Teachers in French. To be admitted to graduate study for this degree, the applicant must meet requirements as specified on page 15. The primary intent of the program is to strengthen the linguistic and literary knowledge and skill of secondary-school teachers of French. Students in this program must complete 10 courses. Eight must be in French, six from French courses numbered 800 or above. Two courses may be taken in related departments. For the convenience of in-service teachers, two courses leading to this degree are offered in the late afternoon hours each semester. Courses are also offered in the Summer Session according to demand. The candidate for this degree must pass a departmental oral and written examination six weeks before the degree is to be granted.

The department is also prepared to offer work leading to the degree of Master of Arts in French. Admission to this program is suspended until there is again sufficient interest in it. Those interested in the program are urged to express their interest to the dean of the Graduate School and to the coordinator for French. Applicants must have completed an undergraduate major in French. Requirements for the Master of Arts degree are similar to those for the MST in French except that the master's thesis replaces two French courses and the departmental examination.

All applicants for graduate study in French must submit their scores in the Graduate Record Examination, both the Aptitude Test and the Advanced Test in French.

All French courses, except 891, are conducted in French. Except for 899, the courses listed below are also available at the 700 level.

841. FRENCH LITERATURE OF THE MIDDLE AGES

Epic, lyric poetry, and romance. (Offered irregularly.) 3 cr.

842. FRENCH LITERATURE OF THE RENAISSANCE

(Offered irregularly.) 3 cr.

859-860. FRENCH LITERATURE OF THE 17th CENTURY

(Not offered every year.) 3 cr.

861-862. 18th CENTURY FRENCH LITERATURE AND THOUGHT

(Not offered every year.) 3 cr.

867-868. 19th CENTURY FRENCH LITERATURE

Romanticism and Realism. (Not offered every year.) 3 cr.

870. INTRODUCTION TO MODERN FRENCH POETRY

Baudelaire to the present. (Offered irregularly.) 3 cr.

881-882. CONTEMPORARY FRENCH NOVEL AND THEATER

From 1890 to the present. (Not offered every year.) 3 cr.

888. A SEMINAR IN FRENCH LITERATURE

A study of French authors chosen by the instructor. 3 cr.

890. ADVANCED LANGUAGE AND STYLE

Translation of literary texts, intensive study of principal techniques of style, explication de textes. 3 cr.

891. METHODS OF FOREIGN LANGUAGE TEACHING — FRENCH

Interdepartmental course. Objectives, methods, and techniques in teaching Spanish, French, German, and Latin from elementary through college. Discussion, demonstration, preparation of instructional materials, microteaching of the language skills. Prereq: permission of instructor. 3 cr.

895,896. SPECIAL STUDIES IN FRENCH LANGUAGE AND LITERATURE

Individual guided study of the work of a major author, a genre, or specific topics in literature. Training in bibliography and organization of material. Prereq: permission of the section coordinator. Variable cr.

899. MASTER'S THESIS

1-6 cr.

Italian (Ital)

795,796. INDEPENDENT STUDY IN ITALIAN LANGUAGE AND LITERATURE

Individual guided study in special topics. Prereq: permission of the section coordinator. 2 or 4 cr.

Ancient and Modern Languages and Literatures

German (Germ)

The German section offers a program of graduate study in German leading to the degree of Master of Arts.

The graduate program is offered only through the German Summer School of the Atlantic, which represents a new approach in educating teachers of German in American secondary schools and universities and combines the resources of UNH with the experience of the Goethe Institute of Munich, Germany. The program is designed to meet such needs as: conversational mastery, teaching skills, and transfer credit for students with varied backgrounds in advanced German. The courses are offered only in the summer and are selected to provide a well-balanced program for the degree in a minimum of four summers.

This program provides the opportunity to master spoken and written German in a concentrated form which cannot be offered by most foreign universities.

To be admitted to graduate study, a student must have completed an undergraduate major in German. The Advanced Test in German of the Graduate Record Examination — unless taken earlier — is to be taken before the end of graduate studies. Students who have not had German 781, History and Development of the German Language, or its equivalent, must take it before completing graduate studies. It is required that students have a very good command of spoken and written German.

To satisfy the requirements for the degree of Master of Arts, the student must: 1) successfully complete ten full courses including two seminars, or 2) complete eight courses successfully and write a master's thesis. The candidate must also pass the departmental comprehensive examination based upon the master's reading list.

A student may take up to 18 credits of graduate study at the University of Salzburg. The student should consult with the director of the Studies Abroad Program.

Courses numbered 700-799 are for graduates and advanced undergraduates.

Courses numbered 800-899 are open only to graduate students. In rare instances, an undergraduate may be admitted with the permission of the instructor and the section coordinator. Graduate students must take a minimum of three courses at the 800 level.

725. HISTORY OF GERMAN-SPEAKING COUNTRIES

Survey of political, ethnological, and economic history of Germany, Austria, and Switzerland. Offered summer only. 4 cr.

726. GERMAN CULTURE AND CIVILIZATION

Historical, social, artistic, and folkloristic developments in German-speaking countries from the beginnings to the present. 4 cr.

771. INTRODUCTION TO MEDIEVAL GERMAN LITERATURE

Reading and critical analysis of selected works of the German High Middle Ages. Texts in the original and in modern German translation. Offered summer only. 4 cr.

772. GERMAN LITERATURE OF THE ENLIGHTENMENT

Literature and criticism of the eighteenth century, including Gottsched, the Swiss critics, Lessing, Wieland, and the "Sturm und Drang." Offered summer only. 4 cr.

773. CLASSICAL PERIOD IN GERMAN LITERATURE

Reading and critical analysis; emphasis on Goethe and Schiller. Offered summer only. 4 cr.

774. GERMAN ROMANTICISM

Romantic movement from W. Schlegel to Eichendorff including writers outside the Romantic school, such as Kleist and Hölderlin. Offered summer only. 4 cr.

775. THE AGE OF REALISM

The outstanding prose and lyrics of Keller, Meyer, Storm, Fontane, and others. Offered summer only. 4 cr.

776. GERMAN LITERATURE FROM NATURALISM TO EXPRESSIONISM.

Major literary movements 1880-1925, including Hauptmann, Wedekind, Mann, Hesse, Kafka, Rilke, and Benn. Offered summer only. 4 cr.

777. GERMAN LITERATURE FROM 1918 TO 1948

Literature of Germany between the two world wars and German exile literature; Brecht, Döblin, Zuckmayer, Musil, Broch, Graf, and others. Offered summer only. 4 cr.

781. HISTORY AND DEVELOPMENT OF THE GERMAN LANGUAGE

The changes in sounds, structure, and vocabulary from the earliest record to the present. Required for German majors. 4 cr.

792. METHODS OF TEACHING GERMAN

Critical study of modern language teaching from elementary school through college; use of equipment, including films, tapes, and other audio-visual aids. Offered summer only. 4 cr.

795,796. SPECIAL STUDIES IN GERMANIC LANGUAGES, LITERATURE, AND CULTURE

Topics to be arranged. Examples of typical courses: Bibliography and Methodology, Influence of German Philosophy on Literature, Phonol-

Ancient and Modern Languages and Literatures

ogy, The Structure of Modern German, Renaissance, Baroque, "Biedermeier," Büchner. Offered summer only. Normally 2 credits equal half-course. Variable to 4 cr.

878. CONTEMPORARY GERMAN LITERATURE

Literary trends since 1948 in the two German states, Austria, and Switzerland; Böll, Johnson, Celan, Frisch, Dürrenmatt, Weiss. Offered summer only. 3 cr.

885-886. GRADUATE STUDIES ABROAD

Program of studies at University of Salzburg, Austria, for students who have been admitted to the Graduate School. Students should consult with the director of the Studies Abroad Program.

888. SEMINAR

An intensive study of a literary or cultural topic. Offered summer only. 3 cr.

895. SPECIAL STUDIES IN GERMAN LANGUAGE AND LITERATURE

Independent investigation of a range of subjects. Barring duplication of material, course may be repeated for credit. Offered summer only. 3 cr.

899. MASTER'S THESIS

6 cr.

Spanish (Span)

The Spanish section offers courses leading to two degrees in Spanish: the Master of Arts and the Master of Science for Teachers.

Master of Arts

To be admitted to graduate study for the Master of Arts degree in Spanish, a student must have completed 30 credits in Spanish language and literature beyond first year Spanish, including a survey of Spanish literature and two other literature courses. In addition, all candidates for admission must take the Graduate Record Examination Aptitude Test and Advanced Test in Spanish. To obtain the degree, the student must fulfill the course requirements, pass a comprehensive examination based on a master's degree reading list, and submit an acceptable thesis if such an option is chosen.

To satisfy the course requirements, the student must: a) successfully complete 10 graduate courses (of which eight should be from the Spanish offerings); or, b) successfully complete at least eight courses in Spanish and submit a thesis (six credits, thus completing the minimum of 30

credits required by the Graduate School). All advanced literature courses are conducted in Spanish.

In addition, M.A. students are required to take 801. Teaching assistants must also take 803. No student may register for a graduate course if she/he has already taken the corresponding undergraduate course here or its equivalent elsewhere.

A comprehensive examination based on a master's degree reading list will be given four times a year; in January, May, August, and September. The candidate will be permitted to take the examination only twice. Students failing their first attempt must wait at least three months before taking it again. The thesis option must embody the results of independent investigation and be written in a form acceptable to the Spanish section. It must be submitted to the thesis director six weeks before expected time of degree conferral.

Master of Science for Teachers

To be admitted to graduate study for the Master of Science for Teachers degree in Spanish, a candidate must have satisfactorily completed the requirements for secondary school teacher certification in the language. To obtain the degree, he/she must complete ten graduate courses of which eight will be from among Spanish offerings. Candidates must pass a department examination based on the master's degree reading list. Secondary school teachers interested in this degree should consult the section coordinator.

801. BIBLIOGRAPHY AND METHODS OF RESEARCH

Required of all graduate students in their first year of study. An introduction to standard bibliographical techniques and to form and style in the preparation and writing of research findings. Preparation of a research paper. 1 cr.

803. APPLIED LINGUISTICS

Required of all graduate assistants teaching in the departmental program, but open to all graduate students in Spanish. Discussion of current methodology and linguistic approaches to the teaching of Spanish. Instruction in the use of audio-visual aids including language laboratories. Readings, discussion, class observation. 1 cr. May be repeated for a total of 3 cr.

811. MEDIEVAL SPANISH LITERATURE

Spanish literature including social and historical backgrounds, 1100-1500: The *Poema de mio Cid*, Berceo, The *mester de clerecia*, The *Libro de buen amor*, The *cancionero* poets, and *La Celestina*. 3 cr.

831. RIVER PLATE LITERATURE

Sarmiento, Jose Hernandez, Rodó, Florencio Sánchez, Mallea. Focus on the question of *Argentinidad*. (Not offered every year.) 3 cr.

852. DRAMA AND POETRY OF THE SIGLO DE ORO

Social and historical background of Baroque period. Representative plays of Lope de Vega, Tirso de Molina, Calderón; lyric poetry of Lope, Góngora, and Quevedo; prose developments. (Not offered every year.) 3 cr.

854. CERVANTES

Cervantes' literary art. Selections from the major works. The *Quijote*, its originality and significance; its antecedents; its religious, philosophical, and sociological aspects; and its artistic structure. (Not offered every year.) 3 cr.

855. LITERATURE OF THE 19th CENTURY

Larra, Espronceda, Bécquer, Pérez Galdos, and Blasco Ibáñez. Romanticism, realism, and naturalism. (Not offered every year.) 3 cr.

857. THEATER AND POETRY OF THE 20th CENTURY

The Generation of 1898 and *Modernismo*: Lorca, Casona, Buero Vallejo, Sastre, Salinas, Guillén, and Miguel Hernández. 3 cr.

858. SPANISH PROSE OF THE 20th CENTURY

Novels, short stories, and essays. Unamuno, Baroja, Menéndez Pidal, Ortega y Gasset, Julian Marias, Aranguren, Pérez de Ayala, Gironella, and Cela; survey of contemporary prose. (Not offered every year.) 3 cr.

860. UNAMUNO AND ORTEGA Y GASSET

Philosophical ideology and literary content of major contributions of Miguel de Unamuno and José Ortega y Gasset. (Not offered every year.) 3 cr.

871. SPANISH-AMERICAN DRAMA

From pre-Hispanic origins to the present; modern playwrights of Mexico and Puerto Rico. (Not offered every year.) 3 cr.

872. SPANISH-AMERICAN NOVEL

Development from Romanticism to present; contemporary trends and techniques. (Not offered every year.) 3 cr.

873. SPANISH-AMERICAN SHORT STORY

Representative authors; stress on 20th century. Principles of interpretation. (Not offered every year.) 3 cr.

874. MAJOR SPANISH-AMERICAN AUTHORS

(Not offered every year.) 3 cr.

891. METHODS OF FOREIGN LANGUAGE TEACHING — SPANISH

Interdepartmental course. Objectives, methods, and techniques in teaching Spanish, French, German, and Latin from elementary through college. Discussion, demonstration, preparation of instructional materials, microteaching of the language skills. Prereq: permission of instructor. 3 cr.

895-896. SPECIAL STUDIES IN SPANISH LANGUAGE AND LITERATURE

1) The history of the Spanish language; 2) Medieval Spanish literature; 3) Spanish literature of the Renaissance; 4) Spanish literature of the Golden Age; 5) Spanish literature of the 18th and 19th centuries; 6) Spanish literature of the 20th century (1898-1936); 7) Contemporary Spanish literature; 8) Spanish-American literature of the 16th and 17th centuries; 9) Spanish-American literature of the 18th and 19th centuries; 10) Spanish-American literature of the 20th century; 11) Contemporary Spanish-American literature; 12) Structural and applied linguistics; 13) Spanish Literary Criticism; 14) Spanish-American Essay; 15) Latin America; 16) Catalan; 17) Spanish-American Poetry; 18) Spanish Poetry; 19) Galdos; 20) Archetype Latin American literature; 21) Special Teaching Problems; 22) Spanish Civilization and Culture; 23) Latin-American Civilization and Culture; 24) Borges; 25) Spanish Theater. Guided study with training in bibliography and organization of material. Topics selected by instructor and student in conference. Prereq: permission of major supervisor. Variable, 1-3 cr.

899. MASTER'S THESIS

6 cr.

Animal Sciences (AnSc)

Chairperson: W. C. Skoglund

PROFESSORS: Walter M. Collins, William R. Dunlop, Winthrop C. Skoglund, Samuel C. Smith, Richard G. Strout

ASSOCIATE PROFESSORS: Allan C. Corbett, Thomas P. Fairchild, James B. Holter, Gerald L. Smith, Larry L. Stackhouse

ASSISTANT PROFESSORS: William Condon, Walter Hylton, Frank Repka, Charles Schwab, Thomas Wight

LECTURER: Elizabeth Smith

To be admitted to graduate study in animal sciences, an applicant is expected to have had sufficient undergraduate training in the basic biological sciences to qualify for special work in this field. The M.S. degree is offered in the areas of genetics, nutrition, physiology, diseases and parasites, and management. A thesis is required, and a candidate for the

Animal Sciences

master's degree shall pass an oral examination covering the graduate courses and thesis. We encourage all students to obtain teaching as well as research experience during their graduate study.

701. PHYSIOLOGY OF REPRODUCTION

Physiology, embryology, endocrinology, reproduction, and lactation in domestic animals. Mr. Condon. Lab. 4 cr.

702. EXPERIMENTAL ENDOCRINOLOGY OF REPRODUCTION AND LACTATION

An in-depth study of the hormonal control of the estrous cycle; pregnancy and mammary gland growth and lactation. Emphasis will be placed on current experimental data. Mr. Condon. Lab. Prereq: AnSc 701 and permission of instructor. 4 cr.

709. BIOCHEMISTRY OF NUTRITION

Intermediary metabolism of nutrients and energy; metabolism transport mechanisms; biological oxidation; interrelationships of carbohydrate, fat, and protein metabolism; obesity; control of hunger and appetite. Mr. Repka. 4 cr. (Also offered as HEC 709.)

710. RUMINANT NUTRITION

Feeding and management of dairy animals; calf feeding, raising young stock, feeding for economical milk production. Mr. Holter. Lab. 4 cr.

711. COMPARATIVE ANIMAL GENETICS

How heredity affects domestic animals, poultry, other mammals, and fish; emphasis on the organism and population. Quantitative inheritance, principles of selection, disease resistance also studied. Statistical and experimental techniques. Lab. Prereq: 4 cr. of genetics or permission of instructor. Mr. Collins. 4 cr.

712. ANIMAL BREEDING AND IMPROVEMENT

Population genetics and selection in dairy cattle, livestock, and horses. Lab. Prereq: AnSc 711. Mr. Fairchild. (Not offered every year.) 4 cr.

714. INTRODUCTION TO ELECTRON MICROSCOPY

A detailed consideration of the principles and methods used in preparing and examining vertebrate, invertebrate, microbial, plant, and physical specimens in the electron microscope. Topics include the theory and application of fixation and embedding procedures, ultramicrotomy, operation of the electron microscope, and special techniques such as autoradiography and ultrastructural histochemistry. Lab. Prereq: General Chemistry and permission of instructor. Mr. Wight. 4 cr.

795-796. INVESTIGATIONS IN DAIRY, LIVESTOCK, POULTRY

- 1) **Genetics:** Mr. G.L. Smith, Mr. Collins, Mr. Fairchild.
- 2) **Nutrition:** Mr. G.L. Smith, Mr. Holter, Mr. Repka, Mr. Schwab.
- 3) **Management:** Mr. G.L. Smith, Mr. Skoglund.
- 4) **Diseases:** Mr. Corbett, Mr. Dunlop, Mr. Hylton, Mr. Strout, Mr. S.C. Smith, Mr. Stackhouse, Mr. Wight.
- 5) **Products:** Mr. G.L. Smith.
- 6) **Light Horses:** Ms. Briggs, Mr. Gaiser.
- 7) **Physiology:** Mr. Condon.

The student may select a special problem in any of the fields listed under the guidance of the instructor. Elective only after consultation with the instructor in charge. May be repeated. 1-4 cr.

801. ADVANCED STUDIES IN ANIMAL BREEDING

Independent study and research on modern breeding methods and newer systems of selection for quantitative traits. Prereq: AnSc 712. Mr. Collins, Mr. Fairchild, Mr. G.L. Smith. Hours to be arranged. 3 cr.

802. MEATS, LIVESTOCK MARKETS, AND PRODUCTS

The essential factors in meat selection, cutting, curing and smoking; study and discussion relative to the problems of livestock marketing and the procedure in the large central markets. Trips are taken to various packing plants. Mr. Gerald Smith. Lab. 4 cr.

803. ENERGY METABOLISM AND NUTRITION

Incidental lectures, assigned reading, and laboratory practice in methods of research with major emphasis on protein and energy metabolism. Mr. Holter. (Not offered every year.) 3 cr.

804. PROTEIN METABOLISM AND NUTRITION

Metabolism of dietary amino acids in the mammalian system with emphasis on various aspects of protein nutrition. Prereq: permission of instructor. Mr. Schwab. (Not offered every year.) 3 cr.

805-806. AVIAN MICROBIOLOGY

The disease process (acute or chronic) in the intact host at cellular levels when invaded by viruses of virus-like agents, fungi, and protozoans. Physiological and cytopathological changes in tissue culture. Prereq: AnSc 612 or the equivalent. Mr. Dunlop, Mr. Strout, and Mr. Corbett. 3 cr.

807-808. AVIAN HISTOPATHOLOGY

First semester: general histopathology. Second semester: the special histopathology of common diseases with emphasis on correlation of light and electron microscopy of tumors and tumor formation. Prereq: histology or the equivalent. Mr. Dunlop and Mr. Strout. 3 cr.

810. MINERALS AND VITAMINS IN NUTRITION

Metabolism and function of mineral elements and vitamins in higher animals. Prereq: permission. Mr. Schwab. (Not offered every year.) 4 cr.

812. QUANTITATIVE GENETICS AND SELECTION

Gene frequency, genetic and environmental variation, heritability, fitness, selection, inbreeding, outbreeding, correlated characters. Prereq: 1 course each in genetics and statistics. Mr. Collins. (Not offered every year.) 3 cr.

851. CELL CULTURE

Theory, principles fundamental to the culture cells in vitro. Introduction to techniques of preparation, maintenance of animal, plant, insect, fish cell cultures. Application of cell culture to contemporary research in biological sciences. Lab. Prereq: Micr 503 and permission of instructor. (Also offered as Micr 851 and Bot 851.) 4 cr.

853. ADVANCED CELL BIOLOGY

A study of the ultrastructure and function of cell organelles followed by an analysis of various specialized animal cells to show how differences in form and location of various organelles lead to differences in function. Prereq: biochemistry; physiology; vertebrate anatomy; /or permission of instructor. Mr. Wight. (Not offered every year.) 4 cr.

897-898. ANIMAL SCIENCE SEMINAR

A survey of recent literature and research in the animal sciences. Staff. 1 cr. May be repeated.

899. THESIS

Hours to be arranged. 6-10 cr.

Biochemistry (Bchm)

Chairperson: Gerald L. Klippenstein

PROFESSORS: Donald M. Green, Edward J. Herbst, Miyoshi Ikawa, Samuel C. Smith, Arthur E. Teeri

ASSOCIATE PROFESSORS: Gerald L. Klippenstein, James A. Stewart

For admission to graduate study in biochemistry an applicant is expected to have completed basic courses in chemistry, biological sciences, mathematics, and physics. Otherwise well qualified applicants will be permitted to correct deficiencies in undergraduate education by enrollment in the appropriate courses or by independent study.

The department offers opportunities for specialization in developmental biochemistry, biochemistry of natural products, physical biochemistry, biochemical genetics, and structure and metabolism of macromolecules. Opportunities also exist for interdisciplinary research specialization in marine biochemistry, biochemical nutrition, and cell biology in adjunct facilities on campus and at the Jackson Estuarine Laboratory. In addition to the graduate courses in biochemistry, courses in advanced organic chemistry, radiochemistry, advanced microbiology, and genetics are usually recommended.

Participation of all graduate students will be required in the instructional activities of the department, either in the laboratory, in lectures, or in an individual instruction format. These teaching assignments are an essential part of the graduate academic programs of the department and are designed to give graduate students practical teaching experience. Normally one year of part-time teaching will be required of each student.

A Master of Science degree candidate will be expected to develop a thesis on a basic research problem or to prepare a report or publication based on an applied project in biochemistry. All candidates for the M.S. degree will be required to pass an oral examination based on the thesis or project report and on the graduate courses completed in the degree program.

The Doctor of Philosophy degree candidate will be required to complete a dissertation on original research in biochemistry. At the end of the first year of graduate study, a preliminary examination on organic chemistry, physical chemistry, and general biochemistry will be presented to students in the doctoral program. The results of this examination and the student's academic record will be evaluated at this time to ascertain eligibility to proceed to candidacy in the doctoral program. Upon completion of graduate courses recommended by a guidance committee and demonstration of proficiency in the translation of biochemical literature in either German, French, or Russian, a doctoral student will be required to pass an oral qualifying examination conducted by the guidance committee. The successful completion of these requirements and advancement to candidacy for the Ph.D. degree must occur at least six months prior to the final oral defense of the Ph.D. dissertation administered by the student's doctoral committee.

601. GENERAL BIOCHEMISTRY

The general principles. Lab. Prereq: organic chemistry. Students receiving credit for Bchm 601 may not receive credit for Biochem 501. Mr. Ikawa. 4 cr.

656. PHYSIOLOGICAL CHEMISTRY AND NUTRITION

Mammalian biochemistry with emphasis on the human. Lab study includes procedures basic to chemical methods of medical diagnosis. Lab. Prereq: organic chemistry. Mr. Teeri. 4 cr.

Biology: Intercollege Biological Sciences Organization

702. COMPARATIVE MARINE BIOCHEMISTRY

Nutrition, metabolism, and composition of marine organisms and relation to phylogeny; marine natural products. Prereq: Bchm 601 or equivalent. Mr. Ikawa. (Not offered every year.) 3 cr.

721. NEUROCHEMISTRY

The biochemistry of the nervous system; metabolism and alterations of normal brain chemistry by drugs, chemicals, nutrition, memory, and learning; pathological changes. Prereq: biochemistry. Mr. Stewart. (Not offered every year.) 3 cr.

751-752. PRINCIPLES OF BIOCHEMISTRY

Chemistry, structure, and function of biological molecules. Metabolism and biological role of carbohydrates, lipids, amino acids, proteins, and nucleic acids. Lab. Prereq: one year of organic chemistry; /or permission. Mr. Klippenstein and Mr. Stewart. 4 cr.

760. ENZYME CHEMISTRY

Structure, properties, and function of enzymes; kinetics and mechanisms of enzyme-catalyzed reactions; purification, characterization, and assay of enzymes. Mr. Klippenstein. Lab. (Not offered every year.) 4 cr.

770. BIOCHEMICAL GENETICS

The mechanisms of storage, replication, transmission, transcription, recombination, mutation, and expression of genetic information by cells and viruses. Lab. Prereq: Bchm 751 or permission of instructor. Mr. Green. (Not offered every year.) 4 cr.

781. THE NUCLEIC ACIDS

Chemistry and metabolism of nucleic acids; molecular structures, purification and separation, biosynthesis, and biological functions. Prereq: organic chemistry and biochemistry. Mr. Herbst. 3 cr.

795,796. INVESTIGATIONS IN BIOCHEMISTRY

Subject matter and hours to be arranged. Prereq: permission. 2 cr.

811. BIOCHEMISTRY OF LIPIDS

The chemistry, metabolism, and function of lipids. Prereq: Bchm 752 or equivalent. Mr. Smith. (Not offered every year.) 3 cr.

813. BIOCHEMISTRY OF MEMBRANES

The structural and functional characteristics of biological membranes. Chemical composition, molecular interactions, enzymatic properties, biogenesis, and turnover. Metabolic systems associated with specific kinds of membrane systems. Mr. Smith. Prereq: Bchm 601 or equivalent. (Not offered every year.) 3 cr.

832. BIOCHEMISTRY OF CARBOHYDRATES

The chemistry, metabolism, and functions of carbohydrates. Emphasis will be placed on polysaccharides, glycoproteins, and the nature of cell surfaces. Prereq: Bchm 601 or equivalent. Mr. Ikawa. (Not offered every year.) 3 cr.

842. BIOCHEMICAL REGULATORY MECHANISMS

The nonreplicative functions of DNA. Transcription and translational control of protein synthesis. Quantitative regulation of proteins. Regulation of metabolism by hormones, allosteric regulation and repression. Regulatory mechanisms operating during development and differentiation. Prereq: a course in biochemistry. Mr. Stewart. (Not offered every year.) 3 cr.

850. PHYSICAL BIOCHEMISTRY

Structure, interactions, and physical properties of biomolecules. Thermodynamic, hydrodynamic, and spectroscopic methods for study of proteins and nucleic acids. Prereq: physical chemistry and biochemistry. Mr. Klippenstein. (Not offered every year.) 3 cr.

852. ADVANCED BIOCHEMISTRY LABORATORY

Techniques for purification and characterization of proteins and nucleic acids. Lab. Prereq: Bchm 751. (Not offered every year.) 2 cr.

897,898. BIOCHEMISTRY SEMINAR

Prereq: permission. 0 cr.

899. MASTER OF SCIENCE THESIS

To be arranged. 6-10 cr.

999. DOCTORAL RESEARCH

Biology: Intercollege Biological Sciences Organization

Chairperson: Robert Blanchard

Chairperson of Graduate Advising Committee: Miyoshi Ikawa

The Master of Science and Master of Science for Teachers programs in biology are administered by the Intercollege Biological Sciences Organization, which is composed of faculty members involved in teaching and research in various biological sciences. Students in these degree programs consult with the Graduate Advising Committee in planning their individual programs. At present, participating faculty are drawn from the following areas; molecular, cellular, and developmental biology; systematics and evolution; physiology; anatomy and nutrition; genetics; ecology; and pathobiology.

Master of Science

This is a general, nonthesis program which is applicable to interests which may not be met in a formal department. Curricula may be individually designed for persons working for agencies which require advanced, in-breadth training in the biological sciences, or for those who wish to prepare for junior or community college teaching. Applicants should have a bachelor's degree in biology, zoology, botany, microbiology, or a strong background in biological and physical sciences including physics, college mathematics, and organic chemistry. Those admitted to the program will be required to pass a final comprehensive examination on coursework taken for the degree.

Master of Science for Teachers (MST)

This is a nonthesis program designed to provide experienced and/or certified secondary school teachers with an opportunity to update and expand their knowledge of biology. Applicants must have three years experience as biology teachers, be teaching high school at the time of application, or have a valid teaching certificate for secondary school science. An applicant's teaching experience will be considered as well as undergraduate academic performance. Courses are chosen from the participating biological science disciplines in consultation with the graduate student's adviser.

Persons interested in either of these programs should contact the chairperson of the Graduate Advising Committee for further information.

Botany and Plant Pathology (Bot)

Chairperson: A. Linn Bogle

PROFESSORS: Arthur C. Mathieson, Avery Rich, Richard W. Schreiber

ADJUNCT PROFESSORS: John M. Kingsbury, Alex L. Shigo

ASSOCIATE PROFESSOR: A. Linn Bogle

ASSISTANT PROFESSORS: Alan L. Baker, Robert O. Blanchard, Garrett Crow, Russell S. Kinerson, Jr., William E. MacHardy, Subhash C. Minocha

ADJUNCT ASSISTANT PROFESSOR: Walter C. Shortle

Students admitted to graduate study in botany and plant pathology are expected to have adequate preparation in basic botany courses and in the physical sciences.

The candidate for the Master of Science degree will meet the Graduate School's requirements for the degree and, in addition, will be required to defend a thesis based on field or laboratory research.

A student who is working toward the Doctor of Philosophy degree will be advanced to candidacy for the Ph.D. after a successful comprehensive examination and completion of the following language requirement: a reading knowledge of at least one foreign language. The guidance committee may request a reading knowledge of two foreign languages, or a reading knowledge of one foreign language and proficiency in a cognate field such as statistics or computer techniques. The student will be required to defend a dissertation that is to be a substantial contribution to botanical knowledge.

All botany and plant pathology graduate students without professional teaching experience will satisfy the following departmental teaching requirement: each student will assist a faculty member for one semester in teaching an introductory botany course; a Ph.D. candidate will assist for one additional semester in an advanced botany course. Each student will also register for one semester of Section 9, Botanical Teaching, of either Botany 795-796 or Botany 895-896.

The department's areas for graduate study include: plant physiology, Mr. Minocha; plant ecology, Mr. Kinerson; systematic botany, Mr. Crow; phycology, marine-freshwater, Mr. Mathieson, Mr. Baker, Mr. Kingsbury; plant pathology, Mr. Rich, Mr. Blanchard, Mr. MacHardy, Mr. Shigo, Mr. Shortle; plant morphology and anatomy, Mr. Bogle; mycology, Mr. Blanchard; cell biology, Mr. Schreiber; developmental botany, Mr. Minocha.

606. PLANT PHYSIOLOGY

Function of higher plants; water relations, metabolism, growth, and development. Prereq: elementary botany, survey of the plant kingdom, or concepts of plant growth; one year of chemistry or permission of instructor. Mr. Minocha, Mr. Pollard. 4 cr.

717. GENERAL LIMNOLOGY

Special relationships of freshwater organisms to the chemical, physical, and biological aspects of their environment; factors regulating their distribution; and the primary and secondary productivity of lakes. Individual projects. Prereq: General Ecology or equivalent. Mr. Baker, Mr. Haney. 4 cr.

719. FIELD LIMNOLOGY

Principles of freshwater ecology, from a variety of habitats; the methods used to study lakes and interpret data. Occasional Saturday field trips. Prereq: prior or simultaneous enrollment in Bot 717 and permission of instructor. Mr. Baker and Mr. Haney. 4 cr.

721. THE MICROSCOPIC ALGAE

Survey of phytoplankton and periphyton in local marine and freshwater habitats. Identification, systematics, and evolution. Class and individual collection trips. Prereq: elementary botany, or survey of the plant kingdom. Mr. Baker. 4 cr.

Botany and Plant Pathology

722. MARINE PHYCOLOGY

The identification, classification, ecology, and life histories of the major groups of marine algae, particularly the benthonic marine algae of New England. Periodic field trips. Prereq: elementary botany, or survey of the plant kingdom. Mr. Mathieson. (Alternate years; offered 1977-78.) 4 cr.

723. MARINE ALGAL ECOLOGY

Distribution, abundance, and growth of marine plants in relation to their environment. Scheduled field trips and an independent research project are required. Prereq: Bot 722 or Zool 715 or permission of instructor. Mr. Mathieson. (Alternate years; offered 1978-79.) 4 cr.

724. FRESHWATER ALGAL ECOLOGY

Survey of physiology and ecology of microscopic algae; models of algal population dynamics. Lab or field project. Prereq: Bot 721 or permission of instructor. Mr. Baker. 4 cr.

730. MORPHOGENESIS

Principles of differentiation; internal and external factors in cellular and organismic development. Prereq: Bot 606 or permission of instructor. Mr. Minocha. 4 cr.

732. CELL BIOLOGY

Structure, behavior, and development of cells; the cellular basis of heredity. Prereq: one year of biological science and chemistry. Mr. Schreiber. 4 cr.

735. CELL PHYSIOLOGY (PLANT)

Function of living cells, emphasis on algal cells. Prereq: one year of general chemistry and biological science. Staff. (Alternate years; offered 1978-79.) 4 cr.

741. ECOSYSTEM ANALYSIS

Ecosystem structure and function; energy flow and biochemical cycles. Computer simulations of natural ecosystems. Prereq: General Ecology or permission of instructor. Mr. Kinerson. 4 cr.

742. PHYSIOLOGICAL ECOLOGY

Physiological responses of plants to the physical environment; photosynthesis, water relations, mass and energy flow. Prereq: Bot 606 or permission of instructor. Mr. Kinerson. 4 cr.

747. AQUATIC HIGHER PLANTS

Flowering plants and fern relatives, Bryophytes found in and about bodies of water in the northeastern United States; extensive field and herbarium work, preparation techniques, and collections. Prereq: plant taxonomy. Mr. Crow. (Alternate years; offered 1978-79.) 4 cr.

751. PLANT PATHOLOGY

Nature, symptomatology, etiology, and classification of plant diseases. Prereq: elementary botany or equivalent. Mr. Rich. 4 cr.

752. MYCOLOGY

Parasitic and saprophytic fungi; growth, reproduction, and identification; preparation of pure cultures. Prereq: elementary botany or equivalent. Mr. Blanchard. (Alternate years; offered 1977-78.) 4 cr.

753. FOREST PATHOLOGY

Principles, etiology, epidemiology, and control of forest and shade tree diseases. Prereq: elementary botany or equivalent. Mr. Blanchard. 4 cr.

754. PRINCIPLES OF PLANT DISEASE CONTROL

Exclusion, eradication, protection, immunization, and the specific practical methods used to control plant diseases. Lab. Prereq: Bot 751 or 753. Mr. MacHardy. (Alternate years; offered 1977-78.) 4 cr.

758. PLANT ANATOMY

Anatomy of vascular plants, emphasizing structure and development of basic cell and tissue types, and of the major plant organs. Prereq: elementary botany, or survey of the plant kingdom. Mr. Bogle. (Alternate years; offered 1978-79.) 4 cr.

761. PLANT GEOGRAPHY

The distribution of plants, a consideration of vegetation types and floras, and problems of endemism with emphasis on North America; the major influential factors such as geologic, climatic, edaphic, and biotic, including man's activities. The major contributions from Humboldt to the present time. Prereq: plant taxonomy or permission of instructor. Mr. Crow. (Alternate years; offered 1978-79.) 4 cr.

762. MORPHOLOGY OF THE VASCULAR PLANTS

Comparative form and structure of the major living and extinct groups; evolutionary modifications of the vegetative and reproductive organs, and the basic life history pattern. Prereq: elementary botany, or survey of the plant kingdom. Mr. Bogle. (Alternate years; offered 1977-78.) 4 cr.

764. MICROTECHNIQUE

Methods of preserving cell and tissue structure, embedding, sectioning, and staining plant tissues, and an introduction to microscopy. Lab. Prereq: permission of instructor. Mr. Bogle. (Alternate years; offered 1978-79.) 4 cr.

795-796. INVESTIGATIONS IN: 1) SYSTEMATIC BOTANY; 2) PLANT PHYSIOLOGY; 3) PLANT PATHOLOGY; 4) PLANT ANATOMY; 5) PLANT ECOLOGY; 6) MYCOLOGY; 7) CELL BIOLOGY; 8) PHYCOLOGY; 9) BOTANICAL TEACHING; 10) MORPHOLOGY; 11) CELL PHYSIOLOGY; 12) SCIENTIFIC WRITING; 13) BRYOLOGY

Individual projects under faculty guidance. Elective only with permission of instructor. Hours to be arr. 2-4 cr.

822. ADVANCED MARINE PHYCOLOGY

Classification, ecology, and life histories of marine algae considered at an advanced level. Seminars, discussions, assigned reading, and laboratory. Mr. Mathieson. Prereq: Bot 722 or its equivalent. 4 cr.

843. THE PLANT AND THE MICROCLIMATE

Productivity, water-relations, plant distribution as dependent upon soil and atmospheric physics. Laboratories provide experience with instrument design, calibration, and use for measurement of plant-environment factors. Prereq: permission of instructor. Mr. Kinerson. (Alternate years; offered 1978-79.) 4 cr.

851. CELL CULTURE

Theory and principles fundamental to the culture of cells in vitro. Introduction to techniques of preparing and maintaining animal, plant, insect, and fish cell cultures. Application of cell culture to contemporary research in the biological sciences. Mr. Strout and staff, Mr. Metcalf, and Mr. Minocha. Prereq: microbiology; permission of instructor. (Also offered as Micr 851 and AnSc 851.) 4 cr.

852. METHODS IN MYCOLOGY

Laboratory procedures employed in various aspects of mycological research from selection of research problem to journal publication. Prereq: Bot 752 or permission of instructor. Mr. Blanchard. (Alternate years; offered 1978-79.) 4 cr.

853. ADVANCED PLANT PATHOLOGY

Advanced theories and methods in plant pathology. Mr. MacHardy. Prereq: Bot 751 or 753; permission of instructor. Assigned reading, conferences. (Alternate years; offered 1978-79.) 4 cr.

867. ADVANCED SYSTEMATIC BOTANY

Principles and rules of plant classification and nomenclature; plant families; field and herbarium work. Prereq: plant taxonomy. Mr. Crow. (Alternate years; offered 1977-78.) 4 cr.

895-896. INVESTIGATIONS IN: 1) SYSTEMATIC BOTANY; 2) PLANT PHYSIOLOGY; 3) PLANT PATHOLOGY; 4) PLANT ANATOMY; 5) PLANT ECOLOGY; 6) MYCOLOGY; 7) CELL BIOLOGY; 8) PHYCOLOGY; 9) BOTANICAL TEACHING; 10) MORPHOLOGY; 11) CELL PHYSIOLOGY; 12) SCIENTIFIC WRITING; 13) BRYOLOGY

Individual projects under faculty guidance. Elective only by permission of the appropriate instructor. Hours to be arranged. 2-6 cr.

899. MASTER OF SCIENCE THESIS

Variable credit, 10 cr. maximum total.

999. DOCTORAL DISSERTATION

Business Administration (Admn)

Director of M.B.A. Programs: Allan R. Cohen

PROFESSORS: Robert F. Barlow, John A. Beckett, Jan E. Clee, Allan R. Cohen, Stephen L. Fink, Herman Gadon, James O. Horrigan, John L. Korbel, Dwight R. Ladd, Robin D. Willits, Dwayne E. Wrightsman
ASSOCIATE PROFESSORS: Allan J. Braff, John M. Burt, Jr., Dale G. Broderick, R. Stephen Jenks, Fred R. Kaen, Richard L. Mills, Barry Shore, Linda G. Sprague, William E. Wetzel, Jr.
ASSISTANT PROFESSORS: George W. Miaoulis, Jr., Gordon D. Smith
INSTRUCTORS: Dean Plager, Lawrence R. Scheewe

The Whittemore School day and evening programs leading to the degree of Master of Business Administration are designed to prepare graduates for professional careers in administration in both profit and not-for-profit organizations in a rapidly changing world. The MBA programs are directed toward a broad preparation in general administration through the study of: 1) the increasing body of relevant knowledge drawn from the behavioral sciences, mathematics, and economics; 2) the existing and emerging processes and institutions of the functional fields of administration; and 3) the role of business and other organizations in a complex and ever-changing society.

There is a consistent emphasis on developing basic analytical skills rather than on developing extensive technical expertise. Also, the program fosters the ability to utilize conceptual and theoretical material in the analysis and solution of practical problems.

Candidates for admission must possess a bachelor's degree from an accredited college or university. In addition, all candidates are expected to take the Graduate Management Admission Test (GMAT) given by the Educational Testing Service. Details concerning the dates and locations for these examinations may be obtained from Educational Testing Service, Box 955, Princeton, New Jersey 08540.

Business Administration

The Whittemore School welcomes applicants with an above-average academic record in any undergraduate specialty other than business or commerce. No previous exposure to business courses is expected. However, previous work in mathematics, economics, the behavioral sciences, and the branches of engineering are of particular usefulness for graduate study in administration. Because of the increasing use of mathematical concepts, models, and notation in the practice and study of administration, applicants should normally have successfully completed one year of college mathematics, preferably including an introduction to calculus. Students lacking this background may still enroll in the program, provided they obtain adequate substitute preparation prior to beginning the program.

In all cases, the applicant's entire educational background, relevant experience, references, and professional aims will be considered in the admissions process. Exceptions may be made to any of the foregoing requirements by the Committee on Admissions.

The Whittemore School day MBA program consists of an integrated sequence of 21 courses requiring two years of study which can be started only in the fall semester. During the first year, 13 required courses or part courses in the basic disciplines (quantitative analysis, economics, and behavioral science) and the functional areas of management (accounting, marketing, operations management, and financial management) are integrated into an overall study of the process of administration. Special attention is also given to the study of the modern corporation as a partly economic, legal, and social organization by requiring all students to complete the course, *The Organization and its Environment*.

The second year of the day program continues the emphasis on overall management by requiring all students to complete the integrating course, *Business Policy*. In addition, with the help of a faculty adviser, the student will select the equivalent of seven four-credit elective courses with some concentration in an area of special interest. Students are encouraged to select appropriate graduate-level courses offered by other colleges of the University as well as by the Whittemore School.

The evening MBA program involves completion of 21 courses offered in an integrated sequence over three years. The evening program may normally be started only in the fall term and, because of the cumulative nature of the program, students should expect to stay on schedule with their class. The program is designed for the nonbusiness undergraduate and is aimed at broad training rather than intensive specialization. It is comparable to the day MBA program in curriculum, but specially tailored to the content and scheduling needs of people working full time.

Required Business Administration Courses (day and evening MBA candidates): 800, 801, 802, 803, 804, 806, 808, 810, 811, 815, 816, 817, and 818.

Further information on both the day and evening MBA programs can be obtained by writing to the dean, Whittemore School of Business and Economics, University of New Hampshire, Durham, New Hampshire 03824.

705. OPERATIONS RESEARCH

Synthesis and analysis of mathematical decision models; mathematical programming, networks, inventory, queuing, scheduling, and Markovian models. Prereq: permission of instructor. 4 cr.

712. ORGANIZATIONAL CHANGE

Process of change in organizations. Change strategies; role of the change agent and his/her relation to the client system. Bases of resistance to change and problems encountered by internal and external change agents. Theoretical reading material, cases, and exercises. Prereq: permission of instructor. 4 cr.

713. INTERPERSONAL AND GROUP DYNAMICS

Dynamics of small groups through the use of the class itself as an intensive laboratory study group. Students examine their own behavior and its effects on others through the use of the Laboratory Training Group (T-group), and develop conceptual ability and behavioral skills. Readings in group dynamics, interpersonal relations, and sensitivity training. Prereq: permission of instructor. Lab fee. 4 cr.

714. CONFLICT MANAGEMENT

Conflict among individuals, small groups, and organizations. Analysis of cases, readings, simulations, and roleplays (often using videotape) develops useful concepts and skills for dealing with conflict. Students examine their own behavior in coping with conflicts within the class. Field project required. Prereq: permission of instructor. 4 cr.

717. ADVANCED FINANCIAL ACCOUNTING

Theory and practice as they contribute to the significance and limitations of the financial statements. Prereq: permission of instructor. 4 cr.

718. COST AND MANAGEMENT

Effective use of cost accounting, cost analysis, and budgeting in planning and controlling operations. Analysis of cost behavior, direct and absorption costing, cost-price-volume relationship, distribution costs, transfer pricing, and capital expenditure analysis. Prereq: permission of instructor. 4 cr.

720. AUDITING

The independent auditor and his/her attest function in society. Professional ethics and responsibility. Audit concepts, procedures, objectives, and reports. Operational audits, social audits, and management services. Prereq: Admn 717 or permission of instructor. 4 cr.

722. ACCOUNTING SEMINAR

Special topics. Prereq: Admn 717 or 718, depending on topics; consent of instructor. 4 cr.

728. STATISTICAL DECISION MAKING

Probability and statistics applied to decision problems. Bayesian approach to decisions under uncertainty, which explicitly injects prior judgements of decision makers and the consequences of alternative actions. Prereq: Admn 424 or equivalent. 4 cr.

730. INVESTMENTS ANALYSIS

Capital market patterns and techniques useful for security analysis. Securities, market institutions, yield series, random walks, intrinsic-value analysis, and portfolio management. Security analysis research projects. Prereq: permission of instructor. 4 cr.

732. EXPLORATIONS IN ENTREPRENEURIAL MANAGEMENT

Past and probable future role of the entrepreneur in the economic and social development of the U.S. Differences between entrepreneurial and administrative management. Mythology of the "American Dream," entrepreneur as a change agent, entrepreneurial motivation and behavior patterns, venture-capital markets, and role of the entrepreneur in nonprofit institutions. Prereq: permission of instructor. 4 cr.

741. TRANSPORTATION

Problems of American transportation system. Economic structure of transportation industries; competition among the several modes. Public policy questions: merger, cost-benefit analysis of facilities, for example. Freight transportation; problems of passenger transportation, especially in urban areas. Prereq: permission of instructor. 4 cr.

745. INTERNATIONAL BUSINESS

Issues and problems confronting managers in the international economy. Emphasis on problems of working across national borders rather than on those encountered within the framework of different national economies, cultures, and institutions. For managers working in a multinational enterprise. Prereq: permission of instructor. 4 cr.

747. FEDERAL TAXATION

Current federal income, estate, and gift taxes and their impact on corporations, partnerships, and individuals. Tax analysis and decision making. 4 cr.

750. MARKETING MANAGEMENT

Practical application of theories taught in Admn 651 or 808. Planning, organization, and control of marketing activities in large corporations and small businesses; new product development; pricing policies; selection of channels of distribution; interrelationships between marketing, production, and finance. Sound policy formulation and decision making established through analysis of cases and computer simulation. Prereq: a basic marketing course. 4 cr.

751. ADVERTISING AND PROMOTION

Advertising, personal selling, and other promotional tools to help solve marketing problems; advertising as a medium of communications and as a social cultural force in the Western world. Prereq: Admn 651, 808, or permission of instructor. 4 cr.

752. MARKETING RESEARCH

Identification, collection, and analysis of data for the marketing process. Strengths, limitations, environment, and evaluation of research in the marketing process. Prereq: Admn 424 and 651 or their equivalent. 4 cr.

754. CONSUMER BEHAVIOR

Consumer-firm relationship: concepts from contemporary social science findings, particularly small group studies, learning, memory, cognition, motivation, emotion, perception concepts and global models related to present and prospective marketing activities of a business organization. Prereq: Admn 651 or permission of instructor. 4 cr.

755. ADVANCED BUSINESS FINANCE

Development of analytical tools and practical skills for recognizing and solving complex problems of business finance. Working-capital management, capital budgeting, cost of capital, capital structure, and dividend policy. Prereq: Admn 653 or 806. 4 cr.

756. MANAGEMENT OF FINANCIAL INSTITUTIONS

How financial institutions manage their sources and uses of funds; impact of external environmental factors upon the operation and performance of financial institutions. Optimal portfolio strategies for commercial banks, savings and loan associations, mutual savings banks, insurance companies, and pension funds. Implications of monetary theory for individual financial institution policies; credit analysis; competition among financial institutions; regulation of financial institutions. 4 cr.

770. PERSONNEL ADMINISTRATION

Role of personnel administration and human resource management in achievement of goals in "for-profit" and "not-for-profit" organizations. Functions of management; scope, technique, and current issues of personnel administration; organization of personnel activities and staff. How managers relate to personnel administration and interact with personnel administration staff and services. Prereq: permission of instructor. 4 cr.

798. SEMINAR IN ADMINISTRATION

Special topics; may be repeated. Prereq: consent of adviser and instructor. Variable 1-4 cr.

Business Administration

All 800-level courses normally open to Master of Business Administration students only.

2elt

800. INTRODUCTION TO THE STUDY OF BUSINESS

Introduction to information sources and business institutions. Orientation in communication strategies and techniques. Identification of critical issues in economic organizations and approaches to business education. 2 cr. *M + M 246,30 -*

801. STATISTICS

Basic mathematical and statistical concepts useful in managerial decision making. Probability, statistics, decision trees, and mathematical models. Emphasis is on applications. 3 cr. *212 MC C*

802. MODELS FOR ANALYSIS AND DECISION MAKING

Synthesis and analysis of models as aids in describing systems and in making effective management decisions. System definition, conceptualization, formulation, data collection, validation, analysis, and managerial implementation. Qualitative as well as mathematical models. 2 cr.

803. HUMAN BEHAVIOR IN ORGANIZATIONS

To provide students with an understanding of behavioral science concepts and their use in the analysis of individual, group, and leadership relationships in organizations, and to develop skills in dealing with others at work. 3 cr.

804. MANAGEMENT ORGANIZATION

Theories of organization and analysis of contemporary forms and structure. Concern is with development of rational management processes in a dynamic society. 2 cr.

806. FINANCIAL MANAGEMENT

Concepts and techniques for determining the need for, the acquisition of, and the management of, financial resources of the business. 3 cr.

808. MARKETING

Identification, development, and retention of markets for the goods and services offered by the firm. Attention is given to the dynamics of demand and to the blending of the marketing mix. 3 cr.

810. OPERATIONS MANAGEMENT

Analysis of operational problems in the product and service sectors, focusing on production system design and development; emphasis on standards, capacity, inventory, scheduling, and control. 3 cr.

811. THE ORGANIZATION AND ITS ENVIRONMENT

Study of the modern corporation as a partly economic, legal, and social organization, including examination of widely held views of business and views of businessmen about themselves. 3 cr.

815. FINANCIAL ACCOUNTING

Introduction to the accounting methods employed in organizations to determine and communicate their financial position to interested parties outside the organization. 3 cr.

816. BUDGETING AND CONTROL

Introduction to various models employed by organizations in the financial planning and control processes. 2 cr.

817. BUSINESS CONDITIONS AND ECONOMIC FORECASTING

Managerial effects of historical and forecasted movements in interest rates, national income, inflation, and unemployment. 2 cr.

818. MANAGERIAL ECONOMICS

An economics approach to the conceptualization, analysis, and management of revenues, costs, and profits. 2 cr.

820. BUSINESS POLICY

A "capstone" course, focused on industries, companies, and other organizations in operation, and studied through case examples, with emphasis on integration of materials covered in prior courses. 4 cr.

848. LAW: USE AND APPLICATION IN BUSINESS

The use and understanding of law as it applies to business judgement and policy decision-making. Emphasis on learning basic legal rules and their application. Contracts, corporations, agencies, partnerships, administrative agencies, commissions, and other related business matters. Case-method teaching with outside research. 4 cr.

861. THE PHILOSOPHY OF MANAGEMENT SCIENCE

A study of management from a systems analysis point of view. 4 cr.

895. SPECIAL PROJECTS AND INDEPENDENT STUDY

Projects, research, and reading programs in areas required for concentration. Sixty days advance approval of the student's plan of study by adviser and by proposed instructor required. Staff. Variable credit. May be repeated.

Chemical Engineering (ChE)

Chairperson: Stephen S.T. Fan

PROFESSOR: Stephen S.T. Fan

ASSOCIATE PROFESSOR: Gail D. Ulrich

ASSISTANT PROFESSORS: Ihab H. Farag, Virendra K. Mathur, Charles E. Wyman

To be admitted to graduate study in chemical engineering, an applicant is expected to have completed a course of study substantially equivalent to that required for the degree of Bachelor of Science in Chemical Engineering in this University. However, students with good undergraduate records but with deficiencies in certain areas may be admitted on condition that they complete specified courses without credit to make up for their deficiencies.

A minimum of 30 credits, which must include Chemical Engineering 813, 815, 816, and 823, is required for the Master of Science in Chemical Engineering degree. The core-courses requirement can be waived only in special cases with permission from the department faculty. A candidate for the Master of Science degree must prepare a thesis, for which up to six credits will be allowed, unless the candidate is specifically exempted by the faculty because of previous research experience.

For students who are interested in graduate studies beyond the Master of Science degree, an interdepartmental Engineering Doctor of Philosophy program is available which includes the following areas of specialization: engineering system design, signal processing, theoretical and applied mechanics, and transport phenomena. For details refer to the section entitled Engineering Ph.D. Program on page 79.

Courses numbered between 600 and 699 may be taken for graduate credit by nonmajors only.

Permission of the instructor and consent of the student's adviser are required for enrollment in all chemical engineering courses.

701. HIGH POLYMERS

Principles and practice of industrial methods of polymerization and processing. Physical and chemical testing of various polymers. 4 cr.

705. NATURAL AND SYNTHETIC FOSSIL FUELS

Study of U.S. and foreign reserves of coal, oil, and natural gas. Petroleum processing and refining. Coal, oil shale, and tar sand. Gasification and liquefaction of coal. 4 cr.

712. INTRODUCTION TO NUCLEAR ENGINEERING

Development of nuclear reactors; basic binding-energy physics; radioactivity; elements of nuclear reactor theory; engineering problems of heat transfer, fluid flow, materials selection, and shielding; environmental impacts. 4 cr.

750. INTRODUCTION TO PROCESS SIMULATION AND OPTIMIZATION

Analysis and numerical simulation of controlled chemical systems. Laplace transforms. Transient responses. Solution of nonlinear equations. Simultaneous, ordinary differential equations; Runge-Kutta, Crank-Nicholson methods. Steady state optimization: linear programming, classical search techniques. Unsteady state optimization: Pontryagin's maximum principle. 4 cr.

772. PHYSICOCHEMICAL PROCESSES FOR WATER AND AIR QUALITY CONTROL

Origin and characterization of pollutants. Controls, including filtration, sedimentation, coagulation and flocculation, adsorption and absorption. Applied fluid mechanics, mass transfer, and kinetics. Thermal pollution, chemical treatment, oil spills on water, and aeration. 4 cr.

813. ADVANCED FLUID MECHANICS

Basic equations describing behavior of static and dynamic fluid systems. The equations of motions and application to laminar and turbulent flow. Momentum and energy equations for advanced problems associated with flow inside conduits. Flow of compressible fluids and boundary layer phenomena. 3 cr.

815. HEAT TRANSFER

Steady-state and transient heat conduction in solids; heat convection; analytic solutions, similarity relations, boundary-layer methods; radiation. 3 cr.

816. DIFFUSIVE MASS TRANSFER

Physical aspects of diffusion; theories of diffusion in dilute gases, dense gases, liquids, and solids; surface diffusion; mixing processes. Simultaneous heat and mass transfer. 3 cr.

823. ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS

The multicomponent open system; the volumetric and phase behavior of pure substances and of multi-component systems at physical and chemical equilibrium; fugacity and activity; thermal properties of equilibrium, chemically reacting systems; introduction to statistical thermodynamics. 3 cr.

832. ADVANCED CHEMICAL ENGINEERING KINETICS

Specialized applied kinetics problems; catalysis; fast reaction and shock tubes; combustion and detonation processes; nonisothermal kinetics; heat and mass transfer in nonequilibrium, chemically reacting systems. 3 cr.

Chemistry

852. ADVANCED PROCESS DYNAMICS

Process dynamics for higher order processes and nonlinear processes. Modeling of complex process by differential equations, linearizing nonlinear elements, and adequately controlling the entire system. (Not offered every year.) 3 cr.

890. LITERATURE REPORT

Instruction in the use of the library for chemical engineering research, culminating in the preparation of a literature report on a topic of mutual interest to the student and the chemical engineering faculty. 1 cr.

895,896. GRADUATE INDEPENDENT STUDY

Directed reading or investigation at the advanced level on topics in chemical engineering. 2-4 cr.

897,898. GRADUATE SEMINAR

Discussion on topics of interest to graduate students and staff; reports of research progress; invited lectures by outside speakers. 0 cr.

899. MASTER'S THESIS

Original investigations in chemical engineering. 1-6 cr.

Chemistry (Chem)

Chairperson: C.L. Grant

PROFESSORS: Alexander R. Amell, Kenneth K. Andersen, Clarence L. Grant, Helmut Max Haendler, Paul R. Jones, James D. Morrison, Frank L. Pilar, Albert K. Sawyer, J. John Uebel, Charles M. Wheeler, Jr.

ASSOCIATE PROFESSORS: N. Dennis Chasteen, David W. Ellis, Colin D. Hubbard, Charles W. Owens, James H. Weber

ASSISTANT PROFESSOR: W. Rudolf Seitz

The Department of Chemistry offers programs leading to three graduate degrees: Doctor of Philosophy, Master of Science, and Master of Science for Teachers. Entering graduate students (except for those desiring the M.S.T. degree) are expected to take proficiency examinations in chemistry to assist in starting each new student's graduate work at the proper level. These examinations will be offered at the beginning of the semester in September and in February.

The faculty of the chemistry department feels that the experience of teaching is a valuable part of the training of the graduate student. Therefore, all graduate students who are Doctor of Philosophy or Master of Science candidates will obtain some teaching experience during their tenure.

Doctor of Philosophy Degree

Admission to this program is based upon superior work in the usual undergraduate courses in inorganic chemistry, analytical chemistry, organic chemistry, and physical chemistry, as well as the normal supporting courses in mathematics and physics. This degree requires the completion of a research problem presented in the form of a thesis.

The Ph.D. candidate will be expected to demonstrate proficiency in reading chemical literature in German and French or Russian. He/she will also demonstrate to the doctoral committee that he/she has a broad basic knowledge of the field of chemistry: 1) by completing certain fundamental graduate courses; and 2) by means of a series of examinations in the major field. The principal emphasis of the last two years will be on the research project that will constitute the dissertation. During this time the doctoral candidate will present and defend an original research proposal before the doctoral committee.

Master of Science Degree

Admission to this program is based upon a superior undergraduate average and requires satisfactory work in the usual undergraduate courses in inorganic chemistry, analytical chemistry, organic chemistry, and physical chemistry, as well as the normal supporting courses in mathematics and physics. This degree requires the completion of a research problem presented in the form of a thesis.

Master of Science for Teachers Degree

This program is offered for candidates who hold a secondary-school teacher certification in chemistry. This degree requires 30 semester hours in courses approved by the department chairperson. Persons interested in this degree should confer with the chairperson.

Interdisciplinary Programs in Chemistry

Graduate students in chemistry may elect to enter one of the interdisciplinary programs offered jointly with the chemistry department and other departments. In these programs, the graduate student, with the advice of the guidance committee, elects courses in chemistry and in the related disciplines, and writes the dissertation on a research problem appropriate to interdisciplinary treatment. Students interested in these programs should write to the chairperson of the department for further information.

Analytical Chemistry

762. INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS

Theory, instrumentation, and application of instrumental methods of analysis including electrochemistry, spectroscopy, and chromatog-

raphy. Prereq: Quantitative Analysis; Physical Chemistry II as a prerequisite or concurrently or permission of instructor. Students must register for Chem 763 concurrently. 3 cr.

763. INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS LABORATORY

Experimental parameters, error analysis, and applications of the methods covered in Chem 762. Must be taken concurrently with Chem 762. Lab. 2 cr.

830. ADVANCED OPTICAL METHODS

Techniques of chemical identification and analysis utilizing optical instrumentation from the standpoint of both theory and application. Topics include NMR, ESR, x-ray fluorescence, mass spectrometry, electron beam microprobe. (Not offered every year.) 3 cr.

831. ADVANCED ELECTRICAL METHODS

Introductory electronics for chemists; theory and applications of important electrochemical techniques such as polarography and cyclic voltammetry. (Not offered every year.) 3 cr.

833. CHEMICAL SEPARATIONS

The use of various separation techniques prior to analysis, and separations as a method of analysis are discussed. 3 cr.

Inorganic Chemistry

774. INORGANIC CHEMISTRY

Basic theoretical concepts and their applications to inorganic reactions and compounds. Prereq: Chem 683; Chem 684 pre- or co-requisite; /or permission of instructor. Undergraduates must take Chem 775 concurrently. 3 cr.

775. INORGANIC CHEMISTRY LABORATORY

Synthesis and characterization of inorganic compounds with an emphasis on techniques not taught in other laboratory courses. Undergraduates must take Chem 774 concurrently. Lab. 2 cr.

803. ADVANCED INORGANIC CHEMISTRY I

Survey of some concepts of modern inorganic chemistry, serving as general background material for all graduate students and as basic fundamentals for further courses in inorganic chemistry: periodicity, stereochemistry and bonding in inorganic compounds, the crystalline state, reactions in solution, energetics, and elementary coordination chemistry. 4 cr.

804. ADVANCED INORGANIC CHEMISTRY II

Specialized topics for the advanced student. Topics may include advanced discussions of topics in Chem 803, inorganic reaction mechanisms, nonaqueous solvent systems, fluorine chemistry, bioinorganic chemistry, solid state chemistry. 3 cr.

847. ADVANCED INORGANIC CHEMISTRY III

Modern theory applied to spectra, magnetism, kinetics, and thermodynamics of coordination compounds. The formation of and reactions of coordination compounds including catalytic reactions. Prereq: Chem 803 or permission of instructor. (Not offered every year.) 3 cr.

848. ADVANCED INORGANIC CHEMISTRY IV

The theory and practice of x-ray diffraction and the determination of crystal structure. Prereq: Chem 803 or permission of instructor. (Not offered every year.) 3 cr.

Organic Chemistry

651-652. ORGANIC CHEMISTRY

Principal classes of organic compounds, aliphatic and aromatic, with emphasis on reactions, mechanisms, and structural theory. Prereq: Chem 404 or Introductory Chemistry or permission of instructor. Students receiving credit for Chem 651-652 may not receive credit for either Chem 545 or 547-548. Must be taken concurrently with Chem 653-654. 3 cr.

653-654. ORGANIC CHEMISTRY LABORATORY

Laboratory exercise to accompany Chem 651-652. Must be taken concurrently with Chem 651-652. 2 cr.

755. ADVANCED ORGANIC CHEMISTRY

Advanced stereochemistry, mechanisms and synthetic reactions; structure determinations and synthesis of complex molecules. Prereq: Chem 548 or 652 or permission of instructor. Undergraduate students must register for Chem 756 concurrently. 3 cr.

756. ADVANCED ORGANIC CHEMISTRY LABORATORY

Modern synthetic and analytical procedures. Must be taken concurrently with Chem 755. 2 cr.

801. THEORETICAL ORGANIC CHEMISTRY I

Discussion of theoretical and experimental methods used in study of reaction mechanisms and molecular stereochemistry. 4 cr.

Chemistry

802. THEORETICAL ORGANIC CHEMISTRY II

A continuation of Chem 801. 3 cr.

811. SYNTHETIC ORGANIC CHEMISTRY I

Advanced synthetic methods for preparing organic molecules. Prereq: permission of instructor. 3 cr.

812. SYNTHETIC ORGANIC CHEMISTRY II

A continuation of Chem 811. Prereq: permission of instructor. 3 cr.

817,818. SPECIAL TOPICS IN ORGANIC CHEMISTRY

Specialized courses for the advanced student. Topics may include reaction mechanisms, stereochemistry, spectroscopy, molecular biochemistry, steroids, and organic sulfur compounds. 2 or 3 cr.

Physical Chemistry

663. INTRODUCTORY RADIOCHEMICAL TECHNIQUES

Radiochemical techniques and laboratory practice in the use of apparatus in many fields of science which utilize radiochemical operations. Lab. Prereq: general inorganic chemistry and general physics. 4 cr.

683-684. ELEMENTARY PHYSICAL CHEMISTRY

The properties of gases, liquids, and solids; thermochemistry and thermodynamics; solutions, chemical equilibria, reaction rates, conductance, and electromotive force. Prereq: Math 426, Calculus II, and physics. Undergraduates must register for Chem 685-686 concurrently. 3 cr.

685-686. PHYSICAL CHEMISTRY LABORATORY

Experimental work illustrating the principles of chemistry. Emphasis is upon the measurement of thermodynamic properties, chemical kinetics, and methods of determining the structure of matter. Lab. Prereq: Math 426, Calculus II, and physics. Must be taken concurrently with Chem 683-684. 2 cr.

776. ADVANCED PHYSICAL CHEMISTRY

Foundations of quantum theory, elementary quantum mechanics, theory of spectra, statistical thermodynamics. Prereq: Chem 683-684. 4 cr.

778. CHEMISTRY OF LARGE MOLECULES

Basic chemistry of high-molecular-weight compounds, including synthetic polymers and substances occurring in living systems. Elementary aspects of the structures, syntheses, and properties of large molecules and their roles in modern science, technology, and living systems. Prereq: one semester of organic chemistry. 4 cr.

805. ADVANCED PHYSICAL CHEMISTRY I

An introduction to topics in quantum mechanics, group theory, and statistical thermodynamics which form the background of all areas of modern chemistry. 4 cr.

806. ADVANCED PHYSICAL CHEMISTRY II

Wave mechanics and quantum chemistry, spectroscopy, molecular structure; statistical thermodynamics, kinetics, and mechanism. Prereq: one year of physical chemistry. 3 cr.

821. PHYSICAL CHEMISTRY — CHEMICAL KINETICS

The kinetics of homogeneous and heterogeneous reactions in gaseous and liquid systems, including an introduction to very rapid reactions. Prereq: one year of physical chemistry. 3 cr.

822. PHYSICAL CHEMISTRY — CHEMICAL THERMODYNAMICS

The foundations and interrelationships of the theory of thermodynamics. The methods by which the theoretical principles may be applied to practical problems. 3 cr.

826. NUCLEAR AND RADIOCHEMISTRY

Nuclear structure and reactions, particle accelerators, radioactive decay, detection of particles, and the interaction of particles with matter. Application of radiochemistry to chemical systems and research. 3 cr.

827,828. THEORETICAL CHEMISTRY I, II

The modern concepts and mathematical formalism of quantum mechanics and applications to electronic structures of atoms and molecules, spectroscopy, and the solid state. 3 cr.

829. THEORETICAL CHEMISTRY III

Statistical mechanics with applications to thermodynamics of nonideal systems, intermolecular forces, and chemical kinetics. Prereq: permission of instructor. 3 cr.

General Offerings

Courses in which all areas of specialization participate.

708. RESEARCH TECHNIQUES

Lectures and laboratory to show experimental methods and interpretation of results. Topics include chromatography, data handling, nuclear magnetic resonance, mass spectrometry, elementary electronics, infrared and ultraviolet spectroscopy, and x-ray. 1-3 cr.

807. INTRODUCTION TO RESEARCH

A course to introduce the Doctor of Philosophy student to the planning, experimental methods, and interpretation of a research problem. The student will present and defend an original research proposal before a faculty committee. Must be completed satisfactorily by all doctoral students. Cannot be used for credit by Master of Science candidates. 2 cr.

895,896. COLLOQUIUM IN CHEMISTRY: (1) INORGANIC CHEMISTRY; (2) ORGANIC CHEMISTRY; (3) THEORETICAL ORGANIC CHEMISTRY; (4) PHYSICAL CHEMISTRY; (5) ANALYTICAL CHEMISTRY

1-4 cr. Sections of the course may be taken to a total of 12 cr.

897,898. SEMINAR

Presentation and discussion of recent investigations in chemistry. 1 cr.

899. THESIS — PROBLEMS IN CHEMISTRY

Conferences, library, and experimental work in some field of chemistry. Cr. to be arranged.

999. DOCTORAL RESEARCH

Civil Engineering (CiE)

Chairperson: Paul L. Bishop

PROFESSORS: Tung-Ming Wang, J. Harold Zoller

ASSOCIATE PROFESSORS: Paul L. Bishop, Louis H. Klotz, Paul J. Ossenbruggen

ASSISTANT PROFESSORS: David L. Gress, Dennis J. O'Brien

ADJUNCT ASSOCIATE PROFESSOR: Gerald H. Batchelder

GRADUATE COORDINATOR: Tung-Ming Wang

A candidate for the degree of Master of Science in Civil Engineering must have completed a baccalaureate degree in engineering, mathematics, or science. If the undergraduate work is deficient, the candidate may be required to take undergraduate courses without graduate credit in order to present the proper prerequisites for graduate courses in the area of a major and minor interest. In addition, other undergraduate courses may be required by the student's adviser in order to achieve an integrated program.

The candidate for the master's degree may elect Plan A or Plan B program. The Plan A program requires a minimum of 24 credits of graduate-level course work plus a thesis for which six graduate credits are

normally awarded. In the case of highly original and unusual work, a maximum of nine credit hours may be awarded for the thesis. The Plan B requires a minimum of 30 hours of graduate-level course work plus a written paper, which is to be written in one of the project courses not included in the 30 credit minimum. The Plan B paper is equivalent to a thesis in style and quality, but not in scope. One bound copy of the thesis or Plan B paper is required by the department for its files. Additional bound copies are usually presented to the library and the candidate's adviser.

All candidates for the master's degree are required to take a final oral examination. The examination committee, appointed by the dean of the Graduate School from nomination by the department chairperson, will consist of at least two senior faculty members from within the civil engineering department and an additional senior faculty member usually selected from another department within the College of Engineering and Physical Sciences. The oral final examination will consist of a defense of the thesis or Plan B paper as well as an examination of the engineering fundamentals leading to the master's degree. The thesis or Plan B paper should be given to the committee members at least two weeks prior to the date of the final oral examination.

The master's programs in civil engineering are becoming increasingly interdisciplinary. Candidates may be required to complete graduate-level courses in other departments in order to enlarge their educational experience and to acquire fundamental skills expected of a master's candidate. Program areas within the department include sanitary and environmental engineering, soil mechanics, foundation engineering, structural design, structural mechanics, transportation and urban systems planning, and others.

Ph.D. programs are available through the Engineering Ph.D. Program within the College of Engineering and Physical Sciences. The Ph.D. is awarded in engineering, and selected candidates work within one of four established areas of specialization. Most Ph.D. candidates with civil engineering backgrounds would work either in the theoretical and applied mechanics or the engineering systems design program areas. All interested candidates are advised to consult the graduate coordinator for the details of these programs. Additional information about the Engineering Ph.D. Program is presented in the Engineering Ph.D. section of this catalog on page 79.

Courses numbered above 700 may be offered biennially or upon demand. Courses numbered between 600 and 699 may be taken for graduate credit only by nonmajors. Permission of the instructor and consent of the adviser are required for enrollment in all civil engineering graduate courses. With the approval of the department chairperson and graduate dean, six graduate credits taken at other institutions prior to admission to the University of New Hampshire Graduate School may be applied to the master's degree. Senior undergraduates interested in the dual bachelor's and master's degree programs should consult the appropriate section of this catalog under "Graduate Credits."

Civil Engineering

701. ADVANCED SURVEYING

Instrumental and analytical photogrammetry. Conformal mapping and its application to the state plan coordinate systems. Geodetic surveying. Error theory and its application to the planning and adjustment of surveys. Application of electronic computers to surveying calculations. Prereq: Surveying. 4 cr.

711. COMMUNITY PLANNING

A student project course that focuses upon an authentic problem facing a community. Investigation of present and future issues, such as, population growth, community needs, economic and legal problems, will be conducted. The use of land use models, survey techniques and economic evaluation methods will be utilized. Oral and written reports are required. Prereq: normally senior standing and permission of instructor. A year-long course: 2 credits each semester, 4 credits total, an "IA" grade (continuous course) will be given at the end of the first semester.

714. CONTRACTS, SPECIFICATIONS, AND PROFESSIONAL RELATIONS

Essential elements and legal requirements of engineering contracts; purposes and content of specification; professional conduct, relations, registration, and ethics. Construction planning and management; cost analysis based on quantity surveys and unit-cost methods. Prereq: permission of instructor. 3 cr.

721. PAVEMENT DESIGN

Flexible and rigid pavements and bases for highways, airports, and city streets; pavement selection, construction methods, materials, specifications, and engineering cost estimates. Prereq: Soil Mechanics. 3 cr.

731. NETWORK PLANNING AND SCHEDULING

Application of critical path methods (CPM) and project evaluation review technique (PERT) to the design and control of engineering projects. 2 cr.

743. ENVIRONMENTAL SAMPLING AND ANALYSIS

Laboratory exercises in the techniques of water, wastewater, and solid-waste sampling and analysis. Interpretation of results from pollution surveys and operation of pollution control facilities; statistics of sampling and statistical evaluation of analytical data. Prereq: Introduction to Environmental Pollution Control or permission. 2 cr.

745. HYDROLOGY AND HYDRAULICS

Occurrence and physical effects of water on the earth; meteorology, ground-water runoff and stream-flow routing, open-channel flow, reservoirs, control works, hydroelectric power, irrigation, drainage, and multipurpose projects. Prereq: Fluid Mechanics. 4 cr.

746. WASTEWATER TREATMENT PLANT DESIGN

Choice of treatment units. Design of the components; preparation of a plan for a particular city that includes a suitable combination of the units previously designed. Prereq: Water and Wastewater Engineering. 3 cr.

748. SOLID WASTE DISPOSAL

Basic concepts and theory of collection and disposal systems. Design methods involved in disposal systems. Prereq: Introduction to Environmental Pollution Control or consent of instructor. 3 cr.

751. TRANSPORTATION PLANNING

Transportation demand forecasting techniques applied to regional and urban situations. Calibration and use of mathematical models for forecasting land use, trip generation, trip distribution, modal choice, and trip assignment. Prereq: Statistics. 3 cr.

752. TRAFFIC ENGINEERING

Statistical and probabilistic methods to analyze and design roadway facilities. Level of service and capacity analysis of roadways under uninterrupted and interrupted flow conditions. Queuing theory, simulation models, design of traffic facilities. Prereq: Statistics. 3 cr.

763. ADVANCED SOIL MECHANICS I

The physical and mechanical properties of soil in relation to engineering structures. The theory of consolidation, shearing resistance, bearing capacity, settlement, slope stability, earth pressure, and seepage studies. Prereq: permission of instructor. 4 cr.

765. FOUNDATION ENGINEERING

Application of the principles of soil mechanics to selection of the type of substructure; determination of allowable soil-bearing capacities based on rupture and settlement theories; determination of active and passive earth pressures; and foundation construction methods. Prereq: Soil Mechanics; Structural Design Concepts; senior standing. 4 cr.

768. SEEPAGE THROUGH EARTH STRUCTURES

Groundwater flow, Darcy's law, flow nets, Dupuit's theory and application, conformal mapping techniques, confined flow, flow through earth and rock structures, seepage towards wells. Prereq: Fluid Mechanics; Soil Mechanics. 2 cr.

782. TIMBER DESIGN

Properties and characteristics of structural woods, mechanics of wood, connection methods, design of timber members, and connections in beams, columns, and trusses, and glued laminates of wood. Prereq: Structural Design Concepts; permission. 2 cr.

784. STRUCTURAL ANALYSIS BY MATRIX AND NUMERICAL METHODS

Unifying concept of basic structural analysis theories; matrix and numerical methods of analysis, and their application by linear graph concepts using computers. Prereq: Indeterminate Structures. 4 cr.

790. INELASTIC STRUCTURAL DESIGN

A continuation of modern design theory; ultimate design of reinforced concrete; plastic analysis of steel structures. 4 cr.

793,794. ADVANCED STRUCTURAL DESIGN I AND II

Design in steel by elastic and plastic theories and in reinforced concrete by the working stress and ultimate strength methods for structural elements and connections using the appropriate controlling specifications. Prereq: Structural Design Concepts or permission. 4 cr.

795,796. INDEPENDENT STUDY

A limited number of qualified senior and graduate students will be permitted to pursue independent studies under faculty guidance. Seniors may write terminal theses reporting the results of their investigation. 2-4 cr.

822. HIGHWAY AND AIRPORT ENGINEERING

Design of flexible and rigid pavements and bases for highways, airports, and city streets; pavement selection, construction methods, materials, specifications, and engineering cost estimates. Prereq: CiE 721. 2-4 cr.

855. MICROBIOLOGY OF WASTEWATER TREATMENT

Detailed study of the microbiological aspects of wastewater treatment and the techniques used in the biological testing of water and wastewater. Lab. Prereq: Water and Wastewater Engineering; General Microbiology; /or permission. 4 cr.

856. INDUSTRIAL WASTEWATER TREATMENT

Detailed consideration of the origin, characteristics, and treatment of industrial wastewater; the theory and application of unit operations unique to the treatment and disposal of industrial wastes. Prereq: Water and Wastewater Engineering. 4 cr.

857. ADVANCED WASTEWATER TREATMENT

Theory, application, and evaluation of new processes and developing techniques in water and wastewater reclamation and reuse. Prereq: CiE 746. 4 cr.

858. ADVANCED WASTEWATER SYSTEMS DESIGN

A formal design to solve a practical problem in wastewater treatment; field data will be gathered, a laboratory-scale unit run, and a design submitted based upon the experimental findings. Lab. Prereq: CiE 746; CiE 856. 4 cr.

864. ADVANCED SOIL MECHANICS II

The physical and mechanical properties of soil in relation to engineering structures. The theory of consolidation, shearing resistance, bearing capacity, settlement, slope stability, earth pressure, and seepage studies. Prereq: permission of instructor. 4 cr.

865. SOILS ENGINEERING

Application of soil-mechanics' principles to the selection of the type of substructure and the development of its bearing capacity, based on the theories of stability analysis and consolidation. Earth-pressure load determinations by various active and passive earth-pressure theories. Earth dam and foundation construction methods. Prereq: CiE 763 or equivalent. 4 cr.

866. SOIL TESTING FOR ENGINEERING PURPOSES

The essential tests for the physical properties: permeability, capillarity, compressibility, rate and magnitude of consolidation, and shearing resistance. Prereq: CiE 763 or equivalent. 2-4 cr.

867. SOIL DYNAMICS

Vibrations of elementary systems, wave propagation, elastic waves in layered systems, behavior of dynamically loaded soils, vibrations of foundations, isolation of footings, field measurements and instrumentation, design procedures for dynamically loaded foundation. Prereq: CiE 765; CiE 763. 2 cr.

881. ADVANCED STRUCTURAL ANALYSIS I

Advanced structural theory and analysis, including multistory structures, beam columns, frames with variable moment of inertia, continuous trusses and bents, arches and curved frames, stiff rings, and closed frames. 4 cr.

882. ADVANCED STRUCTURAL ANALYSIS II

Advanced treatment, including flexible and axially loaded flexural members, beams with variable cross-section subject to axial loads, suspension bridges and flexible arches, and torsional problems of noncircular sections. 4 cr.

883. STRUCTURAL STABILITY

Study of the elastic and inelastic buckling behavior of structures. Topics include: stability of columns, mathematical treatment of buck-

Earth Sciences

ling problems and buckling criteria, lateral stability of beams, buckling of trusses and framed structures, and stability of rings and curved beams. 4 cr.

884. DYNAMICS OF STRUCTURES

Analysis of structures subjected to dynamic loadings. Free and forced vibrations with one or multi-degrees of freedom. Effects of damping and inelastic action. Vibrations of beams and framed structures. Dynamic response of beams due to moving loads. 4 cr.

885. APPLICATION OF SYSTEM THEORY TO STRUCTURAL ANALYSIS

Comprehensive development of the stiffness matrix of structures. Intuitive concepts of topology and linear graphs and their application to structural frameworks. Analysis of structures using linear graphs. 4 cr.

886. FACILITY PROJECT ENGINEERING

A critical review of the approaches to the planning and decision processes of facilities, including codes and specifications, concepts of engineering economy, index numbers and cost estimation procedures (including an introduction to their statistical basis) mathematical modeling concepts, and the development of design loads and criteria for specific application. 4 cr.

887. APPLICATION OF LINEAR GRAPHS TO CIVIL ENGINEERING

Concepts of topology and linear graphs and their application to civil engineering planning of transportation, water and sewage distribution, and other networks. Network planning and management systems, including Project Evaluation Review Technique (PERT), Critical Path Methods (CPM), and PERT/cost procedures. 4 cr.

890. TOPICS IN STRUCTURES

Studies of topics of special interest and need of the student in structural design, analysis, and optimization. 2-4 cr.

895,896,897. CIVIL ENGINEERING PROBLEMS

The study and investigation of problems selected to meet the needs of the students. 2-4 cr.

899. MASTER'S THESIS

Hours and cr., 6-9, to be arranged.

Earth Sciences (ESci)

Chairperson: Herbert Tischler

PROFESSORS: Cecil J. Schnee, Herbert Tischler

ASSOCIATE PROFESSORS: Franz E. Anderson, Francis S. Birch, Wallace A. Bothner, Henri E. Gaudette, Glenn W. Stewart

ASSISTANT PROFESSORS: Wendell S. Brown, Theodore C. Loder, Paul A. Mayewski

ADJUNCT PROFESSOR: Robert I. Davis

COORDINATOR OF GRADUATE PROGRAM: Franz E. Anderson

The Department of Earth Sciences offers graduate work leading to the degree of Master of Science. Several options are available within the earth sciences program, including geochemistry; igneous and metamorphic petrology; crystallography; geophysics; glacial geology; and chemical, physical, and geological oceanography. A student is expected to have at least a year each of college calculus, chemistry, and physics. Students lacking these requirements may be admitted but will be required to complete certain courses which do not give graduate credit. In applying for admission to the departmental program, students should submit their Graduate Record Examination scores. All candidates for the master's degree shall be required to complete a thesis.

725. IGNEOUS AND METAMORPHIC PETROLOGY

Textural, mineralogical, and chemical analysis, and phase rule and phase diagram interpretation applied to petrogenesis. Prereq: Principles of Mineralogy; Petrography;/or permission. 4 cr.

732. GEOLOGIC MAPPING AND INTERPRETATION

Standard methods of geologic field mapping; interpretation of geologic maps and aerial photographs of selected areas. Course includes field mapping excursions to local areas and an 8-10 day exercise in a selected area of the Appalachian Mountains. \$75 lab fee includes transportation and housing in the field. Prereq: permission. 4 cr.

734. APPLIED GEOPHYSICS

Gravity, magnetic, seismic, electrical, and thermal methods of investigating subsurface geology. Practical fieldwork and use of computers in data analysis. Prereq: Calculus passed or taken concurrently; Intro. Geol.; one year of college physics;/or permission. 4 cr.

741. GEOCHEMISTRY

Thermodynamics applied to geological processes; geochemical differentiation of the earth; the principles and processes which control the distribution and migration of elements in geological environments. 4 cr.

752. CHEMICAL OCEANOGRAPHY

Water structure, chemical composition and equilibrium models, gas exchange, biological effects on chemistry, trace metals, and analytical methods. Laboratory includes short cruise aboard R/V *Jere A. Chase*. Prereq: permission. 3 or 4 cr.

754. SEDIMENTATION-STRATIGRAPHY

Sedimentation: weathering, transportation, and deposition of modern sediments. *Stratigraphy*: classification of sedimentary rocks and principles of stratigraphic correlation. 4 cr.

758. INTRODUCTION TO PHYSICAL OCEANOGRAPHY

Ocean basins; physical properties of seawater; atmosphere-ocean interaction; general ocean circulation; waves, tides, tsunamis, and gulf stream; continental shelf and near shore processes; instrumentation and methods used in ocean research. Simplified physical and mathematical models demonstrate the important concepts. Prereq: one year of college physics; Intro Oceanog;/or permission. 4 cr.

759. GEOLOGICAL OCEANOGRAPHY

Major geological features and processes of the ocean floor; geological and geophysical methods; plate tectonics. Prereq: Intro Geol; Intro Oceanog;/or permission. 4 cr.

762. GLACIAL GEOLOGY

Glacial environment: glaciers as agents of deposition; interpretation of glacial deposits. Review of world glacial stratigraphy in light of causes of glaciation and climatic change. Prereq: Intro Geol; Geomorphology;/or permission. 4 cr.

781. PHYSICAL GEOLOGY

Materials and structures of the earth and erosive agents that modify them. Laboratory and field trips. For certified elementary or high school science teachers who need an introduction to the earth sciences. Not available for credit after completing Intro Geol. 4 cr.

782. HISTORICAL GEOLOGY

Evolution of physical features and life on the earth. Fossil organisms; methods of historical geology; laboratory and field trips. Prerequisite: ESci 781 or equivalent. For certified elementary or high school science teachers who need an introduction to the earth sciences. Not available for credit after completing ESci 402 or equivalent. 4 cr.

795. TOPICS IN EARTH SCIENCES

1) Areal Geology; 2) Geochemistry; 3) Geomorphology, Advanced; 4) Geophysics; 5) Glacial Geology, Advanced; 6) Groundwater Geology; 7) Historical Geology, Advanced; 8) Industrial Minerals; 9) Micropaleontology; 10) Mineral Fuels; 11)

Mineralogy, Advanced; 12) Optical Crystallography; 13) Ore Deposits; 14) Paleontology, Advanced; 15) Petrology, Advanced; 16) Regional Geology; 17) Sedimentation; 18) Stratigraphy; 19) Structural Geology, Advanced; 20) Marine Geology; 21) Physical Oceanography; 22) History of Geology; 23) Earth Science Teaching Methods; 24) Senior Synthesis; 25) Chemical Oceanography.

Special problems by means of conferences, assigned readings, and field or laboratory work, fitted to individual needs from one of the areas listed above. Staff. 1-4 cr.

796. HONORS PROJECT

Independent research projects similar to ESci 795 for students with 3.0, or better, average in earth sciences. 2 or 4 cr.

797. GEOLOGY COLLOQUIUM

Study of selected topics in both classical and modern geological thought. For majors. 0 cr. CR/F.

813. X-RAY CRYSTALLOGRAPHY

Theory and practice of diffraction of x-rays by crystals; lattices, symmetry, and structure analysis. Prereq: Mineralogy or Physical Chemistry or equivalent. (Not offered every year.) 3 cr.

816. MINERALOGY OF CLAYS

The mineralogic composition, structure and properties, origin and mode of occurrence of clay minerals and clay materials. Prereq: permission. (Not offered every year.) 3 cr.

820. ADVANCED IGNEOUS PETROLOGY

Extensive readings and discussions of original sources and recent literature with reference to classical petrologic provinces. Application of thermodynamics and phase-rule chemistry to igneous petrogenesis. Prereq: permission. (Not offered every year.) 3 cr.

821. ADVANCED METAMORPHIC PETROLOGY

Extensive readings and discussions of original sources and recent literature dealing with the facies concept, equilibrium reactions, reaction kinetics, and other chemical aspects of metamorphic petrogenesis. Prereq: permission. (Not offered every year.) 3 cr.

841. ANALYTICAL GEOCHEMISTRY

Introduction to the theory, instrumentation, and applications of analytical methods in geochemistry. Prereq: permission. (Not offered every year.) 3 cr.

Economics

856. ESTUARINE AND MARINE SEDIMENTATION

Unique aspects of sedimentation in marine and estuarine water with special emphasis on cohesive, fine-grained estuarine sediment erosion, transportation, and deposition. Laboratory includes basic statistical analysis of sedimentological data. Course includes completion of a project. Prereq: permission. (Not offered every year.) 3 cr.

858. DYNAMICAL OCEANOGRAPHY

The hydrodynamics of such ocean phenomena as waves, tides, and ocean turbulence; wind driven circulation on the continental shelf and deep ocean will be treated in detail. Prereq: ESci 758; ME 707;/or permission. (Not offered every year.) 4 cr.

895,896. TOPICS IN EARTH SCIENCES

Advanced work on an individual or group basis under members of the graduate staff. Sections of this course are the same as those listed under ESci 795. Prereq: permission of department chairperson and staff concerned. 1-4 cr. May be taken more than once.

897,898. SEMINAR IN EARTH SCIENCES

A review and discussion of recent literature in the earth sciences. Required of graduate students in earth sciences. Staff. 1-3 cr.

899. EARTH SCIENCES MASTER'S THESIS

4 cr.

Economics (Econ)

Director of Economics Studies: William R. Hosek

PROFESSORS: Robert F. Barlow, William R. Hosek, Manley R. Irwin, John J. Korbel, Sam Rosen, Kenneth J. Rothwell, Dwayne E. Wrightsman

ASSOCIATE PROFESSORS: Allan J. Braff, John M. Burt, Jr., Fred R. Kaen, Richard L. Mills, Robert C. Puth

ADJUNCT ASSOCIATE PROFESSOR: James A. Smith

ASSISTANT PROFESSORS: Lawrence P. Cole, Richard W. England, Richard Hurd, Allen R. Thompson

Whittemore School of Business and Economics

The economics faculty of the Whittemore School, together with the resource economics faculty of the Institute of Natural and Environmental Resources, offers a program leading to the degree of Doctor of Philosophy. In addition, the economics faculty offers a plan of study culminating in the degree of Master of Arts.

Admission to both programs is open to students whose undergraduate work shows evidence of superior ability and motivation and who manifest promise of serious scholarship. Normally, the appropriate undergraduate preparation will include exposure to economic reasoning and methodology, including mathematics and statistics. Those who warrant special consideration, even though their backgrounds are deficient, should be aware that remedial work may be required.

Admission requirements in addition to those established by the Graduate School include: the Graduate Record Examinations (aptitude and advanced test in economics); T.O.E.F.L. for applicants from non-English speaking countries; three letters of recommendation from those acquainted with the applicant's work in his/her major.

Doctor of Philosophy Degree

Ph.D. candidacy requires written evidence of proficiency in economic theory, the history of economic thought and methodology, and quantitative methods. In special cases, oral examinations may also be required. The Ph.D. candidate is also required to participate in a minimum of two research workshops. At present, workshops exist in finance, political economy, and labor economics.

Information about fields available for the dissertation as well as other details of the doctoral program can be obtained from the director of economic studies.

Master of Arts Degree

The candidate for a master's degree may take a general course of study or the thesis option. The general requirements of the Graduate School and the following major requirements must be met:

- 1) 32 semester hours of graduate study which may include 8 hours of thesis work;
- 2) Minimum of 24 semester hours in courses numbered 700 and above and at least 12 hours in courses numbered 800 and above apart from Economics 899, Thesis;
- 3) Maximum of 8 semester hours in approved courses numbered 600 and above taken in related disciplines;
- 4) Written evidence of proficiency in economic theory and *either* the history of economic thought and methodology or quantitative methods.

711. ECONOMIC FLUCTUATIONS

Recurrent movements of prosperity and depression; emphasis on causes and public-policy implications. Prereq: intermed macro or permission. 4 cr.

715. MARXIAN ECONOMIC ANALYSIS

Marx's analysis of capitalism within the classical and radical tradition; methodology; organization of capital; labor theory of value; accumulation of capital; growth and distribution; economic crises. Critical evaluation of Marx's analysis. Prereq: intermed micro; intermed macro;/or permission. 4 cr.

720. U.S. ECONOMIC HISTORY

From Colonial times to the present. Applied economic theory; economic models and interpretation of data. Influence of technology, industrialization, foreign trade, monetary factors, and government; non-economic factors. Prereq: intermed micro or macro or permission. 4 cr.

721. EUROPEAN ECONOMIC HISTORY

Western European and Mediterranean economies from medieval times to the Common Market. Economic models and interpretation of data. Capital accumulation, technology, trade, industrialization, monetary factors, and the role of government; relevant non-economic factors. Prereq: intermed micro or macro or permission. 4 cr.

725. STATISTICAL THEORY

Univariate and bivariate mathematical statistics; i.e., probability theory, discrete and continuous random variables and their distributions, moments and moment-generating functions, parameter estimation, hypothesis testing, correlation and regression analysis, analysis of variance. Prereq: Calculus. 4 cr.

727. INTRODUCTION TO ECONOMETRICS

Representation of economic phenomena in mathematical terms; formulation of models of economic activity and the derivation therefrom of propositions which are subject to statistical test, primarily by means of multivariate regression analysis. Prereq: Econ 725 or permission of instructor. 4 cr.

735. ECONOMICS OF FINANCIAL MARKETS

Economic analysis of financial market systems. Topics include financial market functions, theories of saving and investment, financial intermediation, flow-of-funds analysis, loanable funds theory, interest rate forecasting, portfolio theory, capital asset pricing models, structure of interest rates (including term structure theory), and macroeconomic models of the financial sector. Prereq: Econ 635 or permission. 4 cr.

736. SEMINAR IN MONETARY THEORY AND POLICY

Contemporary developments in monetary theory and the evaluation of policy measures. Prereq: Econ 635;/or permission. 4 cr.

741. SEMINAR IN PUBLIC FINANCE — THEORY AND POLICY

Selected topics in contemporary theoretical and policy problems of public finance. Prereq: Econ 641 or permission. 4 cr.

742. SURVEY OF URBAN ECONOMICS

Theoretical and empirical bases; policy alternatives for the problems of poverty, housing, urban renewal, transportation, local fiscal affairs, and pollution. Prereq: intermed micro or permission. 4 cr.

745. INTERNATIONAL TRADE

Contemporary issues in international economic theory and policy. Analysis of trade theory, dynamics of world trade and exchange, and international commercial policy. Prereq: Econ 645 or permission. 4 cr.

746. INTERNATIONAL FINANCE

International monetary mechanism; balance of payments; international investment; exchange rates, adjustment systems, international liquidity, foreign aid, multinational corporations. Prereq: prin of econ. 4 cr.

751. GOVERNMENT REGULATION OF BUSINESS

Analysis of government policy with reference to such problems as conspiracy, monopoly, mergers, unfair practices, and discrimination. This analysis includes a legal and economic appraisal of government policy alternatives. Prereq: Econ 651 or permission. 4 cr.

752. SEMINAR IN INDUSTRIAL ORGANIZATION AND PUBLIC POLICY

An examination of historical and contemporary developments in the theoretical and applied areas of industrial and commercial market structures, behavior and performance. Prereq: Econ 651; permission. 4 cr.

755. COLLECTIVE BARGAINING

Explores the historical development of the U.S. labor movement and the industrial relations system. Contemporary collective bargaining issues are discussed and the role of public policy in industrial relations is examined. Prereq: Econ 655 or permission. 4 cr.

756. LABOR ECONOMICS

Recent developments in labor market analysis and public policies related to contemporary labor issues are discussed. Topics covered include labor supply, the structure and stratification of labor markets, economic discrimination, unemployment and poverty, inflation, and wage-price controls. Prereq: Econ 656 or permission. 4 cr.

Education

758. MANPOWER AND EDUCATION PLANNING

Flows of human beings within and between the educational and manpower sectors of the economy, also related to flows of goods and services in the industrial sector. Interrelationships of these flows; construction of a computer simulation-model tracing the impact throughout the economy of manpower and educational-planning decisions. Prereq: prin of econ or permission. 4 cr.

761. NATIONAL ECONOMIC PLANNING

Planning in a market economy: the new industrial state. Planning as a substitute for markets: the developing countries. Planning as a way of transforming society; socialist economies; techniques of planning social and political issues related to various planning methods. Prereq: intermed micro or macro;/or permission. 4 cr.

768. SEMINAR IN ECONOMIC DEVELOPMENT

A survey of the theories of the development process and an examination of the role of various forces of economic change in developing countries. Prereq: Econ 668 or permission. 4 cr.

769. CASE STUDIES IN ECONOMIC DEVELOPMENT

Problems and policies in selected countries; evaluations of national plans, programs, and projects; comparative analysis. Sections: 1) Southeast Asia; 2) Cost-Benefit and Project Analysis; 3) Africa; 4) South America. Prereq: prin of econ or permission. 4 cr.

798. SEMINAR IN ECONOMIC PROBLEMS

Special topics; may be repeated. Prereq: permission of adviser and instructor. 2 or 4 cr.

825. MATHEMATICAL ECONOMICS

Principal mathematical techniques and their application in economics. Prereq: permission of instructor. 4 cr.

826. EMPIRICAL ECONOMIC METHODS

Application of statistical and econometric methods to problems in economics. Special emphasis on problems such as multicollinearity and autocorrelation and their resolution. Computer application is stressed throughout the course. Prereq: Econ 726 or permission. 4 cr.

857-858. HISTORY OF ECONOMIC THOUGHT

The evolution of economic thought. Examination and critical appraisal of the work of major economists and major schools of economists. 4 cr.

873. MACROECONOMIC THEORY I

Advanced analysis of such aggregates as national income, total output, employment, and the general price-level. Examination of the major aggregate models. 4 cr.

874. MACROECONOMIC THEORY II

A continuation of Macroeconomic Theory I in which the dynamics of the models are stressed and growth theory receives central attention. Prereq: Econ 873. 4 cr.

877. MICROECONOMIC THEORY I

Topics in microeconomics with emphasis on recent developments in such areas as general equilibrium analysis, welfare economics, demand theory, and capital theory. 4 cr.

878. MICROECONOMIC THEORY II

A continuation of Microeconomic Theory I. The course will attempt to bring the student to the frontiers of contemporary research on selected problems of microeconomics. Prereq: Econ 877. 4 cr.

895. INDEPENDENT STUDY

896. RESEARCH WORKSHOP

1) Finance; 2) Political Economy; 3) Labor Economics.

899. THESIS

Staff. 8 cr.

999. DOCTORAL RESEARCH

Staff.

Education (Educ)

Chairperson: Gerald J. Pine

PROFESSORS: Angelo V. Boy, Roland B. Kimball, Carleton P. Menge, Gerald J. Pine

ASSOCIATE PROFESSORS: Michael D. Andrew, Charles H. Ashley, Jason E. Boynton, John G. Chaitas, David D. Draves, Edward D. Durnall, David J. Hebert, Bud B. Khleif, Joseph J. Petroski, M. Daniel Smith, Deborah E. Stone, Dwight Webb

ASSISTANT PROFESSORS: Margaret D. Ackerman, Richard Antonak, Virginia Bereit, John Carney, Ellen Corcoran, Michael Diamonti, Ann Diller, Sidney Eder, Leo Geoffrion, Donald H. Graves

ADJUNCT PROFESSORS: Donald D. Durrell, Frederick Jervis

ADJUNCT ASSISTANT PROFESSORS: John R. Cavanaugh, David Cross

GRADUATE STUDIES COORDINATOR: David J. Hebert

Admission to Graduate Standing

Admission to graduate standing in the Department of Education is granted to applicants meeting the entrance requirements of the Graduate School and accepted by the department. Applications must include Graduate Record Examination scores for the Aptitude Test.

Admission Requirements

1) Above average academic credentials; 2) above average scores on the Graduate Record Examination; 3) three strongly supportive letters of recommendation attesting to intellectual and personal competence from persons in a position to judge the applicant's preparation and fitness for graduate work; 4) applicants for the Certificate of Advanced Graduate Study must meet the preceding admission requirements and also possess a master's degree in an appropriate specialty. Follow general admission procedures.

The Admissions Committee of the Education Department meets according to the following schedule to review applications and make recommendations concerning admission of students to the Graduate School. Applications for part-time study in all programs and for full-time study in administration, elementary education, secondary education, and 5-year teacher education are considered on July 25 for Semester I, December 7 for Semester II, and April 4 for the summer session. Applications for full-time study in counseling, early childhood, post-BS entry into MAT and MEd programs, and reading are considered only once a year on the 2nd Friday in April.

Thesis or Comprehensive Examination

Candidates in the Master of Education program ordinarily will be expected to complete a research thesis, a written comprehensive examination, a set of professional statements with an oral examination, or a clinical experience. Program planned with graduate adviser to meet candidate's professional needs. No thesis or examination requirements for the Master of Arts in Teaching.

Courses are not offered in sequence; consult the *Time and Room Schedule* for current offerings.

Master's Degree Programs in Education

Six graduate programs lead to the Master of Education degree. Some programs are available to part-time admitted graduate students.

Areas of specialization include: counseling, early childhood education, educational administration and supervision, elementary education, reading, and secondary education.

Counseling

Program Information: Angelo Boy, David Hebert, Gerald Pine, and Dwight Webb.

Provides the graduate with the entry credentials of a professional counselor who is able to:

1) Provide behaviorally relevant individual and group counseling relationships;

2) Function as a scholar-practitioner by developing a sophisticated interplay between counseling theory and practice, whereby each expands and enhances the other;

3) Function in any setting dedicated to the educational, vocational, social, and psychological emergence of the person.

Degree candidates must successfully complete one of the following: written examination, oral examination, or research thesis.

Core Requirements (28 credits): 820, Counseling Theory and Practice; 821, Psychology of Career and Personal Development; 822, Assessment in Counseling; 823, Group Counseling; 824, Psychological Stress and Adaptation; 825, Counseling Laboratory; and 826, Counseling Internship.

Electives (8 credits): Graduate-level elective courses are available from any department or school in the University with offerings related to the behavioral sciences.

Early Childhood

Program Information: Donald Graves, Deborah Stone.

(36 Credits) A twelve-month program, beginning with the summer session and continuing through the academic year, to prepare participants as early childhood resource specialists, with competence to assume roles as master teacher, program supervisor, curriculum consultant, staff development director, parent/home educator, family agency coordinator, or college level instructor. The emphasis is on practicum experience coordinated with extensive course work in related academic disciplines.

Intensive summer experience is devoted to study of the young child and an analysis of appropriate learning environments.

September through June, graduate students are completely responsible for setting up and staffing early learning centers in local school districts, private schools, and day care facilities in which they work in a coteaching situation with another participant in the program as well as with volunteer aides from the community. Candidates engage in course work and seminars concurrent with the practicum experience through study on the campus two afternoons and evenings per week. They are expected also to produce a monthly newsletter, provide workshops for staff and parent groups, and do independent study that results in papers of significance to be shared at the annual early childhood conference.

Additional field experiences: visits to schools in Toronto, Canada; to Follow Through models; to Montessori Schools; as well as a three-week experience in British Infants Schools in England.

Education

Curriculum: Education 841, Child Development for the Early Childhood Professional; 843, Environment for Early Childhood; 800-801, Internship and Seminar in Teaching; 846, Assessment in Early Childhood; 848, Contemporary Influences Upon Early Childhood Education; 850, Foundations of Early Childhood Education; 853, Seminar in Curriculum Study; 865, Educational Supervision; and 895, Independent Study in Education.

Electives: Other graduate level courses within or outside of the Department of Education are acceptable alternatives depending upon the student's previous background and individual goals.

Concluding Experience: Plan, execute, and participate in an annual early childhood conference at the New England Center for Continuing Education.

Educational Administration and Supervision

Program Information: Charles Ashley, J. Boynton, Roland Kimball, and Joseph Petroski.

For the experienced teacher to become qualified in the broad area of supervision and administration, grades K-12. Emphasis on the elementary and secondary school principalship and general instructional supervision.

Core Requirements (24 credits): 785, Tests and Measurements; 865, Educational Supervision; 853, Seminar in Curriculum Study; 861, Public School Administration; 863, Seminar in Educational Administration; and 869, Practicum in Education Administration, or 866, Practicum in Supervision and Curriculum.

Electives (12 credits): Individually planned, with major portion selected from the following education courses: 797, Seminar in Contemporary Educational Problems; 864, Personnel and Communication in Educational Organizations; 883, Advanced Psychology of Human Learning; 884, Advanced Human Development; 886, Philosophy of Education; 888, Sociology of Education; 895, Independent Study in Education; and from Business Administration: 713, Interpersonal and Group Dynamics; 803, Human Behavior in Organizations; Sociology 740, Culture Change; and Sociology 770, Culture, Personality, and Society.

Concluding Experience: Comprehensive oral examination based upon the thesis prepared by the candidate or major research study related to school administration, curricula, or educational supervision.

Elementary and Secondary Education

Program Information: Teacher Education Committee: Michael Andrew, Virginia Bereit, Ellen Corcoran, Ann Diller, Carleton Menge.

(Minimum of 30 credits) Primarily for the elementary or secondary classroom teacher.

Core Curriculum (12 credits): Selections may be made from: Education 785, Tests and Measurements; 838, Sociology of Education; Social Organization of Schools and Community; 853, Seminar in Curriculum Study; 883, Advanced Psychology of Human Learning; 884, Advanced Human Development; 886, Philosophy of Education.

Electives (10-18 credits): In consultation with the student's adviser and with his/her approval, electives may be taken in specialized areas from within the Department of Education, in the student's major field, or in some combination of the two.

Concluding Experience: The three options are: 1) 30 credits and the successful completion of an oral examination based on a set of these statements; 2) A research thesis, plus 22 credits from the above; 4 credits in Education 881, Methods and Techniques of Educational Research; and 6 credits in 899, Thesis; 3) 30 credits and a written comprehensive examination, taken with the approval of one's adviser.

Reading

Program Information: John Carney, Leo Geoffron.

A professional preparation required of the reading specialist, concentrating on: 1) the improvement of reading abilities of all children; 2) the prevention, diagnosis, and remediation of reading difficulties.

Within the scope of the program, the following requirements will be satisfied: standards for the professional training of reading specialists recommended by the International Reading Association, and certification requirements for the reading specialist set forth by the New Hampshire State Department of Education.

The specific program will be planned, with the assistance of the student's adviser, to meet individual needs as indicated by the academic and professional background and his/her professional objectives.

Core Curriculum (28 credits): Education 807, Foundations of Reading Instruction; 808, Diagnosis of Reading Difficulties; 809, Remediation of Reading Difficulties; 810, Comprehensive Reading Methods in the Secondary School; 813, Field Practicum in Reading; 814, Seminar in Reading. Choose one of the following: Education 811, Clinical Experience in Reading — Elementary; 812, Clinical Experience in Reading — Secondary.

Electives (8 credits): The remainder of courses are selected in consultation with the adviser. They may be from the offerings of the Department of Education or reflect an interdisciplinary approach with other graduate departments at the University.

Concluding Requirements: 1) Completion of 36 credits: Written comprehensive or theses with oral examination; or 2) Completion of core curriculum (28 credits): 8 credits thesis.

Master of Arts in Teaching and Master of Education Degrees for Preservice Teachers

Program Information: Michael Andrew, coordinator of Teacher Education.

The Department of Education offers two master's degrees for students completing the teacher preparation program at UNH. Students may enter the teacher education program as undergraduates, thus satisfying some of the requirements for certification prior to master's level work. The

programs are also open to people who have completed an undergraduate program with no work in education and to people who have finished college some time ago. Specialization is available at the primary, middle school, and high school levels. Students entering these master's degree programs normally will have completed a bachelor's degree program with a major outside the field of education.

All professional education requirements for certification must be met either prior to or as part of the master's degree programs for preservice teachers. These professional requirements include Education 500, Exploring Teaching, or equivalent, and each of the following education courses: 700, Educational Structure and Change; 701, Human Learning and Development; 703, Alternative Teaching Models; 705, Alternative Perspectives on the Nature of Education; and 800, 801, Internship.

Additional requirements for elementary school teaching are one course in elementary school reading and two courses in mathematics appropriate for elementary school teaching.

Master of Arts in Teaching (Elementary and Secondary)

All candidates must complete, or have completed prior to admission, a one-semester teacher aide experience or its equivalent with supportive recommendation from school staff. Education 500, Exploring Teaching, may be taken by UNH undergraduates. Other candidates will enroll in the experiential summer school program (Educ 831 or 835), which will satisfy this requirement.

Core Curriculum:

1) Twelve graduate credits outside the Department of Education (One of required math courses may be included in these 12 credits for elementary MATs.)

2) Twelve credits of internship: Education 800 (3-6 credits) and Education 801 (3-6 credits). A six-credit internship may be approved for some MAT candidates who have had Education 831, 835, or equivalent classroom experience.

3) Graduate electives inside or outside the Department of Education (Credits in Education 700, 701, 703, and 705 may be counted as electives.)

4) Minimum of 30 credits.

Concluding Experience: Theses (professional statements and oral examination), research thesis or project.

Master of Education for Preservice Teachers (Elementary and Secondary)

All candidates must complete, or have completed prior to admission, a one-semester teacher aide experience, or its equivalent with supportive recommendation from school staff or Education 831 or 835.

Core Curriculum:

1) Twelve graduate credits in education. Credits may be counted from Education 700, 701, 703, and 705 beyond the minimum requirements of 4 credits in each area; the required elementary reading course

may be counted in the 12 hours for prospective elementary teachers. Twelve-hour specializations will be available in a number of areas including the following: reading, counseling, curriculum and instruction, and developmental disabilities.

2) Twelve credits of internship: Education 800 (3-6 credits) and Education 801 (3-6 credits). (Six credits of internship may be approved for some M.Ed. candidates who have had Education 831, 835, or equivalent classroom experience.)

3) Graduate electives inside or outside the Department of Education. (Credits in Education 700, 701, 703, and 705 may be counted as electives.)

4) Minimum total is 30 credits.

5) **Concluding Experience:** theses (professional statements and oral examination), research thesis or project.

Students entering the MAT or M.Ed. programs with none of their professional requirements previously met will generally follow the program format listed below.

First Summer: Summer school teaching and seminars, 10 credits: 8 credits in Education 831 or Education 835, and 2 credits in Education 700. (Satisfies requirement for Education 500, Education 703, and 2 credits of Education 700.)

Academic Year: Internship (6 or 12 credits) plus varying number of credits in professional requirements and courses in area of graduate specialization.

Second Summer: Balance of degree requirements.

Certificate of Advanced Graduate Study

A Certificate of Advanced Graduate Study (CAGS) is available in two programs: Counseling, and Educational Administration and Supervision.

Counseling (CAGS)

This program is designed for those who possess a master's degree in counseling or an equivalent master's degree and want to pursue further study toward the Certificate of Advanced Graduate Study. The candidate for this certificate must successfully complete 32 graduate credits beyond the master's degree, and one of the following before graduation: written examination, oral examination, or research thesis.

Required Education Courses (20 credits): 827, Administration of Counseling Services; 828, Advanced Counseling Theory and Practice; 829, Advanced Counseling Internship; 830, Research in Counseling; and 884, Advanced Psychology of Human Development.

Electives (12 credits): Elective courses available within the Counselor Education Program are: Laboratory in Counseling, and Counseling and Guidance in the Elementary School.

Education

Other graduate-level elective courses are available from the departments of education, business administration, economics, English, history, home economics, mathematics, political science, psychology, and sociology. Contact Professor Angelo Boy, Morrill Hall, for further information concerning electives.

Educational Administration and Supervision (CAGS)

Designed for individuals who possess a master's degree or graduate study equivalent to that outlined in the University of New Hampshire M.Ed. program in Educational Administration and Supervision and who wish advanced preparation for careers as school superintendents, assistant superintendents, business managers, state department of education personnel, vocational education coordinators, curriculum coordinators, or educational personnel in private organizations.

Candidates must complete a significant field project of 12 semester hours within the administrative environment in which the person intends to function. Eight semester hours are required in instructional leadership; eight semester hours are required in management and administration. Twelve semester hours include electives outside the Department of Education.

The program is based upon the following:

- 1) Students in this program pursue basic courses in educational administration and supervision as well as electives which will enable them to function more adequately within a specific administrative environment.

- 2) Because of the complex role of the school administrator, persons seeking preparation as administrators must demonstrate intellectual and personal competence of superior quality.

- 3) The graduate program for administrators will emphasize the ability to apply the relevant facts and formulations derived from administrative theory and research in the solution of significant operational problems.

Contact Roland B. Kimball, Professor of Education, Morrill Hall, for further details regarding the Certificate of Advanced Graduate Study in Educational Administration and Supervision.

700. EDUCATIONAL STRUCTURE AND CHANGE

Organization, structure, and function of American schools; processes of change in education; how successful innovation is accomplished. Field experience options. Variable-credit modules. Sections listed in department prior to preregistration. Prereq: Educ 500 or permission of instructor, except for off-campus programs. Minimum of 4 cr. required for teacher certification. Variable 1-4 cr.

701. HUMAN LEARNING AND DEVELOPMENT

Individual development; learning process analysis. Variable-credit modules on the theories, research, and implications of a specific topic offered each semester and summer. Sections listed in department prior to preregistration. Prereq: Educ 500 or permission of instructor,

except for off-campus programs. Minimum of 4 cr. required for teacher certification. Variable 1-4 cr.

703. ALTERNATIVE TEACHING MODELS

Analysis and application of basic teaching models and techniques (from very teacher-directed to very student-centered). Observation of master classroom teachers and exemplary video-tapes; service as aides to master-teachers; seminars. Techniques and analysis systems through observation of video-tapes, microteaching, completion of appropriate self-instruction units, and seminars. Variable credit modules; sections listed in department prior to preregistration. Prereq: Educ 500 or permission of instructor, except for off-campus programs. Minimum of 4 cr. required for teacher certification. Variable 1-4 cr.

705. ALTERNATIVE PERSPECTIVES ON THE NATURE OF EDUCATION

Students formulate, develop, and evaluate their own educational principles, standards, and priorities. Alternative philosophies of education; contemporary educational issues. Variable credit modules; sections listed in department prior to preregistration. Prereq: Educ 500 and departmental permission, except for off-campus programs. Minimum of 4 cr. required for teacher certification. Variable 1-4 cr.

706. INTRODUCTION TO READING INSTRUCTION IN THE ELEMENTARY SCHOOLS

The reading process; current procedures and materials; diagnostic techniques; clinical experience. Course satisfies reading requirement for prospective elementary teachers in the five-year teacher-education program and may be included in the 12 required graduate credits in education at the graduate level. Course may also be taken for undergraduate credit prior to entrance into fifth year; in this case the course satisfies reading requirement but is not applicable toward the 12 required graduate credits. 4 cr.

707. APPROACHES TO TEACHING READING AT THE SECONDARY LEVEL

The Reading Curriculum in the Secondary School. Analysis of the structural components (developmental, corrective, remedial); materials and methods of instruction and appraisal; instruments of measurement and evaluation in the comprehensive secondary reading program. 2 cr.

Teaching Reading Through the Content Areas: Alternative and Application. Students learn new approaches, concepts, and methodologies of teaching reading; workshop to develop and produce instructional strategies and materials for an integrated reading-content program. 2 cr.

734. CHILDREN'S LITERATURE

Interpretive and critical study of literature for children in the elementary, middle, and junior high schools. Methods of using literature with children. 4 cr.

752. DIAGNOSIS AND REMEDIATION OF LEARNING DISABILITIES

Terminology, etiology, common characteristics, symptoms. Theory and practice in gross-motor, visual, and auditory-testing procedures used in diagnosis. Test findings for use in remediation programs. 4 cr.

753. TEACHING THE CHILD WITH EMOTIONAL AND SOCIAL DIFFICULTIES

Nature and scope of emotional disturbances and social maladjustment in children including causes, characteristics, and treatment programs. 2 cr.

763. INTRODUCTION TO EDUCATIONAL MEDIA

Educational media in the learning process; curricular integration of materials and equipment in the school library media center; design and implementation of learning systems that provide a framework for the development of individual skills. 4 cr.

775. DIAGNOSTIC TEACHING OF READING

An overview of the classroom implementation of the diagnosis and remediation of reading disability for teachers, counselors, administrators, and other school personnel. 4 cr.

785. EDUCATIONAL TESTS AND MEASUREMENTS

The theory and practice of educational evaluation; uses of test results in classroom teaching and student counseling; introductory statistical techniques. 4 cr.

795,796. INDEPENDENT STUDY

Juniors and seniors only with approval by appropriate faculty member. 2 or 4 cr.

797. SEMINAR IN CONTEMPORARY EDUCATIONAL PROBLEMS

Issues and problems of special contemporary significance, usually on a subject of recent special study by the staff member(s). Prereq: permission of instructor(s). May be repeated for different topics. Variable 1-4 cr.

800,801. INTERNSHIP AND SEMINAR IN TEACHING

A two-semester, full-time, supervised internship consisting of less than full teaching responsibility in selected educational settings and programs. Weekly seminars and occasional workshops held concurrently with internship. Admission by application. Variable 3 or 6 cr.

806. APPROACHES TO LANGUAGE ARTS INSTRUCTION

Analysis of current research and trends. Language development and literature, including contributions of allied disciplines such as semantics and linguistics. Focus on processes of communication and application to school curriculum. 4 cr.

807. FOUNDATIONS OF READING INSTRUCTION

Survey of reading process, theoretical models, and basic approaches to the teaching of reading. Emphasis on current methods, materials, and programs. 4 cr.

808. DIAGNOSIS OF READING DIFFICULTIES

Investigation of the nature, causes, and correlates of reading disability. Study of diagnostic procedures and materials through case studies, discussions, demonstrations, and practice. Pre- or Corequisites: Educ 807; Educ 810. 4 cr.

809. REMEDIATION OF READING DIFFICULTIES

Procedures for remediating reading deficiencies and modifications of teaching necessary to adjust to diverse reading handicaps. Emphasis on a diagnostic teaching approach to reading remediation. Prereq: Educ 807; Educ 808 (may be taken concurrently with 809). 4 cr.

810. COMPREHENSIVE READING METHODS IN THE SECONDARY SCHOOL

The nature of the reading process, diagnostic and developmental methods and materials, study skills, and reading in the content areas at the secondary level. Designed for secondary school teachers who wish to foster continuous development of students' reading and study skills. 4 cr.

811. CLINICAL EXPERIENCE IN READING — ELEMENTARY

Individual and small-group work with children provide opportunity for clinical analysis, microteaching, and evaluation. Seminars focus on the process of reading and language and the effects of a variety of materials and methods on learning. Prereq: Educ 809. 4 cr.

812. CLINICAL EXPERIENCE IN READING — SECONDARY

Supervised tutoring of secondary school students in order to develop techniques for improving reading skills. Seminars will focus on corrective techniques and the integration of reading skills to the content areas. Prereq: Educ 809. 4 cr.

813. FIELD PRACTICUM

Field-based experience focusing on roles of the reading specialist in the school setting. Prereq: permission of instructor. 4 cr.

Education

814. SEMINAR IN READING

Investigation of current research findings in reading and the related language arts. Seminars will focus on significant research projects, program designs, and analysis of the field of reading research and ramifications for the reading specialist. Prereq: permission of instructor. 4 cr.

818. PRINCIPLES AND PROCEDURES IN REHABILITATION

Introductory course integrating theory and practice in the field of rehabilitation. History and philosophy of rehabilitation as a social movement, including relevant legislation. Study of institutions. Role, function, and work of the counselor. Relation of the rehabilitation process to the total health and helping service delivery systems. Prereq: permission of instructor. 4 cr.

819. SOCIAL AND PSYCHOLOGICAL ASPECTS OF DISABILITY

Examination of historical and cultural concepts of human deviance and disability. Analysis of social, psychological, and vocational factors resulting from disabling and disadvantaged human conditions. Relationship of rehabilitation to disability and to individual adjustments. Field-based consultation with disabled individuals and rehabilitation agencies. Simulated, eight-hour disability project for each student. Prereq: permission of instructor. 4 cr.

820. COUNSELING THEORY AND PRACTICE

Basic approaches to counseling are examined — their theoretical foundations, process components, goals, and outcomes. 4 cr.

821. PSYCHOLOGY OF CAREER AND PERSONAL DEVELOPMENT

A survey and critical analysis of literature and research regarding effects of sequence of work development. Supervised experiences and training in conducting career readiness groups will also be provided. 4 cr.

822. ASSESSMENT IN COUNSELING

An analysis of evaluative instruments and methods which have particular use in counseling. Systematic procedures for measuring samples of an individual's behavior and statistical concepts which underlie psychological testing. Assessment is viewed from the perspective of its use in the counseling process as well as its use in accountability. 4 cr.

823. GROUP COUNSELING

An examination of the theoretical and applied dimensions of the group counseling process. Class may include laboratory experience to examine one's interactive behavior as a group member and leader. Prereq: Educ 820 and permission. 4 cr.

824. PSYCHOLOGICAL STRESS AND ADAPTATION

An examination of problems in stress that are significant for human adaptation. Behavior patterns which pose the most common problems encountered by contemporary counselors are reviewed, with emphasis upon the concepts and processes of adaptation. 4 cr.

825. COUNSELING LABORATORY

An introductory field experience in counseling with supervision and seminar to integrate theory and practice. Class will provide a format for microcounseling, simulations, and contemporary professional issues. Prereq: Educ 820 and permission. 4 cr.

826. COUNSELING INTERNSHIP

Supervised application of fundamentals of counseling theory and practice in actual counseling relationships. Samplings of the fundamental counseling practices of students will be analyzed and evaluated. Open only to master's degree candidates in UNH graduate program in counseling. Prereq: permission. 4 cr.

827. ADMINISTRATION OF COUNSELING SERVICES

Investigation of organizational patterns and administrative procedures that influence the effectiveness of counseling services. Emphasis upon staff development, accountability, professional issues, and productive supervisory behaviors. Prereq: permission. 4 cr.

828. ADVANCED COUNSELING THEORY AND PRACTICE

Detailed analysis of the counseling relationship: its characteristics, processes, and outcomes. Prereq: permission. 4 cr.

829. ADVANCED COUNSELING INTERNSHIP

Supervised application of advanced counseling theory and practice in actual counseling relationships. Samplings of the advanced counseling practices of students will be analyzed and evaluated. Open only to CAGS candidates in UNH graduate program in counseling. Prereq: Educ 828 and permission. 4 cr.

830. RESEARCH IN COUNSELING

A study of research design and methodology in counseling. Students will develop research projects which demonstrate their knowledge of proper research procedures in evaluating the processes and outcomes of counseling. Prereq: permission. 4 cr.

831. SEMINAR AND PRACTICUM IN ELEMENTARY SCHOOL TEACHING

Supervised Practicum: Exploratory summer practicum in a local summer elementary school to examine teaching as a career and to prepare for the internship in the fall. Summer includes: 1) a prepracticum workshop focusing on interpersonal skill development; 2) a

prepracticum curriculum and instructional laboratory; 3) a six-week practicum in which candidates, with the help of the staff, serve as the teaching staff in a local summer school; 4) seminars in curriculum and instruction. Opportunities for teaching high school students are available for candidates who wish to determine better what level of teaching they prefer. (Summer Session only.) Prereq: admission to the Master of Arts in Teaching Program or Master of Education Program for Preservice Teachers. 8 cr.

835. SEMINAR AND PRACTICUM IN SECONDARY SCHOOL TEACHING

Supervised Practicum: An exploratory summer practicum in a local summer high school to examine teaching as a career and to prepare for the internship in the fall. Summer includes: 1) a prepracticum workshop focusing on interpersonal skill development; 2) a prepracticum curriculum and instruction laboratory; 3) a six-week practicum in which candidates, with the help of the staff, serve as the teaching staff in a local summer school; 4) seminars in curriculum and instruction. Opportunities for teaching on elementary level are available for candidates who wish to determine better what level of teaching they prefer. (Summer Session only.) Prereq: admission to the Master of Arts in Teaching Program or Master of Education Program for Preservice Teachers. 8 cr.

838. SOCIOLOGY OF EDUCATION: SOCIAL ORGANIZATION OF SCHOOLS AND COMMUNITY

Schools in their socio-cultural contexts and as part of the institutional network of society. Relation to stratification and social control. Teaching as a religious occupation and as an emergent profession. 4 cr. (Also offered as Soc 838.)

841. CHILD DEVELOPMENT FOR THE EARLY CHILDHOOD PROFESSIONAL

To understand child growth, components of the course involve students in extended contacts with significant adults related to children in an early learning environment. Includes home visits to interview parents, relatives, and to observe the child in the family setting. Extensive readings, discussions, case study models, film viewings, and continued in-depth child study. Prereq: previous experience with young children. 4 cr.

843. ENVIRONMENT FOR EARLY CHILDHOOD

Examination of various environments with attention to use of time, space, and materials. Study multiple professional roles needed in providing appropriate Learning Center adjustments to maximize individual child development. 4 cr.

846. ASSESSMENT IN EARLY CHILDHOOD

Study, administer, and design a range of assessment materials. Develop strategies for selection and utilization of clusters of assessment materials. Collect and organize relevant data. Prereq: Educ 841; Educ 843. 4 cr.

848. CONTEMPORARY INFLUENCES UPON EARLY CHILDHOOD EDUCATION

Survey of contemporary models in this country and abroad, largely through field experiences (United States, Canada, and England). Application of principles to individual student and specific early learning situations. Prereq: current involvement with a specific group of children. 4 cr.

850. FOUNDATIONS OF EARLY CHILDHOOD EDUCATION

Historical roots of contemporary practices. Perspective of historical precedents in content, methodology, and change. Study and review of child development, assessment, classroom environments. Prereq: Educ 841; 843; 846; and 848. 4 cr.

853. SEMINAR IN CURRICULUM STUDY

Designed to analyze recent trends in public school curriculum and to examine topics such as curricular structures, curricular philosophy, curricular development, curricular change, and curricular evaluation. Primarily for experienced teachers and administrators. Prereq: teaching experience. 4 cr.

854. SURVEY OF DEVELOPMENTAL DISABILITIES

A comprehensive survey of mental retardation, cerebral palsy, epilepsy, and related handicapping conditions; causal factors, physical and psychological characteristics, educational and therapeutic implications. Observations of programs and services for the developmentally disabled are required. 4 cr.

855. SERVICE DELIVERY SYSTEMS IN DEVELOPMENTAL DISABILITIES

A detailed exploration of service delivery system models in developmental disabilities: pre- and postnatal, preschool, elementary, secondary, postschool, and adult occupational. Examination of the New Hampshire state plan for the provision of services and facilities for the developmentally disabled, as well as the plans of other states in the New England region; administrative, social, legal, and educational implications. Prereq: Educ 750. 4 cr.

856-857. FIELD PRACTICUM AND SEMINAR IN DEVELOPMENTAL DISABILITIES

One semester of supervised experiences in a diversity of agencies and facilities serving the developmentally disabled, a one-semester

Education

practicum experience in a particular setting approximating the student's career choice, and biweekly seminars on topics related to the delivery of service to the developmentally disabled. Supervision will be provided by University faculty and staff. Prereq: permission of graduate adviser. 8 cr.

858. ANALYSIS OF TEACHING

Comparative analysis of current techniques and instrumentation for studying the process of teaching in the classroom. Consideration of substantive and procedural issues involved in planning for teaching. Prereq: teaching experience. 4 cr.

861. PUBLIC SCHOOL ADMINISTRATION

Introductory course examining major issues in policy making, school management, personnel, public relations, finance, and research in school administration. Prereq: teaching experience. 4 cr.

862. EDUCATIONAL FINANCE AND BUSINESS MANAGEMENT

Principles of financing education, budgetary procedures, accounting, auditing, school indebtedness, financial reporting, and business management. Experience in handling practical school finance problems will be part of the project work. Prereq: Educ 861. 4 cr.

863. SEMINAR IN EDUCATIONAL ADMINISTRATION

Cases and concepts in educational administration. Prereq: Educ 861. 4 cr.

864. PERSONNEL AND COMMUNICATION IN EDUCATIONAL ORGANIZATIONS

Problems arising from the communications process. Implications of group problem-solving processes. Interpersonal relations and group dynamics among students, faculty, staff, administration, and the community. Application of theories. 4 cr.

865. EDUCATIONAL SUPERVISION

Theoretical foundations of supervisory behavior as a means of effecting changes in instructional practices; consideration of instruments and techniques based on those theoretical foundations; some opportunity for field projects utilizing instruments and techniques. Prereq: teaching experience. 4 cr.

866. PRACTICUM IN SUPERVISION AND CURRICULUM

Supervision of teaching and curriculum development projects in the schools. Opportunity to apply skills in supervising and curriculum development techniques. Prereq: Educ 853; Educ 865; and permission of instructor. 4 cr.

867. LEGAL ASPECTS OF SCHOOL ADMINISTRATION

Investigation of relationship of law to public education. Emphasis on federal constitution, New Hampshire statutes, and case law related to public interests served by elementary and secondary education. Special topics: church-state relationship, due process, desegregation, state agencies, supervisory unions, school districts, school boards, teacher employment, negotiations, student rights, tort liability, school finance. Prereq: Educ 861; Educ 863. 4 cr.

868. COLLECTIVE BARGAINING IN PUBLIC EDUCATION

An examination of collective bargaining as practiced by school boards, administrators, and teacher organizations. Consideration will be given to collective bargaining statutes, case law, employee relations boards, unit determinations, exclusive representation, union security provisions, scope of bargaining, good faith, grievance procedures, bargaining strategies, strikes, public interest, mediation, factfinding, arbitration and the administration of the negotiated contract. Prereq: Educ 863. 4 cr.

869. PRACTICUM IN EDUCATIONAL ADMINISTRATION

Supervised practical experience in dealing with problems in educational administration. Prereq: Educ 863. 4 cr.

870. THE CHANGE PROCESS IN EDUCATION

Role of change agent and the change process in education as related to school personnel; structural characteristics of the school culture; change theory and systems analysis techniques. Students will be required to apply some of the theories in an institutional setting. 4 cr.

871. SCHOOL PLANT PLANNING

A study will be made of the techniques and procedures involved in the long-range planning of school facilities; for example, school population projections, characteristics of the educational program, space requirements, evaluation of existing facilities, future use of existing buildings, analysis of financial resources available, identification of reasonable alternatives, and an examination of the probable consequences of such alternatives to include educational effectiveness and tax impact. Prereq: Educ 863, or permission. 4 cr.

872. EDUCATIONAL PROGRAM EVALUATION

A study of selected models for educational program evaluation. The rationale underlying these models will be examined and compared. Practical applications will be developed. Each student will plan a complete evaluation design for an appropriate educational program. Prereq: Educ 853; Educ 861; or permission. 4 cr.

- 874,875. ADMINISTRATIVE INTERNSHIP AND FIELD PROJECT**
Field-based internship. Administrative experiences in one or several educational and community agencies. Participation in administrative and supervisory work of the agencies. Each intern completes a major field project requiring analysis and action appropriate for resolution of a significant administrative problem at the intern-site. Supervision by University faculty. Prereq: permission of graduate adviser. A grade of credit (Cr.) will be given upon successful completion of the internship and field project. 6 cr. each semester.
- 881. METHODS AND TECHNIQUES OF EDUCATIONAL RESEARCH**
Quantitative methods employed in the investigation of educational problems. Prereq: permission of instructor. 4 cr.
- 883. ADVANCED PSYCHOLOGY OF HUMAN LEARNING**
Review and integration of learning theory, teacher effectiveness, motivation theory, and development through adolescence; application of these to teaching generally and to the areas of specialization of the participants. Prereq: Educ 701 or equivalent. 4 cr.
- 884. ADVANCED HUMAN DEVELOPMENT**
A study of selected principles and skills mankind must consider in the attempt to maximize individual, social, and educational potential, with special emphasis on personal implementation. Prereq: Educ 701 or Psc 401 or equivalents. 4 cr.
- 886. PHILOSOPHY OF EDUCATION**
Seminar in comparative analysis of contemporary educational objectives and practices and the philosophical foundations upon which they are based. Application of theoretical criteria for assessing educational philosophies and for developing one's own position. 4 cr.
- 888. SOCIOLOGY OF EDUCATION: THE CULTURES OF POVERTY AND AFFLUENCE**
Two cultures treated as unit; culture change discussed. Current issues: poverty, school desegregation, schooling of geographically mobile children, social mobility and abundance, rise of counseling and healing trades, teachers' quest for professionalism, education of "culturally endowed" children. 4 cr.
- 889. SOCIOLOGY OF EDUCATION: RACE AND ETHNIC RELATIONS IN SCHOOL AND SOCIETY**
Ethnic stratification and inter-group processes in and outside school. Public schooling of disadvantaged groups such as black, Indian, white Appalachian, and Mexican Americans. Caste and class relations within social contexts. Socio-anthropological perspective. 4 cr.

- 895. INDEPENDENT STUDY IN EDUCATION**
Opportunity for intensive investigation of a special problem or issue in the field of education. Prereq: permission of instructor. 2-4 credits per semester. May be repeated to a maximum of 8 cr.
- 899. THESIS**
Prereq: permission of the department. 8 cr.

Electrical Engineering (E E)

Chairperson: Ronald R. Clark

PROFESSORS: Fletcher A. Blanchard, Ronald R. Clark, Albert D. Frost, Joseph B. Murdoch, Alden L. Winn
ASSOCIATE PROFESSORS: Glen C. Gerhard, Filson H. Glanz, Donald W. Melvin, John L. Pokoski, Kerwin C. Stotz, K. Sivaprasad
ASSISTANT PROFESSORS: John D. Aspnes, Michael R. Cannon, Paul J. Nahin
GRADUATE COORDINATOR: Glen C. Gerhard

To be admitted to graduate study in electrical engineering, a student should have completed a baccalaureate degree in electrical engineering or comparable training which included courses in mathematics and physical science, network theory, fields and waves, electronics, solid state circuits, semiconductor device theory, with appropriate laboratory experiences.

A minimum of 24 credits of coursework plus 6 credits of thesis or project are required for the master's degree. No specific course requirements are mandated; each candidate will meet with the departmental graduate committee to set up a program of study. Students are further required to demonstrate the ability to do independent and creative work by taking either Electrical Engineering 899 or 891-892. With the consent of the Graduate Committee, a student who has satisfied this requirement through industrial experience may substitute approved course work.

Electrical Engineering 899 and 891-892 both involve equivalent independent theoretical and/or applied work under the guidance of a faculty member. The sequence 891-892 is to be completed in two consecutive semesters, with a letter grade given at the end of each semester. An interim report is submitted at the end of 891, and a final (oral and written) report at the end of 892. Electrical Engineering 899 requirements include the submission of a formal thesis suitable for binding. However, no two-semester time limit is imposed, and no interim or final letter grade is given.

Electrical Engineering

Those who intend to undertake graduate work in electrical engineering must consult with the department graduate adviser in order to plan the program of study, since all courses are not given each year. Normally, a minimum of 12 credits of 800-level courses is required, not including 891-892 or 899.

The Electrical Engineering Department considers the development of professional communication skills, through a teaching assignment, a basic component of a graduate education. Every master's candidate is required to satisfactorily complete one year of EE 800 seminar; participation includes presentations as needed to satisfy the teaching requirements.

An interdepartmental Engineering Ph.D. Program is also available in the following areas of specialization: engineering system design, signal processing, theoretical and applied mechanics, and transport phenomena. Electrical engineering students would normally work in one of the first two areas. For details refer to the section entitled Engineering Ph.D. Program on page 79.

Since many graduate courses are given by demand, actual course offerings vary from semester to semester.

Areas of Specialization

Courses may be selected to provide a specialization in the following program areas, both for the M.S. degree or for the Engineering Ph.D. program.

Biomedical and Clinical Engineering

Topics of study in these areas include biomedical instrumentation, computer applications to medical problems, patient safety, direct patient care, health delivery systems, and applications of signal processing and instrumentation techniques to medical areas.

Communications Systems and Information Theory

Areas of interest and activity include electromagnetic and acoustic wave technologies, and the identification of signals in the presence of noise through the use of coding, correlation, or optimal filtering. Related facilities for experiments extending from VLF to microwaves are available at a roof-top communications system for space, terrestrial, and ocean applications.

Computer Engineering and Digital Systems

Theoretical aspects of switching theory; systems that recognize patterns, learn and exhibit intelligence; application of switching logic, design and interfacing of minicomputer peripherals; application of minicomputers to process control and bioelectronics. The Digital Systems laboratory includes four minicomputers with magnetic tape units, teletype terminals, high speed paper tape units, AD and DA converters, graphics output, and interconnect capability with a TR-48 analog computer.

Control and Systems Engineering

Digital, hybrid, and analog computer control of industrial processes and systems. Discontinuous and fluidic control theory for industrial, marine, and oceanographic applications. Linear and stochastic analysis, synthesis techniques in the frequency domain, optimal control, and systems optimization.

Fields and Waves

Radiation of electromagnetic waves in a plasma, electromagnetic and acoustic probing of media with pulses, propagation studies in weakly turbulent media such as sea, the atmosphere, and plasmas.

Geophysical Sensing

Ground based electromagnetic techniques for probing of upper atmosphere and the ionosphere; electromagnetic pulse techniques for probing of ice, snow, and other material media. Acoustic probing of bottom and subbottom sediment in water.

Network Theory

Active network synthesis techniques, application of network theory to societal systems, sensitivity studies of passive and active network synthesis methods, digital adaptive equalizers, and analysis and design of linear phase and constant delay networks.

Ocean Engineering and Instrumentation

Instrument systems (digital and analog) for measuring and recording physical, chemical, and biological parameters primarily associated with ocean behavior, e.g., temperature, pressure, and salinity measurements at midocean depths; wave height and direction determination; buoy performance as affected by waves and currents; remote sensing of the ocean surface; diver physiological data monitoring; and underwater acoustics.

Solid State Electronics

Design of active devices and circuits, and the theory and technology of silicon monolithic devices and circuits.

Permission of instructor is required for enrollment in all electrical engineering courses taken for graduate credit.

620. ELECTRONICS AND INSTRUMENTATION

For nonengineering or nonphysics students; no mathematical or engineering detail. Techniques for using electronic instruments and equipment. DC and AC circuits, electronic amplifiers, grounding and shielding problems, transducers, electronic instruments, schematic reading, transients, noise problems, and digital techniques. Prereq: junior standing. 4 cr.

711. DIGITAL SYSTEMS

Extension of EE 543 to advanced switching theory techniques (design of unclocked sequential circuits, minimization of multiple output circuits, etc.) and digital design tools (L.S.I., multiplexing, etc.). Applications. Prereq: Introduction to Digital Systems (EE 543) or permission. 4 cr.

712. LOGICAL DESIGN OF DIGITAL COMPUTERS

Computer architectures, including arithmetic, memory, control, and input-output units; the trade-offs between hardware, software, and cost. "Hands on" laboratory experience with machine language programming, interfacing of peripherals, etc., on minicomputers and microcomputers. Prereq: Introduction to Digital Systems (EE 543) or permission. 4 cr.

714. MINICOMPUTER APPLICATIONS ENGINEERING

Organization and operation of minicomputer-based systems. Interfacing of special purpose peripherals, data structures, control structures, program and data organization, microprogramming, real-time monitor systems. Applications to communication, automated-measurement, and process control systems. Prereq: Introduction to Digital Systems (EE 543) and programming experience;/or permission. 4 cr.

727. POWER SYSTEMS

Modeling and planning of electric power transmission systems. Prereq: Electromechanical Energy Conversion (EE 654). 4 cr.

741. FLUID CONTROL SYSTEMS

The mathematical modeling of hydraulic-, pneumatic-, and fluidic-control elements and control systems. Methods are developed for the analysis of systems using gases or liquids as the working fluid. Methods for the synthesis of the parameters of the control elements, used in automatic control systems, are developed and methods of design of these systems are discussed. 4 cr. (Also offered as ME 741.)

745. FUNDAMENTALS OF ACOUSTICS

Acoustic wave equation for air; laws of reflection, refraction, and absorption; characteristics and measurement of acoustical sources; microphones; sound level; acoustical materials, ultrasonics; architectural acoustics. Prereq: General Physics II (Phys 408); Differential Eqns (Math 527). 4 cr.

757. FUNDAMENTALS OF COMMUNICATIONS

Communications systems, Fourier analysis of signals, AM and FM detection, digital and sampled-data signals, noise in electrical circuits. Prereq: Introduction to Communication and Control (EE 608). 4 cr.

758. COMMUNICATION SYSTEMS

Design of high frequency communication systems. RF amplification, modulators for AM and FM systems, receiving techniques, antennas, free space propagation, propagation characteristics of the ionosphere. Prereq: Electromagnetic Fields and Waves II (EE 604); EE 757 or equivalent. 4 cr.

762. ILLUMINATION

Radiation; color and spectra; physics of light production; sources of ultraviolet, visible, and infrared energy; lamp circuitry; control of light; lighting design, applications of light in business, industry, school, home, and outdoors. 4 cr.

775. APPLICATIONS OF INTEGRATED CIRCUITS

The design and construction of linear and nonlinear electronic circuits using existing integrated circuits. Use of operational amplifiers. Laboratory course in practical applications of nondigital integrated circuit devices. 4 cr.

781. OCEAN INSTRUMENTATION PROJECT

Interdisciplinary solution of a real-world problem; measurements of physical, chemical, or biological parameters in an ocean or fresh-water environment. Student team formulates system specification, assembles components, and designs a test procedure for demonstrating the feasibility of the prototype system. Written final report and oral demonstration before a panel of invited experts. Prereq: senior standing in engineering. 4 cr.

782. CONTROL SYSTEMS

Design and analysis of feedback control system. Stability criterion, time- and frequency-domain analysis, introduction to nonlinear systems. Prereq: permission. 4 cr.

783. BIOMEDICAL ENGINEERING

Engineering applied to cardiovascular, renal, gastrointestinal, sensory, reproductive, and other organ systems. Topics will include design and utilization of diagnostic, monitoring, and prosthetic techniques and devices. A design-oriented project will be required. Prereq: human physiology (may be taken concurrently). 4 cr.

784. BIOMEDICAL INSTRUMENTATION

Survey of engineering principles applied to medicine including physiological measurements, biotelemetry, modeling and simulation, electrical safety, biosignal processing, and computer applications. Prereq: permission. 4 cr.

Electrical Engineering

785. UNDERWATER ACOUSTICS

Vibrations, propagation, reflection, scattering, reverberation, attenuation, sonar equations, ray and mode theory, radiation of sound, transducers, and small and large signal considerations. Prereq: permission. 4 cr.

786. INTRODUCTION TO RADIO ASTRONOMY

Electromagnetic radiation, propagation. Positional astronomy and the radio sky, discrete radio sources, source structure distribution, the sun as a radio source, flare and burst activity, planetary emissions, quasars, pulsars, techniques of observation and data reduction, radiometry, polarimeters, correlation interferometers, aperture synthesis. Prereq: senior or graduate status in engineering or a physical science. 4 cr.

796. SPECIAL TOPICS IN ELECTRICAL ENGINEERING

New or specialized courses and/or independent study. Prereq: permission. 2 or 4 cr.

800. GRADUATE SEMINAR

This course includes periodically scheduled seminars presented by outside speakers, UNH faculty, and graduate students. Topics will be in general areas of interest of electrical and electronics engineers. Participants will prepare and give presentations to satisfy teaching practice requirements. 0 cr. CR/F.

801. ELECTROMAGNETIC FIELD THEORY

Maxwell's equations; plane wave propagation; reflection and refraction; guided wave propagation; wave guides; simple resonators; elements of microwave circuits, linear and aperture antennas, arrays of dipoles; receiving antennas. Prereq: Electromagnetic Fields and Waves I (EE 603) or equivalent. 3 cr.

802. ELECTROMAGNETIC WAVE THEORY

Selected advanced topics in electromagnetic wave theory taken from such areas as: antennas; propagation in various media; diffraction and scattering; microwave generation and waveguide propagation. Prereq: EE 801. 3 cr.

811. FUNDAMENTALS OF SIGNAL PROCESSING

Matrices and determinants, introductory graph theory. Laplace transforms, and pole-zero concepts, complex variable theory, convolution, concept of state, formulation and solution of state equations. 3 cr.

812. FILTER DESIGN AND SYNTHESIS

Network theoretical techniques basic to the design of electrical filters of various sorts. Approximation theory; driving point and transfer synthesis techniques; passive, active, and digital filters. Prereq: EE 811. 3 cr.

815. ADVANCED ACTIVE CIRCUITS

Investigation of devices and techniques used in advanced circuit design using discrete solid-state devices and integrated circuits. Topics will include oscillators, phase-locked systems, low noise techniques, etc. 3 cr.

817. SPECIAL TOPICS IN NETWORK THEORY

Study of advanced topics in network theory of interest to students and staff, taken from such areas as nonlinear networks, distributed networks, time domain synthesis, computer aided design, time varying networks, n ports, linear graph theory. Prereq: EE 812. 3 cr.

831. SOLID STATE ELECTRONICS

A study of topics in solid state electronics including semiconductor physics, transport phenomena, recombination, pn junctions, bipolar and field effect transistors, photoconductivity, and selected applications of semiconductor technology. Prereq: Electronic Materials and Devices (EE 609) or equivalent. 3 cr.

839. STATISTICAL THEORY OF COMMUNICATIONS

An introduction to probability theory and random waveforms leading to a discussion of optimum receiver principles. Topics include random variables, random processes, correlation, power spectral density, sampling theory, and optimum decision rules. 3 cr.

840. INFORMATION THEORY

A continuation of Electrical Engineering 839. Introduction of information-theory concepts. Topics include: message sources, entropy, channel capacity, fundamentals of encoding, Shannon's theorems. Prereq: EE 839. 3 cr.

841. DIGITAL SIGNAL PROCESSING

An introduction to the theory and practice of digital signal processing. Topics covered include the elements of nonrecursive and recursive digital filters, random number generators and simulation of time series, the Fast Fourier Transform, spectral estimation, envelopes and phases, modeling of time series. Samples of data from various physical experiments will be analyzed as student projects. Some exposure to programming is desirable. 3 cr.

842. DISCONTINUOUS CONTROL

The analysis and synthesis of feedback control systems operating on quantized information; compensation and performance improvement methods which use the quantized nature of the information are also developed. 4 cr. (Also offered as ME 842.)

844. NONLINEAR CONTROL SYSTEMS

Analysis and design of nonlinear control systems from the classical and modern viewpoints are discussed. Topics include: Liapunov's

stability theory; phase space methods; linearization techniques; simulation; frequency response methods; generalized describing functions; transient analysis utilizing functional analysis; and decoupling of multivariable systems. Prereq: EE 851. 4 cr. (Also offered as ME 844.)

851. ADVANCED CONTROL SYSTEMS I

State-space representation of systems. Analysis using state transition matrix. Controllability and observability. Synthesis of optimum control systems, including calculus of variations and maximum principle. Introduction to nonlinear and stochastic control-systems including stability concepts using Liapunov and Popov criteria. Sampled-data systems. Prereq: EE 782. 3 cr. (Also offered as ME 851.)

852. ADVANCED CONTROL SYSTEMS II

Special topics in control theory such as multivariate and adaptive control system; stochastic systems; Wiener and Kalman filter techniques; introduction to dynamic, linear and nonlinear programming. Prereq: EE 851. 3 cr. (Also offered as ME 852.)

853. ARTIFICIAL INTELLIGENCE

A study of current approaches to machine intelligence and the simulation of human cognitive processes, including an introduction to recursive functions and programming with the LISP language. Topics include heuristic programming, programs for game playing and natural language understanding, elementary theory of computability. An individual project implemented on the computer will be required. Prereq: programming experience. 3 cr. (Also offered as Math 853.)

854. AUTOMATA THEORY

A study of formal languages and theoretical "machines" or automata. Topics include formal grammars; context-dependent, context-free, and regular languages; finite state machines and regular expression recognizers; infinite state machines; Turing machines; unsolvable problems and the halting problem; linear-bounded and push-down automata; cellular and reproducing automata. Prereq: programming experience. 3 cr. (Also offered as Math 854.)

856. SWITCHING THEORY

Combinational circuits — including functional decomposition, nonbinary logic, and cellular networks. Sequential networks — including analysis, transient behavior, state reduction methods, state assignment, and synthesis. Prereq: EE 711. 3 cr.

860. COMPUTER ARCHITECTURE

Advanced topics in computer organization. Parallel and pipeline processing; associative and stack computers; microprogramming; virtual memory; current topics. Prereq: EE 712. 3 cr.

865. INTRODUCTION TO PATTERN RECOGNITION

Machine classification of data, feature space, clustering, linear separability, fictitious play algorithm, Braverman's hyperplane training and learning algorithm, learning and game playing computer programs that recognize patterns. Prereq: Knowledge of computer terminal operation, BASIC language; Math 636 and 645 or equivalents. 3 cr.

891-892. RESEARCH

3 cr. each semester.

898. INDEPENDENT STUDY

Independent theoretical and/or experimental investigation of an electrical engineering problem under the guidance of a faculty member. 1-3 cr. per semester.

899. MASTER'S THESIS

Total of 6 cr. (May be taken in any combination or order.)

Engineering Ph.D. Program (Engr)

PROFESSORS: Fletcher A. Blanchard, Ronald R. Clark, Robert W. Corell, Stephen S.T. Fan, Stephen L. Fink, Albert D. Frost, Shan S. Kuo, Joseph B. Murdoch, Godfrey H. Savage, Charles K. Taft, Robin D. Willits, Tung-Ming Wang, Aiden L. Winn, Asim Yildiz, J.H. Zoller
ASSOCIATE PROFESSORS: Paul L. Bishop, Barbaros Celikkol, Glen C. Gerhard, Filson H. Glanz, R. Stephen Jenks, Lois H. Klotz, David E. Limbert, Donald W. Melvin, William Mosberg, P.J. Ossenbruggen, John L. Pokoski, Kondagunta Sivaprasad, Linda G. Sprague, Kerwin C. Stotz, Gail D. Ulrich, Russell L. Valentine, John A. Wilson
ASSISTANT PROFESSORS: Wendell S. Brown, Ihab H. Farag, D.L. Gress, Virendra K. Mathur, Dennis J. O'Brien, M. Robinson Swift, Charles E. Wyman
ENGINEERING PH.D COMMITTEE: Asim Yildiz, Glen C. Gerhard, Stephen S.T. Fan, Robert W. Corell

An interdepartmental engineering program offers graduate work leading to the degree of Doctor of Philosophy and is conducted by a combined engineering faculty. The program consists of areas of specialization within an interdepartmental structure, depending principally upon strengths in engineering, the engineering sciences, mathematics, and the physical sciences. An interdepartmental program is felt to be most meaningful since many contemporary engineering and scientific problems can be solved only through the cooperation of a variety of disciplines. Further, the boundaries between the classical disciplines in engineering and science have become increasingly indistinct. The particular advantage of the nondepartmental program structure is that improved

Engineering Ph.D Program

communication and cooperation develop among faculty and students of the different disciplines and results in more meaningful academic and professional experiences.

Areas of Specialization

The Engineering Ph.D. program includes the following four areas of specialization:

Engineering System Design: Robert W. Corell, chairperson

Students entering this area of the Engineering Ph.D. Program can elect either one of two professional directions. The first seeks to develop professionals with the technical expertise of a Ph.D. and with the ability to work with and direct groups of people working on large-scale technical projects. The second direction seeks to develop engineers with capabilities in the theory and analysis of large-scale complex systems. Concentration in an area of specific individual interest is combined with participation in a larger interdisciplinary project.

Current projects related to the area include coastal engineering, marine soil mechanics, submersibles and underwater habitats, ocean instrumentation, marine structures and buoy systems, arctic engineering, discontinuous control systems, vehicle and transportation systems, fluid power systems, nonlinear decoupling control, computer systems, societal systems, facility systems, social and business systems, and biomedical systems and instrumentation.

Signal Processing: Glen C. Gerhard, chairperson

This area of specialization is concerned with those analytic and experimental techniques that are involved in some aspect of the acquisition, detection, identification, or control of signals. In this context a signal is defined as any quantity which contains or conveys information. While the majority of signal processing systems are partially or wholly electrical in nature, many of the basic aspects of signal processing and utilization are common to a wide range of problems and applications in communications, medicine, environmental modeling, instrumentation, and control.

Current research areas include: network synthesis, biomedical systems and instrumentation, acoustics, geophysical sensing, digital signal processing, systems modeling, digital systems, nonlinear interacting system-control, and fluidics.

Theoretical and Applied Mechanics: Asim Yildiz, chairperson

Treated as an engineering science, this area brings together those aspects of engineering, physics, and applied mathematics that are relevant to the understanding and application of the dynamical and equilibrium behavior of materials and structures. Included are the fields of solid mechanics, structural mechanics, classical and continuum mechanics, rheology, theoretical soil mechanics, biomechanics, elastodynamics, and acoustics.

Current research topics include macro- and micromechanics of composite-material behavior, wood-fiber mechanics, viscoelastic material properties, structural dynamics, dynamics of ocean structures, structural optimization, elastodynamics, elastic wave propagation, scattering of elastic waves, electromagnetic wave propagation, theoretical soil mechanics, nonlinear dynamics, ocean engineering, ocean subbottom resources, oceanography, acoustic determination of the properties of layered media, Cosserat fields, dislocation theories, hydrodynamic turbulence, random vibrations, and estuary modeling.

Transport Phenomena: Stephen S.T. Fan, chairperson

This area deals with the subjects of fluid mechanics, heat transfer, mass transfer, and coupled phenomena in such areas. In addition to their fundamental role in traditional engineering activities, transport-phenomena studies are making significant contributions in the areas of energy production and utilization, environmental control, oceanography, space exploration, and biomedical engineering.

Current research activities include solar energy, new energy sources, pollution control, biomedical engineering, combustion, adsorption, heat transfer with phase change, liquid pumping cavitation, vortex flow, coal gasification, particle formation, and polymer processing.

Requirements

Qualified students with bachelor's or master's degrees in engineering, mathematics, or the physical sciences are eligible for admission to the program. To be admitted, a student must present evidence that he/she has sufficient background in the area in which he/she proposes to specialize.

Following entrance into the program, a guidance committee will be appointed for the student by the dean of the Graduate School upon recommendation of the chairperson of the student's area. This committee will assist the student in outlining the program and in preparing for the qualifying examination and may require him/her to take specified course work, with or without credit. The committee will also conduct an annual in-depth review of the student's progress, through written and/or oral examinations, and following the substantial completion of the student's course work, will administer the qualifying examination. This committee is also responsible for administering any language examination and/or research tool proficiency requirements that are required of the area of specialization.

Upon the successful completion of the qualifying examination and other proficiency requirements, a doctoral committee will be appointed by the dean of the Graduate School upon the recommendation of the chairperson of the student's area. The doctoral committee shall conduct an annual review of the student's progress, supervise and approve the doctoral dissertation, and administer the final examination.

To obtain a Ph.D. degree in engineering, a student must meet all of the general requirements as stated under Regulations of the Graduate School. A student will normally be required to either demonstrate the ability to read scientific and technical literature in an approved foreign language or demonstrate a facility in one or more special "tool of research" techniques. The student, depending on his/her educational objectives, may also be required by the guidance committee to undertake a classroom teaching experience. To complete the Ph.D. degree in engineering a student will normally be expected to take course work equivalent to two full-time academic years beyond the baccalaureate and to complete a dissertation that will require at least one full-time year of study and original research. Specific course requirements have been established for each area of specialization. All these requirements should normally be completed by the end of the second year of full-time graduate study, and must be completed before the student can be advanced to candidacy.

Course Requirements

Course work requirements will be developed on an individual basis by each student's guidance committee. Since each area of specialization has its own specific course requirements, an interested student should contact the area chairperson to determine the particular course work and research activity that may be applicable to his/her educational goals.

Except for Doctoral Research (999), students will follow a program of study consisting of courses from within the chemical, civil, electrical, and mechanical engineering departments, many of which have been established particularly for this program, and from related departments appropriate to the student's needs. A student should consult the Course Descriptions section of this catalog for specific course offerings and descriptions.

999. DOCTORAL RESEARCH

English (Engl)

Chairperson: Donald M. Murray

PROFESSORS: Thomas A. Carnicelli, Carl Dawson, Robert Haggood, Edmund G. Miller, Donald M. Murray, Philip L. Nicoloff, John C. Richardson, Mark R. Smith, Thomas A. Williams, John A. Yount

ASSOCIATE PROFESSORS: S. Anthony Caldwell, Michael DePorte, Karl Diller, Lewis C. Goffe, Gary H. Lindberg, Terence P. Logan, Susan M. Schibanoff, Charles Simic, Theodore Weesner

VISITING ASSOCIATE PROFESSOR: Jean E. Kennard

ASSISTANT PROFESSORS: Lester A. Fisher, Elizabeth H. Hageman, Annette Kolodny, Andrew H. Merton, Hugh M. Potter III, David V. Siddall

The Department of English offers three advanced degrees, Master of Arts, Master of Science for Teachers, and Doctor of Philosophy. All applicants are required to submit Graduate Record Examination scores for the Aptitude Test and the Advanced Test of Literature in English. Applicants for the Ph.D. are normally expected to have a reading knowledge of at least one foreign language.

Master of Arts Programs

Master of Arts in Literature

The Master of Arts may be undertaken as a terminal degree or as preparation for a doctoral program. The program encourages students to pursue their individual interests and to correct deficiencies in their undergraduate training.

An M.A. candidate must pass eight four-credit courses. Six courses, including at least three seminars and either English 895 or 896, must be at the 800 level. At least four courses must be in English or American literature (as distinct from courses in critical analysis, linguistics, writing, teaching methods, or other literatures). Each M.A. candidate must pass at least one course in the English language or in the teaching of composition. As a general rule, all courses counting toward the M.A. degree should be taken in the English department. In special circumstances, however, a student may be allowed to apply toward the degree up to two graduate courses offered by other departments. For students planning a teaching career, the department requires at least one semester of teaching experience (subject to availability of funds).

An M.A. candidate must pass a reading examination in one of the following languages: French, German, Greek, Italian, Latin, Russian, Spanish. Each candidate for the M.A. degree must register for four credits of English 895 or 896 and produce a substantial scholarly paper.

Master of Arts in Writing

The Master of Arts in Writing is designed for students who intend to become professional writers. Seven working writers supervise the program. Students may elect to specialize in fiction, nonfiction, or poetry. Each member of the writing faculty is accomplished in at least one of these fields.

The writers at UNH emphasize conference teaching. Each student meets frequently with writers specializing in the student's area of study. In addition, each student works closely with a writer-adviser throughout the program.

Workshop courses provide forums for prompt, detailed criticism of each student's writing by instructors and fellow students. Each student takes at least two workshops in his or her speciality and may elect to take an additional workshop in another area as well. Form-and-theory courses and literature courses complete the program.

English

Upon completion of the required courses the student submits a portfolio of writing to the staff. The portfolio might consist of short stories, a novel, nonfiction articles, nonfiction book, or a collection of poetry. The degree is awarded upon approval of the portfolio by a committee of writers. There is no foreign language requirement.

Master of Arts in English Language and Linguistics

Students who wish to specialize in any of the various areas of English language and linguistics may design an M.A. program to meet their interests. The graduate committee of the department must approve all such program designs. Specialties include applied linguistics and the teaching of English as a second language as well as the traditional subfields of linguistics. Psycholinguistics is offered through the psychology department. Seven four-credit courses, including two seminars, must be completed, plus an independent study course leading to a scholarly paper. Reading knowledge of one foreign language is required.

Master of Arts With an Emphasis on Junior College Teaching

This is a special M.A. program designed for students committed to junior-college teaching. Regular graduate courses, specially designed seminars, and teaching internships are features of the program. A candidate must pass a reading examination in a foreign language or take a course in applied linguistics. Further details are available from the secretary for graduate programs, Department of English.

Master of Science For Teachers

The Master of Science for Teachers is designed for the high school teacher. No foreign language is required. The student must take eight courses in English, numbered 700 and above, which will not be a repetition of undergraduate work. Applicants should consult the General Regulations of the Graduate School for the special admissions requirements for this program.

Doctor of Philosophy

To be admitted to the Ph.D. program, the student must hold an M.A. degree or be in the final stage of completing requirements for the degree.

The Ph.D. program offers professional training in the teaching of literature and language. The program combines the essential guidance and discipline of course work with the equally essential freedom of independent study and research. Accordingly, in the first year the student is encouraged to follow a program suited to individual interests and needs. In addition to meeting course requirements, each student must pass: 1) reading examinations in two foreign languages (French, German, Greek, Italian, Latin, Russian, Spanish); 2) near the beginning of the work for the Ph.D. degree, a 90-minute oral general examination; and 3) a later written and oral qualifying examination in three areas related to

his/her proposed dissertation: an historical period, a genre or a related field, and a major author. A student must also write a dissertation and defend it at a final oral examination.

M.A. and Ph.D. students holding assistantships teach under supervision; such teaching is considered a vital part of the student's professional training. At least a year of intern teaching or its equivalent is required of all doctoral candidates.

Graduate students should note that not all seminars are offered every year. A detailed guide to the department's programs is available from the secretary for graduate programs, Department of English.

See English department brochure for detailed descriptions of current course offerings.

701-702/801-802. ADVANCED WRITING OF FICTION

Prereq: Engl 625-626 or its equivalent; permission of instructor. May be repeated for credit with the approval of the department chairperson. 4 cr.

703-704/803-804. ADVANCED NONFICTION WRITING

Prereq: permission of instructor. May be repeated for credit with the approval of the department chairperson. 4 cr.

705-706/805-806. ADVANCED WRITING OF POETRY

Prereq: Engl 627-628 or its equivalent; permission of instructor. May be repeated for credit with the approval of the department chairperson. 4 cr.

707/807. FORM AND THEORY OF FICTION

The problems, aims, and structures of fiction from the point of view of the writer. 4 cr.

708/808. FORM AND THEORY OF NONFICTION

Contemporary nonfiction from the point of view of the writer, emphasizing the choices the writer faced in the process of research and writing. 4 cr.

709/809. FORM AND THEORY OF POETRY

From the writer's point of view. Readings in major literary figures who have shaped American poetry in the twentieth century. 4 cr.

712. CRITICAL ANALYSIS OF EXPOSITION

For the English teaching major; students analyze essays and write nonfiction prose. Variety of critical approaches; several methods of teaching composition. 4 cr.

713,714/813,814. LITERARY CRITICISM

Major critics from Plato to the present and the chief critical approaches to literature. 4 cr.

715/815. APPLIED LINGUISTICS

Methods of teaching and learning foreign languages; background work on theories of language acquisition; the methodology of teaching English as a second language. Students interested in teaching other languages may do their projects on those languages. 4 cr.

716/816. PROBLEMS IN APPLIED LINGUISTICS

Variable topics course; problems such as language acquisition in children and adults, bilingualism, and linguistic field methods. 4 cr.

718/818. ENGLISH LINGUISTICS

Introduction to linguistics; transformational, generative grammar. 4 cr.

719. ENGLISH GRAMMAR

Traditional and contemporary approaches to the structure of English; morphology and syntax, parts of speech, phrases, clauses, sentences, punctuation, etymology. 4 cr.

720. NEWSPAPER INTERNSHIP

Students intending to pursue careers in journalism spend a semester working full-time for a daily newspaper under close supervision of editors. Reporting is stressed, but the student may do some editing as well. The number of internships is very limited. Prereq: Engl 621 or its equivalent; permission of instructor. Variable, max. 16 cr.

741/841. LITERATURE OF EARLY AMERICA

Prose and poetry of the periods of exploration, colonization, early nationalism, Puritanism, Enlightenment. Individual works and historical-cultural background. 4 cr.

742/842. AMERICAN LITERATURE, 1815-1865

Fiction, nonfiction, and poetry in the period of romanticism, transcendentalism, nationalism. Individual works and cultural background. 4 cr.

743/843. AMERICAN LITERATURE, 1865-1915

Fiction, nonfiction, and poetry in the period of realism, naturalism, industrialism, big money. Individual works and cultural background. 4 cr.

744/844. AMERICAN LITERATURE, 1915-1945

Fiction, poetry, and drama in the period of avant-garde and leftism, jazz age and depression. Individual works and cultural background. 4 cr.

745/845. CONTEMPORARY AMERICAN LITERATURE

A gathering of forms, figures, and movements since 1945. Individual works and cultural background. 4 cr.

746/846. STUDIES IN AMERICAN DRAMA

Topics vary from year to year. Examples: Twentieth-Century American Drama; Contemporary Playwrights; Theatricality in American Life. Not offered in 1977-78. 4 cr.

747/847. STUDIES IN AMERICAN POETRY

Topics vary from year to year. Examples: Poets of the Open Road; Pound and His Followers; Major American Poets; Contemporary American Poetry. 4 cr.

748/848. STUDIES IN AMERICAN FICTION

Topics vary from year to year. Examples: The Romance in America; The Short Story; Realism and Naturalism; The City Novel; Fiction of the Thirties. 4 cr.

749/849. MAJOR AMERICAN AUTHORS

Intensive study of two or three writers. Examples: Melville and Faulkner; Fuller, Emerson, and Thoreau; James and Wharton; Dickinson and Frost. 4 cr.

750/850. SPECIAL STUDIES IN AMERICAN LITERATURE

Topics vary from year to year. Examples: The Puritan Heritage; Ethnic Literatures in America; Landscape in American Literature; Five American Lives; Pragmatism; American Humor; Transcendentalism; Women Regionalists. 4 cr.

751. MEDIEVAL EPIC AND ROMANCE

Two major types of medieval narrative in translation; comparative study of works from England, France, Germany, and Iceland. *Beowulf*, *Song of Roland*, *Nibelungenlied*, *Gottfried's Tristan*, *Njal's Saga*, and Malory's *Morte d'Arthur*. 4 cr.

752/852. HISTORY OF THE ENGLISH LANGUAGE

The evolution of the English language and relation between linguistic change and literary style. 4 cr.

753/853. OLD ENGLISH

Introduction to Old English language and literature through readings of selected poetry and prose. 4 cr.

754/854. BEOWULF

A reading of the poem and an introduction to the scholarship. Prereq: Engl 753. 4 cr.

755,756/855,856. CHAUCER

755: Chaucer's allegorical poems and *Troilus and Criseyde*.
756: *The Canterbury Tales*. 4 cr.

English

757-758/857-858. SHAKESPEARE

757: Surveys of a number of representative plays. 758: Studies a few plays more intensively. 4 cr.

759/859. MILTON

Milton's life and times, all his poetry, and a selection of his prose. 4 cr.

763. CONTINENTAL BACKGROUNDS OF THE ENGLISH RENAISSANCE

Major philosophers, artists, and writers of the continental Renaissance (in translation); Petrarch, Ficino, Pico, Vives, Valla, Castiglione, Machiavelli, Luther, Calvin, Rabelais, Montaigne, Cervantes, Erasmus, and Thomas More, as representative of the early English Renaissance. 4 cr.

764. LITERATURE OF THE ELIZABETHANS

Shakespeare and his contemporaries. Spenser's *Fairie Queene*, Sidney's *Astrophil and Stella*, Shakespeare's *Sonnets*, Marlowe's *Dr. Faustus*: their literary and intellectual backgrounds. 4 cr.

767,768. LITERATURE OF THE RESTORATION AND EIGHTEENTH CENTURY

Texts studied closely; attention to how texts reflect the central intellectual problems of their age. 767: Dryden, Rochester, Restoration plays, Bunyan, Defoe, Montesquieu, and Swift. 768: Pope, Fielding, Johnson, Boswell, Voltaire, Sterne, Rousseau, Beckford, Diderot, and Blake. 4 cr.

769,770/869,870. THE ENGLISH ROMANTIC PERIOD

769: Wordsworth, Coleridge, Lamb, Hazlitt, DeQuincey. 770: Byron, Shelley, Keats. 4 cr.

771,772/871,872. VICTORIAN PROSE AND POETRY

771: Carlyle, Mill, Ruskin, Newman, Tennyson, and Browning. 772: Arnold, Clough, the pre-Raphaelites, Swinburne, Hopkins, Hardy, Housman, and others. 4 cr.

773,774/873,874. BRITISH LITERATURE OF THE 20th CENTURY

Conrad, Joyce, Yeats, Eliot, Woolf, Lawrence, Auden, and others. 4 cr.

775. IRISH LITERATURE

Historical survey. Works in Irish (read in translation) such as *The Cattle Paid of Cooley*, medieval lyrics, and *Mad Sweeney*. Works in English from Swift to the present. 20th century literary achievement: Joyce, Yeats, Synge, O'Casey, Beckett, and Flann O'Brien. 4 cr.

781. ENGLISH DRAMA TO 1800

Development from the Middle Ages through the 18th century, emphasizing the Elizabethan-Jacobean period and contemporaries of Shakespeare (eg. Marlowe, Jonson, Webster). Selected plays from the Middle Ages, Restoration, and 18th century. 4 cr.

782. MODERN DRAMA

Major English, American, and (translated) European plays by such playwrights as Shaw, Ibsen, Chekhov, Strindberg, Pirandello, O'Neill, Brecht, Beckett, Williams, Miller, Pinter. Live and filmed performances as available. 4 cr.

783/883. THE ENGLISH NOVEL OF THE 18th CENTURY

The rise and development of the novel through study of selected major works by Defoe, Richardson, Fielding, Smollett, Sterne, and Austen. 4 cr.

784/884. THE ENGLISH NOVEL OF THE 19th CENTURY

Representative novels from among Austen, Scott, Dickens, Thackeray, Emily Brontë, Charlotte Brontë, Trollope, George Eliot, Hardy, and Conrad. 4 cr.

785/885. MAJOR WOMEN WRITERS

Intensive study of several writers. Selections vary from year to year. Examples: Woolf and Lessing; Dickinson and Lowell; Charlotte and Emily Brontë; Atwood, Laurence and Oates. 4 cr.

791-792. ENGLISH EDUCATION — PROBLEMS IN THE TEACHING OF HIGH SCHOOL ENGLISH

Methods and techniques of teaching language and literature in grades 7-12. Required of all students in the English-teaching major. Open to English majors with permission of instructor. No credit toward the English major. 2 cr.

793/893. PHONETICS AND PHONOLOGY

Phonetics and phonology in the context of linguistic theory; comparisons of English to other languages. Prereq: a basic linguistics course or permission of the instructor. 4 cr.

794/894. SYNTAX AND SEMANTIC THEORY

Relation between grammar and meaning; special reference to poetic language. Prereq: Engl 718; Engl 752;/or permission. 4 cr.

795/796. INDEPENDENT STUDY

Open to highly qualified juniors and seniors both semesters. To be elected only with permission of the department chairperson and of the supervising faculty member or members. Barring duplication of subject, may be repeated for credit up to a maximum of 16 credits. 1-16 cr.

797,798/897,898. SPECIAL STUDIES IN LITERATURE

1) Old English Literature, 2) Medieval Literature, 3) The Renaissance, 4) The 17th Century, 5) The 18th Century, 6) The English Romantic Period, 7) The Victorian Period, 8) The 20th Century, 9) The Drama, 10) The Novel, 11) Poetry, 12) Nonfiction, 13) American Literature, 14) A Literary Problem. The precise topics and methods of each section will vary. Barring duplication of subject, may be repeated for credit. For details, see the course descriptions available in the English department. 4 cr.

817. SEMINAR IN TEACHING WRITING

Students are introduced to the writing process and experience the process themselves by writing and exploring methods of teaching writing. One three-hour meeting plus individual conferences each week. Permission of instructor required. 4 cr.

820. SEMINAR IN LINGUISTICS

4 cr.

821. SEMINAR — STUDIES IN OLD ENGLISH

4 cr.

824. SEMINAR — STUDIES IN MEDIEVAL LITERATURE

4 cr.

825. SEMINAR — STUDIES IN SIXTEENTH-CENTURY LITERATURE

4 cr.

827. SEMINAR — STUDIES IN SHAKESPEARE

4 cr.

828. SEMINAR — STUDIES IN MILTON

4 cr.

829. SEMINAR — STUDIES IN EARLY SEVENTEENTH-CENTURY LITERATURE

4 cr.

830. SEMINAR — STUDIES IN EIGHTEENTH-CENTURY LITERATURE

4 cr.

832. SEMINAR — STUDIES IN THE ROMANTIC PERIOD

4 cr.

833. SEMINAR — STUDIES IN THE VICTORIAN PERIOD

4 cr.

834. SEMINAR — STUDIES IN TWENTIETH-CENTURY BRITISH LITERATURE

4 cr.

837. SEMINAR — STUDIES IN AMERICAN LITERATURE OF THE NINETEENTH CENTURY

4 cr.

838. SEMINAR — STUDIES IN TWENTIETH-CENTURY AMERICAN LITERATURE

4 cr.

839. PROBLEMS IN TEACHING ENGLISH

An opportunity to explore special topics in teaching within the discipline of English at the graduate level. Inquire at the department to see what topics in the teaching of literature, language, or writing may be scheduled. Open only to graduate students with a professional interest in teaching or to practicing teachers. 1-6 credits depending on the specific course.

840. SEMINAR — STUDIES IN ENGLISH DRAMA

4 cr.

895,896. READING AND RESEARCH

Graduate Faculty. 4 or 8 cr.

899. MASTER'S THESIS

6 cr.

999. DOCTORAL RESEARCH

Entomology (Ento)

Chairperson: G. Thomas Fisher

PROFESSOR: Robert L. Blicke

ASSOCIATE PROFESSORS: James S. Bowman, G. Thomas Fisher, R. Marcel Reeves

ADJUNCT ASSISTANT PROFESSOR: Arthur H. Mason

For admission to graduate study in entomology an applicant is expected to have at least the basic (Entomology 402) course in entomology as well as adequate preparation in the allied sciences of chemistry, botany, and zoology. Students lacking the necessary background courses may be required to complete certain of these courses which do not carry credit before they are admitted to full candidacy for a degree.

Entomology

The program of graduate study is designed to meet the needs of those students planning to take further work leading to a career in professional entomology. Areas of specialization include taxonomy, ecology, ethology, biological control, pest management, chemical control, problems in medical entomology, forest entomology, and agricultural entomology. A thesis is required of all candidates for the master's degree. An oral examination on the thesis is required. Students are given the opportunity to assist the professional staff in field research and as laboratory assistants, and they are also encouraged to attend professional meetings in their appropriate fields.

No language requirements are made for the M.S. degree.

704. MEDICAL ENTOMOLOGY

Especially for students interested in public health or medicine. Insects and arachnids in relation to public health; the biology and control of important disease carriers. Elective for juniors and seniors. Lab. Mr. Blicke. 4 cr.

706. SOIL ARTHROPODS

Biology and systematics of terrestrial arthropods with emphasis on the springtails, sowbugs, myriapods, mites, spiders and other arachnids. Lab. Prereq: permission of instructor. Mr. Reeves. 4 cr.

707. TAXONOMY OF INSECTS

A study of the principles of systematics and/or a study of immature insects. Prereq: permission of instructor. Hours arr. Mr. Blicke. 4 cr.

708. INSECT MORPHOLOGY

The study of the external and internal anatomy of insects. Prereq: permission of instructor. Mr. Blicke. Hours arr. 4 cr.

709. AQUATIC INSECTS

Identification and biology of aquatic forms of insects. Prereq: permission of instructor. Hours arr. Mr. Blicke. 4 cr.

710. INSECT PHYSIOLOGY

An advanced study of the insect organs and their functions. Prereq: permission of instructor. Staff. 4 cr.

720. AGRICULTURAL ENTOMOLOGY

For advanced students interested in agribusiness. A survey of economic insect pests on forage, fruit, and vegetable crops. Life cycles, damage, and current methods of control are studied. Lab. Prereq: permission of instructor. Mr. Fisher. 4 cr.

721. PRINCIPLES OF BIOLOGICAL CONTROL

The natural and applied aspects of biological control of insect and plant pests. Prereq: permission of instructor. Mr. Reeves. (Not offered every year.) 4 cr.

722. CHEMICAL CONTROL OF INSECTS

For advanced students in applied entomology. A systematic review of the chemical groups utilized for insect control; studies in modes of pesticide entry and toxicology. Basic understanding of chemistry is desired. Prereq: permission of instructor. Mr. Fisher. 4 cr.

723. REGULATORY PEST CONTROL

For those students preparing for careers dealing directly with or associated with the movement of agricultural commodities in internal and foreign trade. Emphasis is placed on legal documents, federal and state statutes. Prereq: basic entomology and plant pathology courses; permission of instructor. Mr. Mason. 2 or 4 cr. (Alternate years; offered spring 1977.)

724. STRUCTURAL PEST CONTROL

For students wishing to study household and industrial entomology. Lab. Prereq: permission of instructor. Mr. Fisher. 4 cr.

801,802. GRADUATE ENTOMOLOGY

Concentrated studies in insect biology, systematics, and biological control or chemical control of insects. Mr. Blicke, Mr. Reeves, Mr. Fisher, and Mr. Bowman. Subject matter, hours, and credits to be arranged.

899. GRADUATE ENTOMOLOGY — MASTER'S THESIS

Mr. Blicke, Mr. Fisher, Mr. Reeves, and staff. Hours and credits to be arranged. 6-10 cr.

Genetics Program (Gen)

Chairperson: Owen M. Rogers

PROFESSORS: James P. Barrett; Walter M. Collins; Gerald M. Dunn; D. MacDonald Green; Harold W. Hocker, Jr.; Lincoln C. Peirce; Owen M. Rogers

ADJUNCT PROFESSOR: Ernest J. Schreiner

ASSOCIATE PROFESSORS: Thomas P. Fairchild; Frank K. Hoornebeek; Yun Tzu Kiang; J. Brent Loy; Edward R. Pierce; Willard E. Urban, Jr.; Robert M. Zsigray

ASSISTANT PROFESSOR: W.T. Adams

ADJUNCT ASSISTANT PROFESSOR: Peter W. Garrett

The interdepartmental Genetics Program offers graduate work leading to the degrees of Master of Science and Doctor of Philosophy.

A qualified student is admitted to the program with the approval of the genetics faculty and the chairperson of the department in which he/she has a major interest. Undergraduate preparation should include mathematics through calculus, chemistry through organic, physics, animal or plant biology courses and laboratories, and genetics with laboratory. Preparation in statistics and computer science is desirable. All students will be examined shortly after they arrive in order to diagnose their preparation in basic genetics. Students lacking the appropriate preparation may be admitted but will be required to complete certain courses without graduate credit.

The Aptitude section of the Graduate Record Examination is required.

The program is conducted by faculty members from animal sciences, biochemistry, the Institute of Natural and Environmental Resources, microbiology, plant science, the School of Health Studies, and zoology, as well as faculty from the Agricultural Experiment Station and the U.S. Forest Service, Northeastern Forest Experiment Station.

The core curriculum in genetics requires students in the Ph.D. program to take a minimum of one course from each of the following groups of courses: 1) Population Genetics—Introductory course, Genetics 705; 2) Molecular Genetics—Biochemical Genetics, Genetics 770; Microbial Genetics, Microbiology 804; Developmental Genetics, Plant Science 832; 3) Classical Genetics—Plant Genetics, Plant Science 851; Cytogenetics, Plant Science 853; Quantitative Genetics, Animal Science 811; Human Genetics, Zoology 707. In addition, all students are required to attend genetics seminars.

The requirements for the M.S. candidates will be a minimum of one course from each of any two of the above three groups of courses.

Master of Science Degree

The program for the Master of Science degree is formulated by the student with the approval of the guidance committee. Candidates for the degree will be required to complete a thesis, pass an oral examination covering graduate courses and thesis, and complete courses designated in the core curriculum.

Doctor of Philosophy Degree

The chairperson of the Genetics Program, with the concurrence of the chairperson of the department of major interest, will nominate the student's guidance and doctoral committees which will administer the qualifying and final examinations. Specific course requirements will be developed by the student and the guidance committee, and will include the courses in the core curriculum. Students must complete a dissertation on original research in genetics.

The guidance committee for each graduate student will determine whether a foreign language will be required.

705. POPULATION GENETICS

Population growth and regulation; distribution of genes; factors affecting gene frequency; genetic load; cost of natural selection; ecological genetics. Prereq: introductory genetics; introductory statistics;/or permission. (Not offered every year.) 4 cr.

706. GENETICS LABORATORY

Experiments and demonstrations in classical, developmental, and population genetics and cytogenetics, utilizing a wide range of organisms and techniques. Genetics faculty. Prerequisite or concurrent: Zoo 604, Principles of Genetics, or equivalent; permission of instructor. 2 cr.

740. EVOLUTIONARY BIOLOGY

The synthetic theory of evolutionary processes in the origin of life, species, and higher groups; sources of genetic variability, population structure, causes of evolution; ecological adaptations in animals, plants, and man; evolution of communities; molecular evolution and rate of evolution. Prereq: introductory genetics;/or permission. (Not offered every year.) 4 cr.

770. BIOCHEMICAL GENETICS

The biochemical mechanism of storage, replication, transmission, transcription, recombination, mutation, and expression of genetic information by cells and viruses. Prereq: Bchm 751 or permission. (Not offered every year.) 4 cr.

802. DESIGN OF EXPERIMENTS

The philosophy of experimental design and how it relates to standard statistical designs. Topics include the roles of replication and randomization, factorially arranged treatments, latin squares, incomplete nonfactorial designs, fractional replication and confounding, and crossover designs. Mr. Urban. Prereq: FoRs 711; Math 410, Digital Computer Systems;/or permission of instructor. (Not offered every year.) 3 cr.

812. ADVANCED STATISTICAL METHODS

Methods and techniques for handling typical problems which arise in the analysis of data. Topics include the multiple comparison of means, analysis of unweighted means, proportional subclass numbers, weighted squares of means, orthogonal polynomials, and least squares. Mr. Urban. Prereq: FoRs 711; Math 410, Digital Computer Systems;/or permission of instructor. (Not offered every year.) 3 cr.

Genetics

895-896. SPECIAL TOPICS IN GENETICS

Intended for study in specialty areas not ordinarily included in other courses. May involve formal classes, discussions, or independent investigations. Prereq: permission of staff concerned. 2-4 cr.

898. GENETICS SEMINAR

Presentation and discussion of selected genetic topics. Staff. 1 cr. May be repeated.

899. MASTER'S THESIS

6-10 cr.

999. DOCTORAL RESEARCH

Courses Available in the Cooperating Departments

These courses are fully described below and under the course descriptions of the appropriate department for the convenience of the student.

Animal Sciences

711. COMPARATIVE ANIMAL GENETICS

How heredity affects domestic animals, poultry, other mammals, and fish; emphasis on the organism and population. Quantitative inheritance, principles of selection, disease resistance also studied. Statistical and experimental techniques. Prereq: 4 cr. of genetics;/or permission. 4 cr.

812. QUANTITATIVE GENETICS AND SELECTION

Gene frequency, genetic and environmental variation, heritability, fitness, selection, inbreeding, outbreeding, and correlated characters. Mr. Collins. Prereq: one course each in genetics and statistics. (Not offered every year.) 3 cr.

Forest Resources

711. STATISTICAL METHODS II

Intermediate course in statistics; basic concepts of sampling, linear models and analyses for one-way and multiway classification, factorial arrangement of treatments, multiple regression, and covariance. Prereq: INER 528 or equivalent. 4 cr.

720. FOREST GENETICS

The genetics of forest tree improvement with emphasis on variation in natural populations, evolutionary principles and breeding methods. Prereq: PISc 604 (Zool 604); FoRs 629;/or permission. (Not offered every year.) 3 cr.

Microbiology

804. MICROBIAL GENETICS

Expression, regulation, recombination, and transmission of genetic information in procaryotic and eucaryotic microorganisms. Consideration of chromosomal and extrachromosomal inheritance. Prereq: Micr 503 or permission. (Not offered every year.) 4 cr.

Plant Science

732. PLANT DEVELOPMENTAL GENETICS

Gene action in relation to development in plants; isozymes and differentiation; chromosomal proteins and gene regulation; temporal specificity of gene action; nuclear-cytoplasmic interactions; chemical gradients and gene activation. Prereq: introductory genetics and physiology. (Not offered every year.) 4 cr.

773. METHODS AND THEORY OF PLANT BREEDING

Plant breeding systems for qualitative and quantitative plant improvement. Prereq: introductory genetics; introductory statistics;/or permission. Mr. Peirce. (Not offered every year.) 4 cr.

851. PLANT GENETICS

Linkage, euploidy, aneuploidy, cytoplasmic inheritance, mutation, and genetics of disease resistance. Mr. Dunn. Prereq: Genetics. (Not offered every year.) 3 cr.

853. CYTOGENETICS

Chromosome aberrations and their behavior. Effect of radiation on chromosomes. Mapping and laboratory techniques in cytogenetic analysis. Prereq: Genetics; Cytology. (Not offered every year.) 3 cr.

Zoology

707. HUMAN GENETICS

Inheritance patterns, gene and chromosome mutation rates and effects, linkage, and gene frequency. Prereq: Zool 604 or equivalent or permission of instructor. 4 cr.

History (Hist)

Chairperson: Robert M. Mennel

PROFESSORS: Charles E. Clark, Hans Heilbronner, Charles A. Jellison, William R. Jones, David F. Long, Darrett B. Rutman, Cecil J. Schneer, Douglas L. Wheeler, Donald J. Wilcox

ASSOCIATE PROFESSORS: Robert C. Gilmore, Marion E. James, Allen B. Linden, Frank D. McCann, Robert M. Mennel, Marc L. Schwarz, John O. Voll

ASSISTANT PROFESSORS: Jeffry Diefendorf, Judith A. Silver, Harvard Sitkoff

DIRECTOR OF GRADUATE STUDIES: Donald J. Wilcox

Admission

The department usually requires completion on an undergraduate level of eight semester courses in history together with some preparation in other areas of the humanities and social sciences.

Applicants for admission to any graduate program in history should have a minimum of B+ average in history and allied humanities and social sciences. In addition applicants must submit Aptitude (verbal and quantitative) and Advanced History scores on the Graduate Record Examinations. The department assesses the student's entire application, including letters of recommendation, in making its decision on admission. Deficiencies in an undergraduate program may be rectified by course work as a special student but such course work cannot be used to satisfy requirements for an advanced degree. The department also recommends that a beginning graduate student have some training in a foreign language. It should be noted that students who expect to participate in seminar or reading courses in other than American history are usually required to have a reading knowledge of at least one foreign language appropriate to the particular course. Applicants intending the Ph.D. degree should include with their applications a personal statement indicating their reason for and intentions in undertaking graduate study at the University of New Hampshire.

All graduate students are reviewed annually by the faculty of the department. A student accumulating two course failures is automatically barred from continuing in any degree program in history, but the department reserves the right to exclude others whose overall performance does not give reasonable assurance of a successful program completion. Students are allowed no more than three attempts to meet any language requirements.

Degree Programs

The department offers the Master of Arts and Doctor of Philosophy degrees. The general degree requirements are outlined below, but specific programs are tailored to the goals of the student. The director of graduate studies of the department serves as the initial adviser to entering graduate students, the adviser-of-record to all students throughout their years of graduate study, and, with the Graduate Committee of the department, has general supervision of all student programs. By the beginning of a student's second semester in residence, the student intending a degree will ordinarily have selected a single member of the faculty as the program chairperson and, with that faculty member as principal adviser, will have worked out a specific program of studies leading toward a degree.

The director of graduate studies must approve the registration of special students and students from other departments in graduate history courses. The department welcomes the opportunity to work with students from other departments.

Master of Arts

The student intending the M.A. degree has the option of designing a specific program to meet either of two sets of requirements; the first allows substantial training and research in a single subfield of history but within a foundation of broader coursework; the second allows substantial breadth over at least two subfields. The subfields in history are as follows: The Ancient World; Medieval Europe; Early Modern Europe; Modern Europe; European Intellectual History; Medieval England; Early Modern England; Modern England; Iberian History; Russia; Early American History; Modern American History; Colonial Latin America; Modern Latin America; The Far East; The Near East; Sub-Saharan Africa; and the History of Science.

Completion of the degree under either set of requirements normally requires between three and four semesters of full-time study (three to four courses per semester). Either option may prepare a student for entrance to the Ph.D. program. Option B is particularly recommended for practicing teachers.

Option A: The student shall complete successfully at least eight courses in history numbered above 700, of which a minimum of four shall be numbered between 800 and 898 (seminar and directed readings). In addition, the student shall prepare within the context of any single subfield a thesis meriting the unanimous approval of a thesis committee consisting of the student's program chairperson, under whose direction the thesis shall be prepared, and two other members of the graduate faculty (at least one of them in history). The preparation of the thesis is considered to be the equivalent of two additional semester courses each bearing the designation History 899 for the purpose of meeting the general regulations of the Graduate School.

History

Option B: The student shall complete successfully at least ten courses in history numbered above 700 of which a minimum of four shall be numbered between 800 and 898. Following completion of course work, or during the final semester of course work, the student shall demonstrate a broad competence in two subfields of history ordinarily in oral examination before a committee of three consisting of the student's program chairperson and two other members of the faculty in history. Students proceeding under Option B shall have stood examination no less than three weeks prior to the Commencement at which the degree is to be granted.

Students should note that Option A thesis readings and Option B examinations are available during the summer, only with the consent of all faculty involved.

Doctor of Philosophy

The department offers work leading toward the degree of Doctor of Philosophy with a concentration in either of the two subfields of American history, but with particular stress on Early American history. The degree requires more than formal course work; it is awarded in recognition of high attainment and ability in history as shown by performance in qualifying examinations and by preparation and defense of a dissertation. Normally an entering student intending to be a candidate for the doctorate will complete an M.A. program as a prerequisite. Students with the M.A. from another institution, however, can begin the doctoral program immediately, and a student in residence can, with the consent of the department, omit the M.A. and proceed directly toward the Ph.D.

The doctoral student's cardinal intellectual relationship is with that member of the faculty under whom he/she will write the dissertation and who serves as the student's program chairperson. This relationship should be established early and a broad program supportive of the intended area of dissertation research worked out in consultation with the program chairperson. The program, which must be approved by the Graduate Committee of the department, shall involve each of the following:

1) Two required research seminars in American history, one in early America and one in modern America.

The history department offers these required research seminars in the first semester of each year, alternating between the two fields. Each entering student, with or without the M.A., should take one in each of his first two years in the program. Other seminars and reading courses at the 800 level will also form part of the program drawn up in consultation with the student's program chairperson.

2) Required courses in historiography and historical methods. The history department will offer one of these courses in the second semester of each year, alternating between the historiography course and the historical methods course. Each entering student, with or without the M.A., should take one in each of the first two years in the program.

N.B. No student will be considered to be intending to pursue a Ph.D. program who is not in the process of satisfying these requirements. Only students who are intending to pursue the Ph.D. are considered for graduate assistantships.

3) Two languages or one language and a special research technique, whichever is deemed most relevant to the area of research.

4) The entirety of American history, with accent upon either of the subfields of early or modern America, and two subfields outside of American history.

5) A cognate field outside of history entirely or a subfield of nonwestern history.

The student's preparation for the qualifying examinations will be guided by representatives of each subfield or cognate field in his program. These representatives will make up the student's guidance and, subsequently, examining and dissertation committees. The student will normally not take the qualifying examination until he/she has completed sixteen semester courses or more (including work undertaken in a master's program). This requires three years of study beyond the bachelor's degree, the greater portion of which is ordinarily accomplished in full residence. The student should bear in mind, however, that qualifying examinations will test a mastery of broad subfields of historical knowledge rather than of particular courses. The student is, therefore, expected to read widely and independently in order to expand his/her knowledge beyond formal coursework and to become acquainted with aspects of the subfields not covered in that course work.

Normally there will be eight steps in attaining the degree. The student is expected to be registered in the University for all regular academic semesters during his progress:

1) Satisfaction of historiography, historical methods, and research seminar requirements.

2) Correction of any deficiencies in the student's previous program; for example, lack of a first language.

3) The demonstration of proficiency in a second language or a special research technique. (Departmental regulations regarding the latter are available from the director of graduate studies.)

4) Successful performance in a two-part qualifying examination: the first part, a four-hour written examination covering breadth of knowledge in the subfield of specialization (early or modern American history); the second part, oral and covering all subfields and (if any) the cognate field specified in the program.

5) Within the same semester as Step Three, admission to candidacy and the approval by the candidate's dissertation committee of the specified topic and research plan for the dissertation.

6) Submission of an acceptable dissertation no more than three years after the admission to candidacy.

7) Successful public defense of the dissertation before the dissertation committee.

Apprenticeship

The department considers that graduate work in history, and particularly doctoral work, is professional training. All entering graduate students intending a Ph.D. are, consequently, required (and all others are urged) to participate on a continuing basis in History 801, Proseminar: History as a Profession. Moreover, the department recognizes the dual concerns of the historian's life — teaching and research; when feasible, therefore, all doctoral students are expected to undertake teaching in the department during a part of their residence. Participation in proseminar and in teaching constitutes an apprenticeship in conjunction with formal study.

Courses

703. THE COLONIAL PERIOD OF AMERICAN HISTORY

Interpretative and methodological approach to the development of an Anglo-American culture along the eastern seaboard of North America 1600-1750. 4 cr.

705,706. AMERICA IN THE 18th CENTURY AND THE REVOLUTION

American colonial and revolutionary history from 1740 through the adoption of the Constitution and the establishment of Washington's first administration. 4 cr.

711,712. 19th CENTURY AMERICA

Domestic and international factors in the development of the American Republic, its institutions and people, from the inception of the new nation in 1789 to the emergence of the United States as a world power in 1900. 4 cr.

715,716. 20th CENTURY AMERICA

The United States after 1900, with emphasis on the cultural, political, and social factors causing major changes in American life. First semester: Progressivism through the New Deal. Second Semester: World War II to the present. 4 cr.

719,720. THE FOREIGN RELATIONS OF THE UNITED STATES

Primarily the history of American diplomacy, with attention given to the nondiplomatic aspects. First semester: American Revolution to 1890; second: 1890 to date. 4 cr.

721,722. HISTORY OF AMERICAN THOUGHT

Significant American thinkers considered in their social context. First semester: 1600 to 1860. Second semester: 1860 to the present. (Not offered every year.) 4 cr.

724. AMERICAN URBAN HISTORY

The urbanization process from the colonial period to the present. 4 cr.

731. LATIN AMERICAN HISTORY: REGIONAL OR COUNTRY STUDIES

Seminar; readings and discussions of literature relative to region or country being studied. See department listing for the current semester's topic. Students will be guided through preparation of a research proposal. Hist 531-532 is recommended but not required. 4 cr.

732. LATIN AMERICAN HISTORY: TOPICAL STUDIES

Thematic seminar; readings and discussions of literature relative to topic selected. See the department listing for the current semester. Students will be guided through preparation of a research proposal. Hist 531-532 is recommended but not required. 4 cr.

739,740. THREE MEDIEVAL CIVILIZATIONS

The demise of classical antiquity in the lands bordering the Mediterranean and the genesis and fruition of three new cultural traditions: Latin Christian, Islamic, and Byzantine. Religious, literary, and scholarly survivals and innovations from 400 A.D. to 1400 A.D. 4 cr.

741. THE AGE OF THE RENAISSANCE

The Renaissance from 1300 to 1600 stressing intellectual and cultural history and concentrating on events in Italy. 4 cr.

742. THE AGE OF REFORMATION

Northern Europe from 1300 to 1600, stressing the intellectual and cultural aspects of the European Reformation. Concentrates on the 16th century but important trends in the 14th and 15th centuries will be given considerable attention. 4 cr.

747. FRANCE FROM LOUIS XIV TO THE FRENCH REVOLUTION

The pressures and influences which led to the French Revolution. 4 cr.

748. 19th CENTURY EUROPE

The impact of the Industrial Revolution and the French Revolution on the workers, peasants, middle class, and women of England, France, and Germany. 4 cr.

751,752. EUROPEAN INTELLECTUAL HISTORY

The European intellectual tradition from the Greek philosophers to the end of World War II. How basic ideas have developed out of previous modes of thought in response to new challenges. (Not offered every year.) 4 cr.

History

756. 20th CENTURY EUROPE

World War I, European totalitarianisms, World War II, the loss of European primacy, and the search for a new Europe. 4 cr.

759. HISTORY OF MODERN SPAIN AND PORTUGAL

The Iberian states and their peoples from the coming of liberalism to the present. Failure of Iberian liberalism and liberal government. Political and social change, imperial and intellectual movements, influences of Western European thought and activity. 4 cr.

761,762. ENGLAND IN THE TUDOR AND STUART PERIODS

The political, religious, socio-economic, and intellectual forces for change at work in England from the accession of Henry VII to the Revolution of 1688-89. 4 cr.

763. RUSSIA: ORIGINS TO MODERNIZATION

Russia from its foundation to Emancipation and Reform. Political developments, foreign relations, intellectual and ideological currents. 4 cr.

764. RUSSIA: FROM TSARIST TO SOVIET EMPIRE

The costs of modernization; Leninist and Stalinist revolutions; Soviet consolidation. 4 cr.

767. EARLY MODERN GERMANY: REFORMATION TO THE REVOLUTION OF 1848.

Conflict between Holy Roman Empire and petty states; rise of Prussia; religious conflict and Enlightenment. 4 cr.

768. MODERN GERMANY SINCE 1848

Bismarck and Imperial Germany; Weimar and the rise of Hitler; post-World War II divided Germany. 4 cr.

774. HISTORIOGRAPHY

Analysis of ancient and modern historians. Required of all entering Ph.D. candidates, open to undergraduates with permission of the instructor. (Not offered every year.) 4 cr.

775. HISTORICAL METHODS

An introduction to contemporary historical methods. Required of all entering Ph.D. candidates, open to undergraduates with permission of instructor. (Not offered every year.) 4 cr.

777,778. THE HELLENISTIC-ROMAN WORLD

The Mediterranean and the Near East from the death of Alexander the Great to the collapse of the Roman and Persian Empires (5th to 7th centuries A.D.). Covers the main political and social developments of the area, but stresses artistic, scientific, philosophical, and religious trends, with particular emphasis on the rise of Christianity, Zoroas-

trianism, and the general religious climate that prepared the way for Islam. 4 cr.

781. HISTORY OF MODERN CHINA, 1839-PRESENT

The modernization of China. The political, social, and cultural changes which have occurred in China from its early contacts with the West. 4 cr.

784. HISTORY OF SOUTHERN AFRICA SINCE 1820

The struggle for political and economic control in the only region of Africa where European groups remain in power. The impact of European imperialism, European settler nationalism, racial conflict, economic competition and industrialization, apartheid, and assimilation with special attention to the development of European hegemony. Official American policy. 4 cr.

785. THE MODERN MIDDLE EAST

From the 18th century to the present time. The problems created by modernization and reform of the traditional society, the conservative reaction to reform, the impact of nationalism, and the appearance of new ideologies. 4 cr.

787. BLACK CONSCIOUSNESS AND PROTEST

Origins and causes of the rising consciousness and consequent activism of the peoples of Negro descent in the New World and in Africa from the early nineteenth century to the present. Protest literature, black nationalism, Pan-Negroism, Pan-Africanism, negritude, the Nation of Islam, and separatist religious sects in the Americas and Africa. Crosscultural and multidisciplinary. 4 cr.

789. SEMINAR IN THE HISTORY OF SCIENCE

Selected topics conducted through special lectures, individual study, oral and written reports. Subject varies. Cannot be used for credit in history without permission of the department. Prereq: permission of adviser and instructor. 4 cr.

790. QUANTIFICATION AND COMPUTERS FOR THE HISTORIAN

The historian's use of computers and statistics; practical applications of both interactive terminal operations and batch processing. Data generation and processing, computer languages (BASIC, FORTRAN), programming and library programs, elementary statistics; students will undertake operations of their own on material supplied and will consider particular quantitative studies in history in terms of techniques used. No previous knowledge of computers or college mathematics required. Prereq: admission as an undergraduate major or graduate student in history, or permission of instructor. 4 cr.

793. ADVANCED WORLD HISTORY

History from the perspective of the experience of the whole human community. The histories of separate areas in terms of their relationship to the general historical experience of man. Problems of interpretation, interrelationships, similarities, and differences in the development of the major traditions of civilization. Oral and written reports. 4 cr.

797. COLLOQUIA IN HISTORY

Selected topics in American, European, and non-Western history. Open to advanced undergraduate and graduate students. Prereq: permission of instructor. Depending on the particular subject, may be used to satisfy the major requirements in American, European, or non-Western history. 4 cr.

Graduate Readings and Seminars

Note that in any given semester any number of sections of a general seminar course (819 through 860) may be offered, the content and direction of a specific section depending upon the research interests of the faculty member directing the section. General seminar and reading courses, and particular sections, can be repeated as the section content changes. A full description of the current direction and content of each section offered in a given semester is available shortly before the semester from the department's director of graduate studies.

801. PROSEMINAR: HISTORY AS A PROFESSION

Entering graduate students intending the doctorate and all advanced graduate students serving as research, program, or teaching assistants in the department meet periodically to discuss the obligations and mechanics of the historian's profession, including teaching, scholarship, university and college structures, and the role of the faculty therein. No cr.

819,820. SEMINAR IN EARLY AMERICAN HISTORY

1) Mr. Clark (social and cultural), 2) Mr. Gilmore (Revolution), 3) Mr. Rutman (Anglo-American society). Prereq: permission of instructor. 3 cr.

823,824. SEMINAR IN AMERICAN NATIONAL HISTORY

1) (Afro-American), 2) (twentieth century), 3) Mr. Jellison (nineteenth century and biography), 4) Mr. Mennel (social), 5) Mr. Long (foreign relations). Prereq: permission of instructor. 3 cr.

836. SEMINAR IN LATIN AMERICAN HISTORY

Topics will vary and will include: conservatism and conformity in Latin America; the Portuguese Empire; Brazil and Africa; the Mexican Revolution; nationalism and neocolonial Latin America; Brazil: empire

and republic; and slavery in the Americas: a comparison. Mr. McCann. 3 cr.

843,844. SEMINAR/READINGS IN EUROPEAN HISTORY

1) Mr. Heilbronner (modern Russia). 2) Mr. Jones (Medieval). 3) Ms. Silver (France and European social history). 4) Mr. Wheeler (Spain and Portugal). 5) Mr. Wilcox (Renaissance). 3 cr.

859,860. SEMINAR IN ENGLISH HISTORY

1) Mr. Schwarz (Tudor-Stuart). Prereq: permission of instructor. 3 cr.

888. PROBLEMS IN MODERN AFRICAN HISTORY

Topics will vary each year the seminar is offered. Emphasis will be on Africa South of the Sahara in the colonial and postcolonial eras. Among the topics will be: African resistance movements in precolonial and colonial Africa; African nationalism; problems of the independent African states; the role of the military in postcolonial Africa; and issues in Portuguese African history. Students will write research papers and give oral presentations. Mr. Wheeler. 3 cr.

895,896. TUTORIAL READING AND RESEARCH IN HISTORY

1) Early American History, 2) American National History, 3) Canada, 4) Latin America, 5) Medieval History, 6) Early Modern Europe, 7) Modern European History, 8) Ancient History, 9) Far East and India, 10) Near East and Africa, 11) European Historiography, 12) American Historiography, 13) Russia, 14) World History, 15) English History, 16) Historical Methodology. Staff. Prereq: permission of instructor. 3 cr.

899. MASTER'S THESIS

999. DOCTORAL RESEARCH

Home Economics (HEc)

Chairperson: Elizabeth Snell

ASSOCIATE PROFESSORS: Mary E. Holder, Victor R. Messier, Elizabeth A. Snell

ASSISTANT PROFESSORS: Larry J. Hansen, Sharon F. Young

The department offers graduate work leading to a Master of Science degree in home economics, with the major emphasis in areas which strengthen professional competence in family, community, and educational services. Each student's program will be planned to achieve professional objectives based on specific interests, ability, and undergraduate preparation.

Home Economics

Admission: Students admitted to the graduate program in home economics are expected to have an undergraduate degree in home economics or a related field. If there are deficiencies in the undergraduate program, students may be admitted on condition that they complete specified prerequisites which will not be counted toward the degree. Students seeking admission must submit recent scores from the Miller's Analogies Test or the Aptitude section of the Graduate Record Examination.

Requirements: A candidate for a Master of Science in home economics is expected to fulfill the general requirements of the Graduate School and the following departmental requirements:

(1) A minimum of 22 semester credits in home economics courses including Research Seminar, HEc 897; and Research Project, HEc 898, or Thesis, HEc 899.

(2) A maximum of 8 semester credits selected from the liberal arts or other areas which support the major may be applied toward the degree.

(3) Before the 2nd semester of graduate study the student will have planned a program of studies with the approval of his/her advisory committee.

(4) A final oral and/or written examination.

707. PRACTICUM IN HOME ECONOMICS

Supervised in-depth experience with observation and participation to increase the student's understanding in a specific area of home economics. Choice of practicum from areas of: (1) child; (2) family; (3) consumer; (4) food and nutrition studies. Prereq: HEc major; permission. 4 cr.

709. BIOCHEMISTRY OF NUTRITION

Intermediary metabolism of nutrients and energy; metabolism transport mechanisms; biological oxidations; interrelationships of carbohydrate, fat, and protein metabolism; obesity; control of hunger and appetite. Prereq: college course in biochemistry. (Also offered as AnSc 709.) 4 cr.

715. CLOTHING IN RELATION TO HUMAN BEHAVIOR

Research and theory in the social psychological aspects of clothing; clothing behavior of individuals and groups; stages of the life cycle, development of the self, and the phenomenon of fashion. 4 cr.

725. PRESCHOOL PROGRAMS

Organization of time, space, materials, and people for the purpose of attaining goals in preschool education. Historical and current programs will be studied. Prereq: HEc 627 or permission of instructor. 4 cr.

727. STUDENT TEACHING IN PRESCHOOL

Supervised teaching experience in a preschool setting. Students will spend five half days a week in a selected preschool working with a cooperating teacher. A weekly seminar will also be held on campus. Prereq: HEc major — HEc 525, 527, 626, 627; and permission of instructor. 6 cr.

754. PERSONAL AND FAMILY FINANCE

Financial alternatives available to individuals and families during stages of the family life cycle. 4 cr.

757. CONSUMER PROBLEMS

Consumer problems analyzed from the perspective of family, business, and government interests. Prereq: 8 cr. in consumer studies; permission of instructor. 4 cr.

774. CLINICAL DIETETICS

Principles of normal nutrition applied to clinical problems; altered nutrient requirements in human disease. Diet therapy as applied to clinical nutrition. Lab. Prereq: HEc 573; HEc 506; a college course in biochemistry; permission of instructor. 4 cr.

776. CONTEMPORARY ISSUES IN NUTRITION

Focus on national and worldwide nutrition concerns. Approaches and materials used in nutrition education. Prereq: HEc 506, 573, or 575; permission of instructor. 4 cr.

786. DYNAMICS OF FAMILY CHANGE

Theories and research for the assessment of family interaction patterns; planned intervention techniques. Students examine their interaction processes and their possible effect on intervention efforts. Prereq: HEc 683; Psyc 561. 4 cr.

791. METHODS OF TEACHING HOME ECONOMICS

Home economics in the school program; curriculum materials, methods, and resources in teaching. 4 cr.

793. FAMILY LIFE EDUCATION

A critical review of current issues and literature; materials and methods for programs such as sex education and parent education. Prereq: Biol 409; HEc 683; permission of instructor. 4 cr.

893. PARENTS AND CHILDREN

An in-depth study of the reciprocal relationships among parents and children. Evaluation of service programs in terms of current research. Prereq: HEc 626, 683, or permission of instructor. 4 cr.

Institute of Natural and Environmental Resources

895. SEMINAR AND SPECIAL PROBLEMS

The seminars are open to graduate students with sufficient background for in-depth study in any of the following areas: 1) clothing and textiles, 2) consumer education, 3) family relations, 4) food and nutrition, 5) home economics education, 6) management and family finance, and 7) human development. The student will contribute to a selective review and critical evaluation of the research and current literature and an examination of issues and trends. Independent projects may be a part of the experience. These seminars will not be scheduled every semester. One or more semesters, maximum of 4 credits in one area. 2 to 4 cr.

897. RESEARCH SEMINAR

Survey, evaluation, and use of research in the field of home economics. An introduction to methods and techniques used in defining a problem for study, collecting data, analyzing, and writing a report. 2 cr.

898. RESEARCH PROJECT

A study or project which may be selected in lieu of a thesis. To be taken concurrently with or following HEc 897. 2-4 cr.

899. THESIS

6 cr.

Institute of Natural and Environmental Resources

Director: David P. Olson

Chairperson of Graduate Studies: Robert D. Harter

PROFESSORS: Richard A. Andrews, James P. Barrett, Paul E. Bruns, Gordon L. Byers, William H. Drew, Owen B. Durgin, Bennett Foster, Francis R. Hall, William F. Henry, John L. Hill, Harold W. Hocker, Jr., Allan B. Prince

ADJUNCT PROFESSORS: George E. Frick, Nelson L. LeRay, Douglas E. Morris

ASSOCIATE PROFESSORS: Robert D. Harter, Edmund F. Jansen, Jr., William W. Mautz, David P. Olson, Nobel K. Peterson, R. Marcel Reeves, Oliver P. Wallace, Sr., Richard R. Weyrick

ADJUNCT ASSOCIATE PROFESSORS: C. Anthony Federer, William B. Leak, Robert S. Pierce

ASSISTANT PROFESSORS: W. Thomas Adams, John E. Carroll, S. Lawrence Dingman, Bruce Lindsay, Frederick Lindzey

ADJUNCT ASSISTANT PROFESSOR: Peter W. Garrett

Master of Science, Natural and Environmental Resources

A single master's degree is offered by the institute with six specific options:

Forest Resources

Forest resource management; forest recreation; forest marketing; wood industry management; forest mensuration; forest tree improvement; and wood science and technology.

Hydrology

Hydrochemistry; ground water hydrology; evapotranspiration; and water conservation.

Resource Economics

Agricultural economics; community development; regional economics; land and water economics; rural manpower; and marine economics.

Soil Science

Soil chemistry; soil classification and genesis; soil-plant relationships; and soil conservation.

Resource Administration and Management

Management of publicly and privately owned natural resources; administration of natural resource laws and policies; management of natural resource based firms.

Wildlife Ecology

Habitat evaluation and management; wildlife nutrition and physiology; and land-use planning for wildlife.

Entrance Requirements

Students admitted to institute programs in these options are expected to have completed either an undergraduate degree in the field in which they plan to specialize or show adequate preparation in the basic support courses of the field. Students with good undergraduate records who lack a background in a particular field may be admitted to a program, provided they are prepared to correct the deficiencies. The Graduate Record Examination is required of all applicants.

Students entering the forest resources option are usually expected to have completed a bachelor's degree in forestry equivalent to that obtained at a school accredited by the Society of American Foresters. Students planning for the resource economics option will need satisfactory undergraduate training that includes four or more courses in economics or resource economics. Entering students in hydrology and soil science are required to have adequate preparation in chemistry, physics,

Institute of Natural and Environmental Resources

mathematics, and the biological or earth sciences. Students interested in wildlife ecology are expected to have adequate preparation in biological sciences, chemistry, and mathematics including statistics. Students interested in resource administration and management are expected to have had a minimum of 3 courses in the areas of ecology or natural resources, and resource economics, or be expected to make up this deficiency.

Academic Requirements

The M.S. degree is conferred upon successful completion of the following:

1) A program amounting to not less than 30 credits, including the following course requirements or equivalent: INER 897-898 seminar, 2 credits; INER 803, Approach to Research, 2 credits; quantitative methods or analytical techniques; and directed research, 4-10 credits.

2) A final oral and/or written examination.

Intercollege Cooperative Programs

The institute participates in four doctoral degree programs on a cooperative basis with other departments in the University. The Department of Chemistry offers a soil and water chemistry option in its Ph.D. program, which is coordinated through joint efforts of the soils and hydrology faculty and the chemistry faculty (see Interdisciplinary Options and Programs). A Ph.D. program in genetics is available to students in forest resources through the Genetics Program (see Genetics Program). Students can earn a Ph.D. in economics in the cooperative program with resource economics and the Whittemore School of Business and Economics (see Economics). Through informal cooperative arrangements with the electrical engineering and mechanical engineering departments, opportunities are available for graduate study in wood science and technology in the College of Engineering and Physical Sciences, leading to either the master's degree in electrical engineering or mechanical engineering or the Ph.D. degree in engineering. (See Engineering Ph.D. Program: Theoretical and Applied Mechanics or Signal Processing.)

Natural and Environmental Resources (INER)

701. STATISTICAL METHODS I

Analysis of variance and general linear models; measured numbers, the nature of statistical evidence, sampling distributions, and principles of statistical inference; application of specific linear models to given sets of data. Prereq: upper-division undergraduate or graduate standing. Mr. Durgin. 4 cr.

702. NATURAL RESOURCES POLICY

Contemporary issues in the management and allocation of natural resources; impact of man on agricultural and forest lands, water, wildlife, fisheries, and minerals; historical perspective of current resource policies. Prereq: permission. Mr. Bruns. 4 cr.

709. SOILS AND COMMUNITY PLANNING

Using a town plan and soils map, students develop reports for multiple urban and rural land-use — housing, etc. USDA soil classification system; Soil Conservation Service rating criteria; N.H. soils. Guest lecturers. Prereq: permission. Mr. Peterson. 2 cr.

711. STATISTICAL METHODS II

Intermediate course in statistics; basic concepts of sampling, linear models, and analyses for one-way and multiway classification, factorial arrangements of treatments, multiple regression, and covariance. Prereq: Applied Statistics I or equivalent. Mr. Barrett. 4 cr.

712. SAMPLING TECHNIQUES

The techniques of sampling finite populations in environmental sciences; choice of sampling unit and frame, estimation of sample size, confidence limits, and comparisons of sample designs. Computer programs used in analyzing data. Examples taken from the environmental sciences. Prereq: Applied Statistics I or equivalent. Mr. Barrett. 2-4 cr.

714. QUANTITATIVE ECOLOGY

Applied quantitative techniques: basic concepts in probability and statistics applied to ecological systems, population dynamics, spatial patterns, species and abundance and diversity, classification and ordination, production, and energy and nutrient flow. Additional credit for in-depth mathematical analysis of a particular topic. Prereq: introductory calculus, statistics, and ecology. Mr. Barrett. 3 or 4 cr.

718. LAW OF NATURAL RESOURCES AND ENVIRONMENT

For resource managers: the legal system pertaining to resource management, protection of the environment, and possibilities for future action. Prereq: Contemporary Conservation Issues or Land Economics and Use;/or permission. Mr. Tucker. 3 cr.

735. POLLUTION OF WATER: CAUSES AND CONTROL

Problems in environmental pollution; scientific and technological aspects of pollution and pollution control; sources, effects, and control of water pollution, and its social, economic, and legal implications. Prereq: senior or graduate standing. Mr. Harter. (Not offered in 1977-78.) 4 cr.

Institute of Natural and Environmental Resources

757. BASICS OF REMOTE SENSING

Application of photographic and nonphotographic sensors to information gathering in natural resource fields; interpretation of aerial photographs. Applications to forestry, wildlife, land-use planning, earth sciences, soils, hydrology, and engineering. Mr. Bruns. Lab. 2 cr.

758. APPLICATIONS OF REMOTE SENSING

Student project is developed using available conventional aerial photography or other imagery. Transportation fee. Prereq: Basic Remote Sensing; permission. Mr. Bruns. Lab. 2 cr.

797. FOREST RECREATION SEMINAR

Recreational use of nonurban lands; economics of public and private developments; planning for state and private recreational use, social aspects. Class project. Prereq: junior standing; permission. Mr. Wallace. 4 cr.

803. APPROACH TO RESEARCH

The meaning of science and the application of logic in the scientific method. Principles and techniques of scientific research. Survey of experimental design procedures. Organization of investigative work, problem analyses, working plans, and scientific writing. Staff. Prereq: permission. 2 cr.

811. NATURAL AND ENVIRONMENTAL RESOURCE MANAGEMENT

To develop an understanding of the fundamental scientific, aesthetic, and ethical principles involved in the management of renewable natural resources and ways to apply these principles in the formulation and evaluation of resource-management policies including the identification of unifying concepts in the management of specific renewable resources, soils, water, forests, and wildlife. Prereq: permission. Mr. Dingman. 4 cr.

812. ADMINISTRATION OF RESOURCE LAWS AND POLICIES

Largely devoted to legalistic, policy, and political science aspects of natural and community resource administration. Attention is also given to concepts of private property, home rule, social value, tradeoffs, and bureaucracy as elements in administration. Prereq: permission. Mr. Carroll. 4 cr.

815. LINEAR PROGRAMMING METHODS

Setting up and solving problems by the simplex and distribution methods; variation in linear programming methods with applications; nonlinear programming, discrete programming; and solving input-output and game-theory problems. Mr. Andrews. Prereq: Elementary Matrix Algebra or permission. 2 cr.

897,898. NATURAL AND ENVIRONMENTAL RESOURCES SEMINAR

Presentation and discussion of recent research, literature, and policy problems in the natural and social sciences influencing resource use. Staff. May be repeated. 1 cr.

Forest Resources (FoRs)

720. FOREST GENETICS

The genetics of forest tree improvement with emphasis on variation in natural populations, evolutionary principles, and breeding methods. Lab. Prereq: Principles of Genetics; Silviculture;/or permission. Mr. Adams. (Not offered every year.) 3 cr.

722. ADVANCED SILVICULTURE

Intensive silviculture of forest stands. Artificial regeneration (e.g., alternative regeneration methods and site preparation); plantation management (e.g., thinning schedules and fertilization). Prereq: Silviculture; permission. Mr. Adams and Mr. Hocker. 4 cr.

734. FOREST PROTECTION SEMINAR

Discussion and special problems based on principles and techniques of forest protection. Prereq: FoRs 660, Forest Fire Protection, or courses in entomology or plant pathology. Mr. Weyrick. 3 cr.

737. GAME MANAGEMENT I

Biological characteristics, habitat requirements, research and management practices of upland game birds and big game animals. Several all-day field trips required (possibly on weekends) to New England wildlife areas. Transportation fee. Prereq: wildlife management major or permission. Mr. Mautz. Lab. 4 cr.

738. GAME MANAGEMENT II

Biological characteristics, habitat requirements, research and management practices of small game animals, furbearers, predators, and waterfowl. Several all-day field trips required (possibly on weekends) to New England wildlife areas. Transportation fee. Prereq: wildlife management major or permission. Mr. Lindzey. Lab. 4 cr.

745. FOREST MANAGEMENT

Production control; management objectives; forest production regulation and economic analysis; forest administration; professional responsibilities and opportunities. Lab. Prereq: completion of junior year in forestry curriculum. Transportation fee. Mr. Weyrick. 4 cr.

Institute of Natural and Environmental Resources

753. OPERATIONS CONTROL AND ANALYSIS

Some quantitative tools for decision making in forest resource management activities; development and analysis of cost functions, timber and stumpage valuation, forecasting, linear programming, Monte Carlo simulation, PERT. Lab. Prereq: Calculus; Forest Economics; Statistics; Mensuration. Mr. Foster. 4 cr.

754. WOOD PRODUCTS MANUFACTURE AND MARKETING

Wood products from harvesting and procurement of raw material to finished product processes; management decisions, marketing, and promotion problems. Visits to harvesting operations and manufacturing plants in New England. Lab. Transportation fee. Prereq: Wood Technology;/or permission. Mr. Hill. 4 cr.

764/864. FOREST INDUSTRY ECONOMICS

Business methods and economics in the forest industry; planning for minimum cost operations and profitable use of capital in a forest enterprise. Individual projects. Prereq: senior standing; permission. Mr. Wallace. 4 cr.

798. FOREST RESOURCES MANAGEMENT SEMINAR

Population trends and human needs in relation to forest land productivity for timber, wildlife, water, recreation, and grazing. Class organized for group planning to maximize forest productivity for the state of New Hampshire. Prereq: Forest Management. Mr. Wallace. 4 cr.

801. FOREST MANAGEMENT SEMINAR

Seminar discussions of current literature, plans, principles, and new developments in the general field of forest management. Transportation fee. Prereq: permission. Mr. Bruns and others. 2 cr.

805. UTILIZATION SEMINAR

Conferences, discussions, and reports on assigned topics. Consideration of current literature and developments in the general field of wood utilization. Prereq: permission. Mr. Hill. 2 cr.

806. OPERATIONS CONTROL SEMINAR

Conferences, discussions, and reports on assigned topics. Considerations of current developments in the field of quantitative control of forest operations. Prereq: permission. Mr. Foster. (Not offered every year.) 2 cr.

809, 810. WILDLIFE MANAGEMENT SEMINAR

Discussions and assigned reports on current investigations and developments in wildlife management. Prereq: undergraduate courses in wildlife management. Mr. Olson, Mr. Mautz, and Mr. Lindzey. 1 cr.

816. QUANTITATIVE-FOREST ECOLOGY SEMINAR

Preparation, presentation, and discussion of recent topics in quantitative ecology such as remote sensing, population growth, competition between species, modeling of a population, and energy flow. The seminar is 2 credits with an additional 2 credits available for an in-depth study of a particular topic. Mr. Leak and Mr. Barrett. 2-4 cr.

895,896. INVESTIGATIONS IN 1) FOREST ECOLOGY; 2) REMOTE SENSING; 3) WOOD UTILIZATION; 4) GAME MANAGEMENT; 5) MENSURATION; 6) FOREST ECONOMICS; 7) FOREST MANAGEMENT; 8) OPERATIONS CONTROL AND ANALYSIS; 9) RECREATION; 10) POLICY; 11) WILDLIFE PHYSIOLOGY
Elective only after consultation with the instructor in charge. 1-4 cr.

899. THESIS

Hours and credits to be arranged to meet the needs of the individual student. Prereq: graduate standing; permission of instructor in the selected field of study. 6-10 cr.

Hydrology (Hydr)

705. PRINCIPLES OF HYDROLOGY

Physical principles important in the hydrologic cycle, including: basic equations, properties of water, movement of water in natural environments, formation of precipitation, relations between precipitation and streamflow, snow-melt, evapotranspiration, interception, infiltration, relations between ground water and streamflow, and hydrologic aspects of water quality. Problems of measurement and aspects of statistical treatment of hydrologic data. Lab. Transportation fee. Prereq: calculus. Mr. Dingman. 4 cr.

710. GROUNDWATER HYDROLOGY

Principles governing occurrence, location, and development of groundwater; principles of fluid flow, well hydraulics, regional flow, geophysical exploration, and chemical quality of water; use of fluid and mathematical models and selected problems. Lab. Prereq: physics; geology; calculus. Mr. Hall. 4 cr.

803. ADVANCED HYDROLOGY

Application of quantitative methods to selected hydrologic problems. Critical examination of deterministic and stochastic models, with emphasis on conceptualizing the hydrologic problem, developing appropriate models, obtaining solutions, and evaluating models and solutions in terms of basic assumptions, data requirements, and verification of results. Prereq: Principles of Hydrology; Computer Methods; Basic Statistics. Mr. Hall, Mr. Dingman. 3 cr.

Institute of Natural and Environmental Resources

804. HYDROCHEMISTRY

Chemical principles for dilute aqueous solutions at relatively low temperatures and pressures are applied to the study of fresh waters at or near the earth's surface. Major topics: equilibrium concepts, buffering mechanisms, oxidation-reduction reactions, and ion exchange. Emphasis is given to selected systems involving water, carbon dioxide, calcium carbonate, and silicate minerals. Laboratory exercises utilize simple experiments to give experience with methods of measurement and interpretation of results. Lab. Prereq: two years of chemistry or equivalent;/or permission. Mr. Hall. 3 cr.

808. WATER RESOURCE MANAGEMENT

Hydrologic and statistical aspects of water resource management; nature of water-resource problems and application of models in their solution; geographical aspects of water-resource problems in the U.S.; economic, social, institutional, and environmental aspects of water-resource problems. Prereq: Principles of Hydrology; Basic Statistics;/ or permission. Mr. Dingman. 4 cr.

895-896. INVESTIGATIONS IN 1) HYDROLOGY; 2) CHEMISTRY OF WATER; 3) WATER RESOURCE MANAGEMENT

Elective only after consultation with the instructor in charge. 1-4 cr.

899. THESIS

6-10 cr.

Resource Economics (REco)

705. PLANNED CHANGE IN NONURBAN COMMUNITIES APPLICATION

Application of community development theory and principles using appropriate research methodologies. Students participate in community development activities, discuss problems and report on experience and progress in weekly seminars. May include placement in field agency. Prereq: Applied Community Development or permission. Staff. 4 cr.

706. ECONOMICS OF RESOURCE DEVELOPMENT

Resource scarcity and theories of economic development and the major resource development problems of land and natural resources, urban-rural conflicting demands, and conservation and water supply; capital needs, externalities, and market failure. Prereq: intermediate microeconomic theory. Mr. Jansen. 4 cr.

717. LAW OF COMMUNITY PLANNING

Common law and the Constitution with respect to property law including eminent domain, land-use planning, urban renewal, and

zoning. Makes the nonlawyer aware of the influence and operation of the legal system in community development. Mr. Tucker. 4 cr.

756. REGIONAL ECONOMIC ANALYSIS

Concepts and methods of delimiting regional economies, theories of growth, methods of measuring activity, regional development, and policies. Empirical research studies. Prereq: intermediate economic theory; elementary statistics; calculus; linear programming;/or permission. 4 cr.

804. APPLIED ECONOMICS OF RESOURCE USE

The theory of resource allocation used in solving public and private economic problems. Resource-product relationships, nature of cost, returns to scale, factor valuation and pricing, and uncertainty are analyzed with appropriate methodology. Primary emphasis will be placed on empirical research studies and their implications. Mr. Andrews. Prereq: Applied Statistics I; Intermediate Microeconomic Analysis. 4 cr.

809. AGRICULTURAL ECONOMICS

Analysis of supply, demand, and price relationships. Appraisal of the economic theory relevant to decisionmaking in food production, marketing, and consumption; the competitive structure of the food industry. Mr. Henry. 4 cr.

820. ENVIRONMENTAL ECONOMICS SEMINAR

The use of economic concepts for analyzing current environmental problems. Student reports and class discussion will deal with the application of economic analysis to real world environmental problems at the local, state, and national levels; costs and benefits of alternative methods of dealing with environmental objectives; and other economic goals of society. Mr. Andrews, Mr. Jansen, and Mr. Henry. Prereq: Intermediate Micro- and Macroeconomic Analysis or equivalent; permission. 2 cr.

838. INTRODUCTION TO THE LOCATION OF ECONOMIC ACTIVITY

Economic theories explaining the behavior of individual firms and consumers in selecting sites for carrying on economic activities. The relationship of these theories to patterns of industrial location, systems of cities, and land-use competition in general. Problems of locational change and adjustment and the effects of public policy on spatial economic activities. Prereq: elementary calculus; linear algebra; regression; micro- and macroeconomics;/or permission. (Not offered every year.) 4 cr.

Mathematics

- 895-896. INVESTIGATIONS IN 1) AGRICULTURAL MARKETING; 2) AGRICULTURAL PRODUCTION AND FARM MANAGEMENT; 3) COMMUNITY DEVELOPMENT; 4) ECONOMICS OF HUMAN RESOURCES; 5) ECONOMICS OF POPULATION AND FOOD; 6) LAND ECONOMICS; 7) MARINE ECONOMICS; 8) RURAL ECONOMIC DEVELOPMENT; 9) REGIONAL ECONOMICS; 10) WATER ECONOMICS.

Special assignments in readings, investigations, or field problems. May be repeated. Prereq: permission. Staff. 2-4 cr.

899. THESIS

To be arranged. 6-10 cr.

Soil Science (Soil)

701. PHYSICS OF SOILS

Soil as a physical system; textural and structural analysis of soils, water flow and retention, and heat and gas transfer; the physical properties of soil and plant growth; methods of soil physical analysis. Lab. Prereq: Soils and the Environment; or permission. 4 cr.

702. CHEMISTRY OF SOILS

Chemical composition of soil; colloidal phenomena and the exchange and fixation of elements; cation exchange capacity and source of negative charge; inorganic reactions in soil and their effect on soil properties. Prereq: one year of college chemistry or permission. Mr. Harter. 3 cr.

704. SOIL CLASSIFICATION AND MAPPING

Soil genesis, morphology, classification, and mapping; major classification systems used in the U.S. and throughout the world as they relate to man's uses of the soil. Transportation fee. Prereq: Soils and the Environment; introductory geology; or permission. Mr. Peterson. 4 cr.

802. CHEMISTRY OF SOIL COLLOIDS

Physical chemistry of soil colloids and colloidal phenomena. Electric double-layer theory, solid-solution interfacial reactions, surface acidity, theories of swelling, ionic diffusion. Prereq: permission. Mr. Harter. 3 cr.

- 895-896. INVESTIGATIONS IN 1) SOIL-PLANT RELATIONSHIPS; 2) PHYSICS OF SOILS; 3) CHEMISTRY OF SOILS; 4) SOIL CLASSIFICATION.

Elective only after consultation with the instructor in charge. 1-4 cr.

899. THESIS

6-10 cr.

Mathematics (Math)

Chairperson: M. Evans Munroe

PROFESSORS: Richard H. Balomenos, Edward H. Batho, Homer F. Bechtell, Arthur H. Copeland, A. Robb Jacoby, Richard E. Johnson, Shan S. Kuo, M. Evans Munroe, Eric A. Nordgren, James A. Radlow, Shepley L. Ross, Robert J. Silverman

ASSOCIATE PROFESSORS: Albert B. Bennett, Jr., William E. Bonnice, David M. Burton, Loren Meeker, Berrien Moore III, Albert O. Shar, Samuel D. Shore, Donovan Van Osdol

ASSISTANT PROFESSORS: R. Daniel Bergeron, William Geeslin, Robert Russell

The mathematics department offers courses leading to three graduate degrees: Master of Science for Teachers, Master of Science, and Doctor of Philosophy.

Master of Science for Teachers

Admission Requirements: Completion of all requirements for secondary school teacher certification in mathematics.

Degree Requirements: 1) Ten semester courses approved by the department. These will normally be taken from the courses numbered 801-829 and will usually include the six courses numbered 803-808. 2) A comprehensive examination based primarily on material in courses 803-808. It is not possible to work full time during the academic year toward the Master of Science for Teachers degree. The courses in this program are offered primarily in summer institutes.

Master of Science

Admission Requirements: A year of abstract and linear algebra or a year of real analysis. Preference will be given to applicants who have completed both these sequences.

Degree Requirements: Ten semester courses approved by the department. These must be chosen from courses numbered 701-799 or 830-849. At least six of the ten must be from the 830-849 group. An oral comprehensive examination is based primarily on the courses taken.

Doctor of Philosophy

The department offers the Ph.D. under two labels: mathematics and mathematics-education. (A detailed description of the Ph.D. program is available from the department.) These programs have a common core as follows:

Admission Requirements: same as for the Master of Science.

Basic Degree Requirements: 1) all of the courses numbered 833-839; 2) experience in teaching equivalent to at least half-time for one year; and 3) written comprehensive examination; this involves algebra, analysis (real and complex), and general topology, and should be taken after three semesters in residence.

Additional Degree Requirements for the Ph.D. in Mathematics: 4) proficiency in reading mathematical literature in two of three languages: French, German, and Russian; 5) advanced work in a major (the field of the thesis) and a minor (usually another field of mathematics or mathematics-education) with an oral examination in these two fields; and 6) thesis — new and original mathematical results will be required. Thesis work is available in algebra, applied mathematics, analysis, and topology.

Additional Degree Requirements for the Ph.D. in Mathematics-Education: 4) language requirement as in Ph.D. in mathematics except that mastery of an approved research tool may be substituted for one language; 5) advanced work in a major (mathematics-education) and a minor (usually education) with an oral examination in these two fields; 6) thesis — new and original results involving pedagogical problems in mathematics will be required.

Courses numbered between 600 and 699 may be taken for graduate credit by nonmajors only.

611. ASSEMBLER LANGUAGE PROGRAMMING

Assembler-language coding and programming techniques. Data representation, systems organization, program segmentation, linkage of control sections, manipulation of bits or bytes, micro- and macro-programming. Input/output using system macros. Interrupts. Prereq: digital computer systems or mathematical computer problems. 4 cr.

612. DATA STRUCTURES AND PROCESSES

Data structure programming techniques and program structure using a higher-level language such as PL/1. Linear lists, strings, arrays, trees, and graphs. Symbol tables, sorting and searching techniques. Data organization, record-oriented and stream-oriented data transmission conversion techniques, and storage allocation. Prereq: Math 611. 4 cr.

636. PROBABILITY AND STATISTICS

Sample spaces (discrete only), events, combinations, conditional probability, independence, distributions, expectation, statistical description, random variables, sampling, estimation, tests, and applications. Credit toward a mathematics major only in mathematics-education. 4 cr.

645. APPLIED LINEAR ALGEBRA

Applied matrix theory; eigenvalue problems and their applications in mathematics, physics, and engineering; systems of linear, ordinary,

differential equations. Computer methods will be emphasized. Prereq: differential equations with linear algebra, multidimensional calculus, digital computer systems, or equivalent. 4 cr.

646. ANALYSIS FOR APPLICATIONS

Initial-boundary-value problems of mathematical physics; Sturm-Liouville problems; series expansions by orthogonal functions; Green's functions; numerical methods. Prereq: differential equations with linear algebra, multidimensional calculus, digital computer systems, or equivalent. 4 cr.

647. COMPLEX ANALYSIS FOR APPLICATIONS

Complex numbers; complex integration; infinite series; contour integration; conformal mapping; Fourier and Laplace transforms; Wiener-Hopf techniques. Prereq: multidimensional calculus. 4 cr.

656. INTRODUCTION TO NUMBER THEORY

Unique factorization, linear and quadratic congruences, quadratic reciprocity law, arithmetic functions, quadratic forms, an introduction to algebraic numbers. Prereq: introduction to abstract mathematics. (Not offered every year.) 4 cr.

657. GEOMETRY I

Advanced approach to fundamental properties of Euclidean geometry. Prereq: introduction to abstract mathematics. 4 cr.

658. GEOMETRY II

Systems of postulates of various geometries, geometric invariants, synthetic and analytic projective geometry, introduction to non-Euclidean geometry. Prereq: introduction to abstract mathematics. (Not offered every year.) 4 cr.

682. NONLINEAR DIFFERENTIAL EQUATIONS

Phase plane analysis of autonomous systems; critical points; limit cycles; periodic solutions; approximate methods for second-order nonlinear equations; stability and asymptotic behavior of solutions. Prereq: differential equations. (Not offered every year.) 4 cr.

A maximum of four of the following courses may be applied to the degree of Master of Science in mathematics.

710. ADVANCED PROGRAMMING SYSTEMS

Review of batch-process systems programs. Software organization; multiprogramming systems; techniques for parallel processing; multiaccessing and multiprocessing. Core management, file system design and management, and system accounting. Design of system modules and interfaces. Prereq: assembler language programming. 4 cr.

Mathematics

711. PROGRAMMING LANGUAGE AND COMPILER CONSTRUCTION

Formal definition of programming languages; specification of syntax and semantics. Global properties of algorithmic languages such as PL/1 and ALGOL. Review of special purpose languages for list processing, symbol manipulation, data description and simulation; run-time representation of program and data structures; how these properties affect compilation. Prereq: Math 710. 4 cr.

713. COMPUTER GRAPHICS

Input/output and representation of pictures from hardware and software points of view; emphasis on interactive techniques and the applications of these techniques; development of an interactive graphics system. Prereq: permission. 4 cr.

735. PROBABILITY

Sample spaces (discrete and continuous); random variables; conditional probability; moments; binomial, Poisson, and normal distributions; limit theorems for sums of random variables. Prereq: multidimensional calculus. 4 cr.

736. STATISTICS

Sampling theory, estimation of parameters, testing of hypotheses, nonparametric methods. Prereq: Math 735. 4 cr.

753. NUMERICAL METHODS AND COMPUTERS I

Use of numerical analysis on computers; high-level languages, compilers; linear and nonlinear equations; interpolation, quadrature, curve fitting, system simulations, optimization techniques, finite elements, computer graphics. Selected algorithms will be programmed for computer solution. Prereq: calculus; digital computer systems or equivalent. 4 cr.

754. NUMERICAL METHODS AND COMPUTERS II

Computer solutions of ordinary and partial differential equations, finite differences vs. finite elements, eigenvalues and eigenvectors, algorithms for hidden-line graphics. Mathematical software. Prereq: differential equations; digital computer systems or equivalent. 4 cr.

761. ABSTRACT ALGEBRA

Basic properties of groups, rings, fields, and their homomorphisms. Prereq: introduction to abstract mathematics. 4 cr.

762. LINEAR ALGEBRA

Vector spaces, linear transformations, matrices, determinants, dual spaces, eigenvalues, spectral and canonical decomposition theorems. Not for credit if credit received for Math 645. Prereq: Math 761. 4 cr.

764. ADVANCED ALGEBRA

Vector spaces, modules over principal ideal domains, structure of finitely-generated modules, finite abelian groups, elementary theory of fields. Prereq: Math 761. (Not offered every year.) 4 cr.

767. ONE-DIMENSIONAL REAL ANALYSIS

Theory of limits, continuity, differentiability, integrability, series, uniform convergence. Prereq: multidimensional calculus; introduction to abstract mathematics. 4 cr.

768. ABSTRACT ANALYSIS

Metric spaces, function spaces, theory of uniform limits. Prereq: Math 767. (Not offered every year.) 4 cr.

769. MULTIDIMENSIONAL REAL ANALYSIS

Partial derivatives, multiple integrals, line and surface integrals, Fourier series. Prereq: Math 767. 4 cr.

776. LOGIC

Formal mathematics and formal systems. Consistency, completeness, decidability. Prereq: introduction to abstract mathematics. (Not offered every year.) 4 cr.

780. THEORY OF ORDINARY DIFFERENTIAL EQUATIONS

Fundamental existence and uniqueness theorems; linear systems and higher order linear equations; Wronskian theory; classical Sturm Theorem and generalizations; boundary value problems for second order linear equations. Prereq: Math 767. (Not offered every year.) 4 cr.

781. PARTIAL DIFFERENTIAL EQUATIONS

First order equations; linear second order equations; Cauchy problem; Dirichlet problem; application to physics. Prereq: Math 767. (Not offered every year.) 4 cr.

784. TOPOLOGY

Connectedness, compactness, metrizability, with special emphasis on real line and plane. Prereq: introduction to abstract mathematics. 4 cr.

785. ALGEBRAIC METHODS IN TOPOLOGY

Topology of manifolds, topological groups, homology, knot theory. Prereq: Math 784. (Not offered every year.) 4 cr.

786. CALCULUS ON MANIFOLDS

Differentiable manifolds; differential forms; exterior and Grassman algebras; integration of differential forms; Stokes theorem; closed and exact differential forms. Not for credit if credit received for Math 769. Prereq: Math 762 and 767. (Not offered every year.) 4 cr.

787. DIFFERENTIAL GEOMETRY

Introduction to Lie groups and frame bundles; differential invariants of surfaces and curves; local theory of surfaces. Prereq: Math 786. (Not offered every year.) 4 cr.

788. COMPLEX ANALYSIS

Complex functions, sequences, limits, differentiability and Cauchy-Riemann equations, elementary functions, Cauchy's theorem and formula, Taylor's and Laurent's series, residues, conformal mapping. Not for credit if credit received for Math 647. Prereq: Math 767. 4 cr.

The following courses may be applied to the degree of Master of Science for Teachers in mathematics and to no other graduate degree in mathematics.

801-802. MATHEMATICS AND COMPUTING FOR TEACHERS

Linear equations, linear inequalities, computer arithmetic and programming, never-ending algorithms, algorithms for areas, computer-oriented numerical methods. The course is designed to introduce methods of computation using a computer in the context of a mathematics course. BASIC and FORTRAN programming languages will be taught. 6 cr.

803-804. HIGHER ALGEBRA FOR TEACHERS

The integers, integral domains, and topics from number theory; equivalent relations and congruences; real numbers, complex numbers, and fields, polynomials; group theory; elements of matrix theory; vectors and vector spaces; rings; Boolean algebra. 3 cr.

805-806. HIGHER GEOMETRY FOR TEACHERS

Systems of postulates of various geometries; geometric invariants; synthetic and analytic projective geometry; an introduction to non-Euclidean geometry; and topology. 3 cr.

807-808. HIGHER ANALYSIS FOR TEACHERS

The real number system; variables, functions and limits; elements of set theory; numerical sequences and series; continuity; the derivative and the Riemann integral maxima and minima. 3 cr.

809. PROBABILITY AND STATISTICS FOR TEACHERS

Permutations and combinations; finite sample spaces; random variables; binomial distributions; statistical applications. 3 cr.

810. MATHEMATICS EDUCATION

Current developments and issues in mathematics education. A seminar focused on content, curricula, methods, and psychology of teaching mathematics. 1-4 cr.

811. COMPUTERS AND THEIR USES

3 cr.

814. TOPOLOGY FOR TEACHERS

Fundamental concepts of elementary topology; network and map problems; sets, spaces, and transformations. 3 cr.

816. THEORY OF NUMBERS FOR TEACHERS

Divisibility and primes; congruences; quadratic reciprocity; number theoretic functions; Diophantine equations; Farey fractions; algebraic numbers. 3 cr.

817. THEORY OF SETS AND ELEMENTARY LOGIC

An introduction. 3 cr.

819. THE REAL NUMBER SYSTEM

A postlational approach. Brief discussion of algebraic structures. Introduction to the sequences, limits, and continuity. 3 cr.

820. HISTORY OF MATHEMATICS

A problem-study approach to mathematical problems and solutions from the period of Greek mathematics until the 1950s will be used to present the history of mathematics. 3 cr.

821. A MODERN APPROACH TO GEOMETRY

The foundations and development of Euclidean geometry, with emphasis on the recent School Mathematics Study Group's recommendations in the field of high school geometry. 3 cr.

826. SELECTED TOPICS IN ALGEBRA

Topics selected to supplement the teacher's previous training in algebra, chosen from among the following: linear algebra, vector spaces, groups, rings and ideals, and fields. 3 cr.

827. SELECTED TOPICS IN GEOMETRY

Topics selected to supplement the teacher's previous training in geometry, chosen from among the following: analytic projective geometry, non-Euclidean geometry, transformation theory, elementary metric differential geometry, topology. 3 cr.

828. SELECTED TOPICS IN ANALYSIS

Topics selected to supplement the teacher's previous training in analysis, chosen from among the following: sequences and series of real functions, Riemann integration, partial differentiation, complex functions, differential equations. 3 cr.

Mathematics

829. DIRECTED READING

A directed reading project on a selected topic in mathematics chosen to supplement the teacher's previous institute courses. A written examination will be required. 3 cr.

The following are the basic courses for both the Master of Science and Doctor of Philosophy degrees in mathematics.

833-834. ALGEBRA

Groups; rings, modules; fields; linear algebra. Prereq: undergraduate abstract algebra. 3 cr.

835. MEASURE AND INTEGRATION

Outer measures and measures; Lebesgue integrals; convergence theorems. Prereq: undergraduate real analysis. 3 cr.

836. FUNCTIONAL ANALYSIS

Banach spaces; representation of linear functionals; weak and weak* topologies. Prereq: Math 835. 3 cr.

837. COMPLEX ANALYSIS

Open mapping theorem; maximum modulus theorem; normal families and Riemann mapping theorem; harmonic functions; representation theorems; analytic continuation. Prereq: undergraduate complex analysis. 3 cr.

838. ALGEBRAIC TOPOLOGY

Chain complexes; homology of simplicial complexes, singular homology and cohomology; axiomatic homology; cup and cap products. Prereq: undergraduate abstract algebra and topology. 3 cr.

839. GENERAL TOPOLOGY I

Subspace, product and quotient topologies; embedding; separation and countability axioms; connectedness; compactness and compactifications; paracompactness, metrization and metric completions. Prereq: undergraduate general topology. 3 cr.

840. GENERAL TOPOLOGY II

Function spaces; cardinal invariants; extensions; realcompactness; Stone-Weierstrass theorems; uniform spaces. Prereq: Math 839. 3 cr.

The following courses are designed primarily for Master of Science students. They are offered on an irregular schedule whenever mutual faculty and student interest justifies it. Content will vary from year to year and will normally be chosen from among the topics listed. With the permission of the instructor, each of these courses may be taken more than once for credit.

842. TOPICS IN ALGEBRA

Algebraic geometry; homological algebra; algebraic number theory, local algebra; category theory; group theory; ideal theory; field theory; Lie algebra. 3 cr.

843. TOPICS IN TOPOLOGY

Topological groups; Lie groups; sheaf theory; manifolds; differential geometry; algebraic topology; homotopy theory. 3 cr.

844. TOPICS IN ANALYSIS

Riemann surfaces; calculus of variations; harmonic analysis; integral equations; operator theory; linear topological spaces; partially ordered spaces. 3 cr.

845. TOPICS IN DIFFERENTIAL EQUATIONS

Linear systems; general autonomous systems; two-dimensional systems; boundary value problems; qualitative theory; stability theory; partial differential equations; functional analytic methods. 3 cr.

846. TOPICS IN APPLIED MATHEMATICS

Hilbert spaces; distribution theory; potential theory; stochastic processes; multivariate statistical analysis; time series analysis. 3 cr.

847. TOPICS IN MATHEMATICS EDUCATION

The psychology of teaching and learning mathematics; supervision in mathematics teaching; curriculum theory; new curriculum projects; curriculum evaluation. 3 cr.

The following graduate courses are offered in computer science.

853. ARTIFICIAL INTELLIGENCE

A study of current approaches to machine intelligence and the simulation of human cognitive processes, including an introduction to recursive functions and programming with the LISP language. Topics include heuristic programming, programs for game playing and natural language understanding, elementary theory of computability. An individual project implemented on the computer will be required. Prereq: Math 612 or equivalent programming experience. 3 cr. (Also offered as EE 853.)

854. AUTOMATA THEORY

A study of formal languages and theoretical "machines" or automata. Topics include formal grammars; context-dependent, context-free, and regular languages; finite state machines and regular expression recognizers; infinite state machines; Turing machines; unsolvable problems and the halting problem; linear-bounded and push-down automata; cellular and reproducing automata. Prereq: programming experience. 3 cr. (Also offered as EE 854.)

The following courses are introductions to research opportunities for Doctor of Philosophy candidates. With the permission of the instructor, each of these courses may be taken more than once for credit.

- 861-862. ADVANCED TOPICS IN ALGEBRA**
3 cr.
- 863-864. ADVANCED TOPICS IN ANALYSIS**
3 cr.
- 865-866. ADVANCED TOPICS IN TOPOLOGY**
3 cr.
- 867-868. ADVANCED TOPICS IN GEOMETRY**
3 cr.
- 869-870. ADVANCED TOPICS IN FUNCTIONAL ANALYSIS**
3 cr.
- 871-872. ADVANCED TOPICS IN DIFFERENTIAL EQUATIONS**
3 cr.
- 873-874. ADVANCED TOPICS IN APPLIED MATHEMATICS**
3 cr.
- 875-876. ADVANCED TOPICS IN PROBABILITY AND STATISTICS**
3 cr.
- 877-878. ADVANCED TOPICS IN LOGIC AND FOUNDATIONS**
3 cr.

Mechanical Engineering (M E)

Chairperson: William Mosberg

PROFESSORS: Robert W. Corell, Godfrey H. Savage, Charles K. Taft, Asim Yildiz

ASSOCIATE PROFESSORS: E. Eugene Allmendinger, Wayne M. Beasley, Barbaros Celikkol, Frederick G. Hochgraf, David E. Limbert, William Mosberg, Russell L. Valentine, John A. Wilson

ASSISTANT PROFESSOR: M. Robinson Swift

The mechanical engineering department offers programs of study, from the viewpoint both of the engineering sciences and of engineering design, in mechanics, materials science, automatic control, and the thermal sciences, leading to the degree of Master of Science in Mechani-

cal Engineering. The programs provide the background required for careers in research, engineering design, or teaching, or for further graduate study.

To be admitted to graduate study in mechanical engineering, students should have completed work equivalent to that required by the University of New Hampshire for a Bachelor of Science degree in the field.

A candidate for the degree of Master of Science shall satisfy the requirements of either a thesis plan or a project plan. The thesis plan requires 24 semester hours of course work in addition to Mechanical Engineering 899, Master's Thesis; the project plan requires 30 semester hours of course work in addition to Mechanical Engineering 892, Master's Project. Individuals with special qualifications may petition the department to be excused from the project requirement. An oral examination covering the candidate's graduate work will be given whether or not a thesis is presented.

Students interested in graduate study beyond the master's degree should refer to the interdepartmental Engineering Ph.D. program which includes the following areas of specialization: engineering system design, signal processing, theoretical and applied mechanics, and transport phenomena. For details refer to the section entitled Engineering Ph.D. program on page 79.

Students completing degree requirements through the Division of Continuing Education must be admitted to the Graduate School and have their programs approved by the department.

No more than two graduate courses taken prior to admission to the Graduate School may be applied to the master's degree. Courses numbered between 600 and 699 may be taken for graduate credit by non-majors only.

Permission of the instructor and consent of the adviser are required for enrollment in all mechanical engineering graduate courses.

701. MACROSCOPIC THERMODYNAMICS

Thermodynamic principles using an analytic, postulational approach and Legendre transformations to obtain thermodynamic potentials. Prereq: Thermodynamics I. 4 cr.

702. STATISTICAL THERMODYNAMICS

Macroscopic thermodynamic principles developed by means of microscopic analysis. Prereq: Thermodynamics I. 4 cr.

703. HEAT TRANSFER

Analysis of phenomena; steady-state and transient conduction, radiation, and convection; engineering applications. Prereq: thermodynamics; fluid dynamics. 3 cr.

704. EXPERIMENTAL HEAT TRANSFER

Methods in the study and solution of problems, including a critical comparison with analytical and other methods. Prereq: ME 703. 4 cr.

Mechanical Engineering

707. ANALYTICAL FLUID DYNAMICS

Potential flow, development of the Navier-Stokes equations, turbulence and boundary-layer theory. Prereq: thermodynamics; fluid dynamics. 4 cr.

708. GAS DYNAMICS

Basic equations of motion of one-dimensional, subsonic and supersonic flows of compressible, ideal fluids. Wave phenomena. Rankine-Hugoniot relations. Linear approach to two-dimensional flow problems. Prereq: thermodynamics; fluid dynamics. 4 cr.

715. INTERNAL COMBUSTION ENGINES

Basic and engineering science applied to spark and compression-ignition engines; design, management, and reporting of experimental studies. Prereq: thermodynamics. 4 cr.

716. PROPULSION SYSTEMS

Basic engineering sciences applied to the engineering problems of propulsion systems. Prereq: thermodynamics; fluid dynamics. 4 cr.

717. CRYOGENICS

Phenomena and processes with very low temperatures. Basic engineering sciences applied to problems of low temperature refrigeration, liquefaction, separation, and storage; transport of cryogenic fluids; measurement systems; vacuum technology. Prereq: Thermodynamics I. 4 cr.

723. ADVANCED DYNAMICS

Classical dynamics oriented to contemporary engineering applications. Review of particle dynamics. Hamilton's principle and the Lagrange equations. Kinematics and dynamics of rigid bodies, gyroscopic effects in machinery and space structures. Prereq: mechanics. 4 cr.

724. VIBRATION THEORY AND APPLICATION

Theory of discrete vibrating systems. Single-degree-of-freedom system with general excitation. Matrix theory and eigenvalue problems. Many degrees of freedom. Numerical methods. Continuous systems. Applications to structural and mechanical systems. Prereq: introduction to vibrations or graduate standing. 4 cr.

726. EXPERIMENTAL MECHANICS

Experimental methods and theoretical bases applied to measurement of stress, strain, and motion. Transmitted and scattered-light photoelasticity; strain gage applications; brittle coating and grid techniques; dynamic measurements, and associated instrumentation. 4 cr.

727. ADVANCED MECHANICS OF SOLIDS

Beams on elastic foundation, curved bars, inelastic behavior, instability, introduction to thin plates and shells, introduction to elasticity, energy methods, and numerical methods. 4 cr.

730. MECHANICAL BEHAVIOR OF MATERIALS

Elastic and inelastic behavior of materials in terms of micro- and macromechanics. Stress, strain, and constitutive relations related to recent developments in dislocation theory and other phenomena on the atomic scale and to continuum mechanics on the macroscopic scale. Elasticity, plasticity, viscoelasticity, creep, fracture, and damping. Anisotropic and heterogeneous materials. 4 cr.

737. OCEAN MECHANICS I

Ocean as a continuous medium, its mechanical and thermodynamic properties. Shallow and deep ocean modeling for the investigation of gravity and sound waves. Ocean subbottom and its soil mechanical and sound propagation properties. Instrumentation, rudimentary data collecting and processing procedures, and computer usage. Prereq: fluid dynamics and mechanics; differential equations; multidimensional calculus. 4 cr.

738. OCEAN MECHANICS II

Ocean dynamical laws are generalized to include temperature and salinity variations in the water column. Conservation laws with generalized equation of state. Air-sea interaction, energy transport phenomena, reflection from different coastal geometry, harbour resonances, internal currents. Sound reflection from subbottom sound probing techniques to determine subbottom properties by ray theory, and generalization of subbottom soil from an elastic to a viscoelastic medium. Prereq: ME 737; ME 781 is desirable but not required. 4 cr.

741. FLUID CONTROL SYSTEMS

The mathematical modeling of hydraulic-, pneumatic-, and fluidic-control elements and control systems. Methods are developed for the analysis of systems using gases or liquids as the working fluid. Methods for the synthesis of the parameters of the control elements, used in automatic control systems, are developed and methods of design of these systems are discussed. (Also offered as E E 745.) 4 cr.

751. NAVAL ARCHITECTURE IN OCEAN ENGINEERING

Marine vehicle naval architecture principles for ocean engineers. Selected hydrostatic and hydrodynamic fundamentals of surface, semisubmersible and submersible vehicles used in ocean systems. Some rules and regulations governing marine vehicle systems. Prereq: Fluid Dynamics or permission of instructor. 4 cr.

752. SUBMERSIBLE VEHICLE SYSTEMS DESIGN

Conceptual and preliminary design of submersible vehicle systems; submersibles, environmental factors, hydromechanic and structural principles, materials, intra/extra-vehicle systems, operating considerations, predesign and design procedures. Design projects are selected and completed by student teams. 4 cr.

757. COASTAL ENGINEERING AND PROCESSES

Water waves and their effects. Equations for gravity waves and laboratory tank demonstration of wave trains, wave groups, and wave spectra. Estuarial and coastal processes including wave refraction and long shore transport of sediments simulated by computer models. Effects of structures on waves and functional design of structures including towers, breakwaters, and ocean outfall. 4 cr.

760. PHYSICAL METALLURGY

Introduction to the electron theory of materials; entropy and free-energy concepts of the solid state; diffusion in metals; nature and kinetics of selected solid state reactions. 4 cr.

761. X-RAY DIFFRACTION

The physics of x-ray diffraction, the reciprocal lattice, lattice parameter determinations, space group identification, phase identification, characterization of preferred orientation. 4 cr.

763. MICROSTRUCTURE OF SOLIDS

Basic concepts and measurements; statistically exact expressions for points, lines, surfaces, and volumes; random, partially-oriented and oriented structures; particle and grain characteristics and distributions; projected images and shape specification. 4 cr.

766. PHYSICAL CERAMICS

Characteristics of crystalline and noncrystalline ceramic solids; defect structures; diffusion in ceramic materials; nucleation, crystal growth, and solid-state reactions; kinetics of grain growth, sintering, and vitrification. 4 cr.

781. MATHEMATICAL METHODS IN ENGINEERING SCIENCE — I

Solution of discrete and continuous systems. Review of calculus, linear algebra, complex numbers, Fourier series, differential and partial differential equations with examples from acoustics, vibration theory, hydrodynamics, elasticity, solid mechanics, transport theory, and particle mechanics. 4 cr.

782. CONTROL SYSTEMS

Fundamental principles involved in the design and analysis of feedback control systems. Topics include stability criterion, time-domain

analysis, frequency-domain analysis, and introduction to nonlinear systems. (Also offered as E E 782.) 4 cr.

793 a-d, 794 a-d. SPECIAL TOPICS IN ENGINEERING

Course numbers refer to topics in a) thermodynamics; b) mechanics; c) engineering design; and d) materials; respectively. Content of these courses may vary from year to year. 2-4 cr.

795 a-d, 796 a-d. INDEPENDENT STUDY

Course numbers refer to topics in a) thermal science; b) solid mechanics; c) engineering design; and d) materials, respectively. 2-4 cr.

801. IRREVERSIBLE THERMODYNAMICS

Nonequilibrium thermodynamics from the viewpoint of fluctuation theory. The Onsager reciprocal relations. Prereq: ME 701. 4 cr.

803. CONDUCTION HEAT TRANSFER

Heat conduction equation temperature fields and heat flux vector; analytical solution of the conduction equation in several variables; initial and boundary value problems; numerical methods of solution. 4 cr.

804. RADIATION HEAT TRANSFER

The fundamentals of radiant heat transfer. Development and solution of the wave equation for electromagnetic radiation. Analysis of Planck's law of radiation and earlier theories. Methods of solution of radiant interchange in real systems with and without absorbing media. 4 cr.

806. CONVECTION HEAT TRANSFER

An analytical study of heat transfer to laminar and turbulent boundary layers of compressible and incompressible fluids. Basic differential equations governing the heat transfer are derived and analytical solutions are obtained where possible and checked with experimental results. 4 cr.

807. COMPRESSIBLE FLUID FLOW

General equations of motion for real and ideal compressible fluid flow, including boundary layer equations, methods of solution. Prereq: ME 707 or 708. 4 cr.

808. THEORETICAL AERO/HYDRO-MECHANICS

The mathematical development of the equations of frictionless fluid flow, using both tensor notation and various coordinate systems. Conformal mapping; Blasius theorem; Joukowski hypothesis; flow around airfoils. Schwarz Christoffel theorem and vortex motion. 4 cr.

Mechanical Engineering

822. CONTINUUM MECHANICS

Conservation laws for gases, liquids, and solids in a continuum are developed starting from Liouville and Boltzmann equations. Passage from a discrete system to a continuum is discussed. Constitutive equations for viscoelastic and thermoelastic fields; and non-linear gas, liquid, and elastic fields. General discussion of rheological behavior. Causality conditions for continuum fields. Examples for solids, liquids, and gases, and biomechanics. Introduction to phenomenological Lagrangian theories. 4 cr.

824. VIBRATIONS OF CONTINUOUS MEDIA

Classical and numerical methods are employed to study the vibration of continuous elements and structures. Topics considered are axial and torsional vibration of rods, transverse vibration of beams and thin plates, wave propagation, and vibration of simple structures. 4 cr.

826. THEORY OF ELASTICITY

The analysis of stress and deformation in elastic solids; conservation laws for elastic media; stress and strain relations by continuous functions; Airy stress functions; elastodynamic fields; inhomogeneous, anisotropic, wave equations; wave propagation, and stress concentration problems; generalizations to thermoelasticity and viscoelastic fields. Complex variable techniques will be used. 4 cr.

827. THEORY OF PLASTICITY

Analysis of stress and deformation in inelastic solids; general development of stress invariants, variational principles, constitutive relations, and yield and loading functions. Special emphasis on ideal plasticity, strain-hardening, creep, limit analysis, and limit design. 4 cr.

829. THEORY OF PLATES AND SHELLS

Theory of elasticity developed for plates and shells; conservation laws for elastic media; stress and strain relations by continuous functions; Airy stress functions; stress and strain relations in curvilinear coordinates; thin and thick plate and shell theories; vibration of spherical, cylindrical, and conical shells and plates. 4 cr.

838. THEORETICAL ACOUSTICS

Fundamentals are presented with emphasis on theory and applications in underwater acoustics and in the acoustic determination of dynamic material properties. Topics include: a review of vibration theory; derivation of nonlinear acoustic field equations; linearization; Green's function techniques and solution of boundary value problems; scattering, reflection theories of boundary roughness; development of ray theory (geometric optics) from field equations; and Eikonal approximations. 4 cr.

842. DISCONTINUOUS CONTROL

The analysis and synthesis of feedback control systems operating on quantized information; compensation and performance improvement methods which use the quantized nature of the information are also developed. (Also offered as E E 842.) 4 cr.

844. NONLINEAR CONTROL SYSTEMS

Analysis and design of nonlinear control systems from the classical and modern viewpoints are discussed. Topics include: Liapunov's stability theory; phase space methods; linearization techniques; simulation; frequency response methods; generalized describing functions; transient analysis utilizing functional analysis; and decoupling of multivariable systems. Prereq: ME 851. 4 cr.

851. ADVANCED CONTROL SYSTEMS I

State-space representation of systems. Analysis using state transition matrix. Controllability and observability. Synthesis of optimum control systems, including calculus of variations and maximum principle. Introduction to nonlinear and stochastic data systems. Prereq: ME 782. (Also offered as E E 851.) 3 cr.

852. ADVANCED CONTROL SYSTEMS II

Special topics in control theory such as multivariate and adaptive control system; stochastic systems; Wiener and Kalman filter techniques; introduction to dynamic, linear, and non-linear programming. Prereq: ME 851. (Also offered as E E 852.) 3 cr.

865. CONDUCTION PROPERTIES IN SOLIDS

Topics in metal and semiconductor physics. Quantum theory, electron energy states, scattering processes, band theory, electron and hole conduction, and the P-N junction. 4 cr.

882. MATHEMATICAL METHODS IN ENGINEERING SCIENCE II

This course is a continuation of ME 781. Topics treated include complex variable techniques, integral transform techniques for the solution of differential and partial differential equations, Green's functions. Wiener-Hopf techniques, variational techniques. Stochastic problems with application to random vibration, statistical control theory, turbulence, heat conduction and fluctuation phenomena in solids, transport theory, gases, and liquids. Topics may vary from year to year. Prereq: ME 781. 4 cr.

883. TENSOR ANALYSIS AND DIFFERENTIAL GEOMETRY

Mathematical groundwork for applied group theory, transformation groups, affine groups and affine geometry. Coordinate transformations and point transformations. Affinors, tensors, and their algebraic properties. Invariant differential operators. Lie derivative, holonomic and anholonomic coordinate systems. Curvature tensor, Bianchi

identity, tensor densities. Green's theorem, Green's functions, potential functions. Pfaff's problem. 4 cr.

890 a-d and 891 a-d. SPECIAL TOPICS IN ENGINEERING

Course numbers refer to topics in a) thermodynamics; b) mechanics; c) engineering design; and d) materials. Content of these courses may vary from year to year. 2-4 cr.

892. MECHANICAL ENGINEERING MASTER'S PROJECT

The student works with a faculty member during one or two semesters on a well defined research and/or original design problem. A written report and seminar are presented. 1-4 cr.

895 a-d and 896 a-d. GRADUATE INDEPENDENT STUDY

Investigation of graduate level problems or areas germane to mechanical engineering. 1-4 cr.

899. MASTER'S THESIS

6-10 cr.

Students may also enroll in Technology 601.

601. STATISTICAL METHODS IN ENGINEERING AND PHYSICAL SCIENCE

Methods of organizing data and statistical techniques for data analysis, as applied to problems in engineering and physical science. Elementary probability theory, probability distribution; tests of significance, correlation, and regression analysis. Design of experiments; completely randomized blocks; factorials, fractional factorials; process optimization. Introduction to quality control; construction and analysis of control charts for variables and attributes; statistical aspects of tolerance. 4 cr.

Microbiology (Micr)

Chairperson: Galen E. Jones

PROFESSORS: William R. Chesbro, Galen E. Jones, Theodore G. Metcalf

ASSOCIATE PROFESSOR: Robert M. Zsigray

ASSISTANT PROFESSOR: Thomas G. Pistole

Students admitted to graduate study in microbiology are expected to have had adequate preparation in the biological and physical sciences and in the basic courses in microbiology.

The candidate for the Master of Science degree will be required to complete a thesis. Candidates for the Doctor of Philosophy degree must demonstrate proficiency in reading microbiological literature in one foreign language, usually French or German; must teach at least one semester, or have had equivalent experience; must demonstrate to the doctoral committee a broad, basic knowledge of the field of microbiology; and must complete a dissertation embodying the results of original research in microbiology.

Departmental research activities emphasize immunologic aspects of bacterial host-parasite interactions, analysis of microbial structures at cellular and molecular levels, bacterial and bacteriophage genetics, studies of viruses pathogenic for man and animals, cell culture phenomena, public health and sanitary aspects of microbiology and virology, and marine microbiology.

701. TAXONOMY AND ECOLOGY

Isolation, identification, and classification of procaryotes by classical and newer techniques; analysis of the interplay between organism and environment based on energy metabolism and use of this to deduce a natural classification; uses of taxonomic and ecological information. Lab. Prereq: gen micro; gen biochem or Physiological Chem and Nutrition or Principles of Biochem. 4 cr.

702. PATHOGENIC MICROBIOLOGY

The morphological, cultural, biochemical, serological, and pathogenic characteristics of microorganisms causing human and animal diseases. Lab. Prereq: Gen Micr. 4 cr.

705. IMMUNOLOGY AND SEROLOGY

Defensive elements possessed by man and animals protective against infectious microorganisms. Principles of serological techniques for recognition and identification of biological materials including microorganisms. Preparation of vaccines and production of antisera in animals. Lab. Prereq: Path Micr. 4 cr.

706. VIROLOGY

Viruses, including animal and bacterial, and rickettsiae; interaction of viruses and host cells; technics for propagation and recognition including immunologic methods; applications to infectious disease, the environment, and cancer. Lab. Prereq: Path Micr. 4 cr.

707. MARINE MICROBIOLOGY

Characterization of microorganisms in the sea including taxonomy, physiology, and ecology; sampling, enumeration, distribution; and effects of marine environment upon microbial populations. Lab. Prereq: Gen Micr; Org Chem. 4 cr.

Microbiology

708. MICROBIAL BIOGEOCHEMISTRY

Geochemical processes influenced by biochemical processes catalyzed by marine and terrestrial microorganisms; transformations of carbon, nitrogen, and other elements. Petroleum microbiology, natural gas production, sulfur formation, ferromanganese nodules, corrosion, and fossil microorganisms. Lab. Prereq: Gen Micr; Org Chem. 4 cr.

795,796. PROBLEMS IN MICROBIOLOGY

Prereq: permission of department chairperson and staff. Cr. to be arranged.

800. SYSTEMATIC MICROBIOLOGY

Procedures, methods for classification of microorganisms; review of systems of classification. Lab. Prereq: one year of microbiology. (Not offered every year.) 4 cr.

802. MICROBIAL PHYSIOLOGY

Means by which microorganisms survive: nutritional, chemical, physical factors; metabolism and its regulation; generation of cell ultrastructure; ecological interactions. Lab. Prereq: Gen Micr; gen biochem. (Not offered every year.) 4 cr.

804. MICROBIAL GENETICS

Expression, regulation, recombination and transmission of genetic information in procaryotic and eucaryotic microorganisms. Consideration of chromosomal and extrachromosomal inheritance. Lab. Prereq: Gen Micr; permission. (Not offered every year.) 4 cr.

851. CELL CULTURE

Theory, principles fundamental to culture of cells in vitro. Introduction to techniques of preparation, maintenance of animal, plant, insect, fish cell cultures. Application of cell culture to contemporary research in biological sciences. Lab. Prereq: gen micro; permission. (Also offered as AnSc 851.) 4 cr.

897-898. MICROBIOLOGY SEMINAR

Reports, discussions, microbiological literature, and current developments in microbiology. Prereq: permission of instructor. 1 cr.

899. MASTER'S THESIS

6-10 cr.

999. DOCTORAL RESEARCH

Music (Musi)

Chairperson: Paul Verrette

PROFESSORS: Donald Steele, John Wicks

ASSOCIATE PROFESSORS: Mark DeVoto, Alan Grishman, Cleveland Howard, Keith Polk, Mary Rasmussen, John Rogers, Niel Sir, Paul Verrette, John Whitlock, Henry Wing, Jr.

ASSISTANT PROFESSOR: Stanley Hettinger

The Department of Music offers programs leading to the degrees of Master of Arts in music and Master of Science in music education.

Master of Arts in Music

At the University of New Hampshire the degree of Master of Arts in music is designed for students interested in broadening their knowledge of the history of music, but at the same time it offers ample opportunity to pursue more specialized studies in music theory, performance, performance-practice, or music literature. The following courses are required: Music 855, 856, 857, 858, 891, 893 or 894, or their approved equivalents. The student may elect courses in the 700 series in music or the 600, 700, and 800 series in other departments with the permission of the student's adviser. The department recommends that a student allow more than two semesters for completion of the program.

The department requires a Bachelor of Arts degree in music or its equivalent from an accredited institution for admission to this program. Placement examinations in theory, music history, and aural identification are required of all applicants and are taken in the semester or summer preceding entrance into the graduate program. Students not meeting standards in the placement examinations will not be officially admitted to the Graduate School until such examinations are passed to the satisfaction of the department.

A reading knowledge of both German and French is strongly recommended before entering the program; a German reading examination will be administered by the department. On recommendation of the graduate adviser, this requirement may be waived for students who do not plan further study beyond the M.A. degree. Oral examinations are required of all Master of Arts degree candidates.

Master of Science in Music Education

The goal of the Master of Science in music education degree is to develop a broad knowledge at the graduate level in the fields of music education, performance, history, theory, and independent study. Each candidate will be required to complete one of the following: a professional paper; a field study in music education; a satisfactory recital appearance; a major composition, orchestration, or band arrangement; or the prepara-

tion and conducting of a major work in public performance for band, orchestra, or chorus. The following courses are required: Music 855, 893 or 894; Music Education 796; 883 or 884. Also required are two courses in the Department of Education from courses such as the following: Education 820, 827, 841, 853, 858, 861, 865, 883, 884, 886, and in special cases, 700, 701, and 705. Vocal or instrumental study at the 800 level is required to a minimum of 4 credits. A maximum of 9 credits is allowed if the graduate recital option is elected. Sufficient electives must be taken to total 30 credits.

Admission to this program depends upon a bachelor's degree in music education or its equivalent from an accredited institution. Placement examinations in theory, music history, and aural identification will be required of all applicants. The student must take these examinations in the semester or summer preceding entrance into the graduate program. Students not meeting standards in the placement examinations will not be officially admitted to the Graduate School until such examinations are passed to the satisfaction of the department.

Music

701. MUSIC OF THE MEDIEVAL PERIOD

The nature of the beginnings of polyphony. The preeminent influence of the church in the 13th century and the rising secular movement in the 14th. Music as a dominant force in the political and social life of the Middle Ages. 4 cr.

703. MUSIC OF THE RENAISSANCE

Works of 15th and 16th century composers from Dunstable to Palestrina. 4 cr.

705. MUSIC OF THE BAROQUE

Music of Europe from deRore to Bach. 4 cr.

707. MUSIC OF THE CLASSICAL PERIOD

The growth of musical styles and forms from early classical, baroque-influenced composers through the high classicism of Haydn and Mozart, to the budding romanticism of the young Beethoven. Representative symphonies, concerti, and operas will be heard. 4 cr.

709. MUSIC OF THE ROMANTIC PERIOD

The symphonies, concerti, chamber music, and keyboard works of Beethoven, Berlioz, Schubert, Mendelssohn, Schumann, Brahms, Franck, Chopin, and Liszt. Romantic elements contained in the development of harmony, orchestration, sonority, expressive content. The rise of the short piano piece, the German art song, the symphonic poem, nationalism in music. 4 cr.

711. MUSIC OF THE 20th CENTURY

Contemporary music including its literature, its trends, and an analysis of techniques, styles, forms, and expression. 4 cr.

721. THE LIFE AND WORKS OF BEETHOVEN

The piano sonatas, the concerti, symphonies, and string quartets. 4 cr.

732. THE ART SONG

The history and literature of the solo song with piano accompaniment. Survey of national styles of the 19th and 20th centuries and deeper study of the central core of the art song — the German Lied. 4 cr.

733. SURVEY OF OPERA

Representative masterpieces of this art form through listening, reading, and discussion. 4 cr.

735. SURVEY OF PIANOFORTE LITERATURE

Keyboard literature from Bach to the present. Discussion and performance of the works of Bach; the sonatas and concerti of Haydn, Mozart, Beethoven, Schubert, the romantic composers, and of contemporary writers. 4 cr.

754. COLLEGIUM MUSICUM

Instrumentalists and singers perform small ensemble music from all periods, with emphasis on Renaissance and Baroque music. Prereq: permission of instructor. 1 cr.

755. PERFORMANCE STUDIES IN MEDIEVAL MUSIC

Performance of vocal, vocal-instrumental, and instrumental ensemble, circa 1100 to 1450; rhythm, musica ficta, notation, melodic ornamentation, improvised polyphony, and the clear projection of a polyphonic texture. Evaluation of the writings of selected medieval theorists and modern scholars; practical exercises in transcription; and performance on reconstructions of medieval instruments, especially the organ, harp, psaltery, rebec, vielle, and recorder. 2 or 4 cr.

756. PERFORMANCE STUDIES IN RENAISSANCE MUSIC

Problems of musical performance, circa 1450 to 1600, via the small vocal, vocal-instrumental, and instrumental ensemble; rhythm and tempo, musica ficta, text underlay, articulation, diminution, tablature notation, and effective distribution of voices and instruments. Survey of performance manuals, iconographical sources, and current research; development of editing technique through the preparation of transcriptions; and an opportunity to perform on the organ, harpsichord, lute, viols, recorders, cornets, and trombones. 2 or 4 cr.

Music

757. PERFORMANCE STUDIES IN BAROQUE MUSIC

Performance practices in solo keyboard works, sonatas a2 and a3 and solo cantatas, circa 1640 to 1750, concentrating on ornamentation, realization of figured basses, improvisation, articulation, rhythm, keyboard registration, and the influence of the construction of baroque musical instruments (including the organ) on sonority and technique. Course work includes an examination of manuscripts (on microfilm), prints, treatises, and iconographical sources and the editing and realization of selected works for recital performance. 2 or 4 cr.

758. PERFORMANCE STUDIES IN CLASSICAL MUSIC

Performance of keyboard music and instrumental chamber music, circa 1760 to 1815, emphasizing the relationship between structure and interpretation, late 18th century conventions of ornamentation and articulation, a survey of tutors and relevant theoretical writing, and a critique of currently published editions and editing techniques. 2 or 4 cr.

759. PERFORMANCE STUDIES IN 19th CENTURY MUSIC

Performing and coaching Lieder, piano music, and instrumental chamber music from Schubert through Debussy; effective ensemble, traditions of interpretation, and the influence of structure on performance. 2 or 4 cr.

760. PERFORMANCE STUDIES IN 20th CENTURY MUSIC

Small instrumental or vocal-instrumental ensembles, with intensive work in structural analysis, rhythmic ensemble coordination, dynamic and articulation control, new instrumental techniques, notation, improvisation, and the interaction between jazz and European styles. 2 or 4 cr.

771-772. COUNTERPOINT

Contrapuntal techniques of tonal music. Melodic construction and dissonance treatment through work in species counterpoint and studies in harmonic elaboration and prolongation. Analysis of selected compositions emphasizes the connection between fundamental contrapuntal techniques and the voice-leading of composition. Prereq: Musi 572 or permission of instructor. 2 cr.

773. CANON AND FUGUE

A continuation of Musi 772. The procedures of polyphonic tonal textures through the analysis and composition of canons and fugues. Prereq: Musi 772 or permission of instructor. 2 cr.

775-776. COMPOSITION

Construction of phrases, periods, and short compositions following classical models. Problems of text-setting. Prereq: Musi 572 or permission of instructor. 3 cr.

777-778. ADVANCED COMPOSITION

A continuation of Musi 776. Individual compositional projects. Prereq: Musi 776 and permission of instructor. 3 cr.

779. ORCHESTRATION

The characteristics of band and orchestral instruments both individually and in small (homogeneous) and large (mixed) groupings. Students study scores, write arrangements, and have arrangements performed if at all possible. Some aspects of vocal writing. Prereq: Musi 572 or permission of instructor. 4 cr.

781. FORM AND ANALYSIS

Formal and textural elements; concepts and examples. Thorough analysis of smaller and larger masterworks from the standpoint of harmony, counterpoint, structural line, and formal articulation. Prereq: Musi 572 or permission of instructor. 4 cr.

785. ELECTRONIC SOUND SYNTHESIS

Part I: "traditional" or "analog" electronic sound synthesis; work with the Buchla Synthesizer in the electronic music studio. Part II: 1) elementary programming in FORTRAN, 2) the logic of computer sound synthesis, and 3) programming in MUSIC 4BF. Students will have the opportunity to run programs on a DEC K110 computer equipped with 4-channel digital-to-analog and analog-to-digital converters. Part III: completion of a major independent study project in electronic music. Prereq: permission of instructor. 4 cr.

795. SPECIAL STUDIES IN MUSIC EDUCATION

Allows upper-level students to explore, individually or in groups, areas related to their specific professional interests. Prereq: permission of instructor. 1-4 cr.

841-850. APPLIED MUSIC FOR GRADUATE CREDIT

The following courses offer further development of technique, music interpretation, and repertory on the various instruments. Emphasis may also be directed toward the functional use of the instrument in the school room. Prereq: student must exhibit sufficient proficiency to warrant graduate study and must have permission of the department chairperson and the student's graduate adviser. Audition required. A student may register for credit in the same courses in successive semesters with the approval of the major adviser. Music staff. 1-2 cr.

- 841. GRADUATE VOICE
- 842. GRADUATE PIANO
- 843. GRADUATE HARPSICHORD
- 844. GRADUATE ORGAN
- 845. GRADUATE VIOLIN, VIOLA
- 846. GRADUATE VIOLONCELLO, STRING BASS
- 847. GRADUATE WOODWIND
- 848. GRADUATE BRASS
- 849. GRADUATE PERCUSSION
- 850. GRADUATE HARP

855. INTRODUCTION TO BIBLIOGRAPHY

An intensive survey of basic reference works, music periodicals, collected editions, series, treatises, books on musical instruments and performance practice, and the important monographs on major composers from Machaut to Schoenberg. A reading knowledge of German and French is very useful. 3 cr.

856. READINGS IN MUSIC HISTORY: ANTIQUITY TO 1600

An opportunity to read and study in detail a restricted number of monographs and editions. 3 cr.

857. READINGS IN MUSIC HISTORY: 1600-1820

An opportunity to read and study in detail a restricted number of monographs and editions. 3 cr.

858. READINGS IN MUSIC HISTORY: 1820 TO THE PRESENT

An opportunity to read and study in detail a restricted number of monographs and editions. 3 cr.

891-892. RESEARCH SEMINAR

Guidance in individual research projects. Prereq: permission of instructor. Variable cr.

893. THEORY SEMINAR

Through reading, analysis, and composition, the student is acquainted with music theory from the Middle Ages to Monteverdi. Prereq: permission of instructor. 3 cr.

894. THEORY SEMINAR

Theory and practice from the Baroque to contemporary music. Performance practice in the Baroque and later periods. Score analysis. Prereq: permission of instructor. 3 cr.

895. INDEPENDENT STUDY IN THE HISTORY AND THEORY OF MUSIC

This course provides the opportunity for especially qualified students to investigate with guidance specific areas of their scholarly concern. Prereq: permission of instructor. 1-4 cr.

Music Education

741-742. TECHNIQUES AND METHODS IN CHORAL MUSIC

Problems in the organization and performance of high school, college, and community choruses. Techniques of choral conducting and rehearsal, repertory, and materials. 2 cr.

743. MATERIALS AND METHODS IN PIANO MUSIC

Gives potential piano teachers a coherent but flexible approach to the instruction of students of different ages and levels of talent through evaluation of methods and materials and discussion of the role of the private teacher. 2 cr.

745-746. TECHNIQUES AND METHODS IN STRING INSTRUMENTS

Class and individual instruction. Four hours practice per week required. Intensive training on the violin, viola, cello, and double bass, enables participants to perform in string ensembles. Classroom procedures, establishment of string programs, and evaluation of available methods materials. 2 cr.

747-748. TECHNIQUES AND METHODS IN WOODWIND INSTRUMENTS

Basic fundamentals of performance, class instruction, associated acoustical problems, and study of woodwind literature. First semester: clarinet, flute, and saxophone. Second semester: double-reed instruments. 2 cr.

749-750. TECHNIQUES AND METHODS IN BRASS INSTRUMENTS

A basic course in embouchure formation, tone, tonguing, lingering, flexibility, accuracy, and range development as applied to the trumpet or baritone horn, French horn, and trombone; methods, studies, solos, and ensembles most likely to be useful with grade school, junior high school, and high school players of brass instruments. Qualified advanced students may elect honors work in composition, arranging, and ensemble coaching. 4 cr.

Occupational Education

751. TECHNIQUES AND METHODS IN PERCUSSION INSTRUMENTS

Basic performance skills on snare drum, timpani, mallet instruments, and the other percussion instruments used in bands and orchestras. Materials and methods of instruction. 2 cr.

785. MUSIC FOR THE ELEMENTARY CLASSROOM TEACHER

Designed for the nonspecialist. The correlation and integration of music in the school curriculum, and the basic skills and techniques necessary. 4 cr.

787-788. THE TEACHING OF ELEMENTARY AND MIDDLE SCHOOL MUSIC

Aims, scope, and organization of materials and activities in the elementary and middle schools. Modern trends in educational philosophy; development of the child's voice; demonstration of materials and methods for the various grades. Observation and teaching in schools. 2 cr.

791-792. THE TEACHING OF SECONDARY SCHOOL MUSIC

Educational principles applied to music teaching and learning; curriculum organization for junior and senior high school. Adolescent voice, voice classification, selection of vocal and instrumental materials, and building unified concert programs. Problems of administration; management; relationship of the teacher to school and community. Observation of secondary school music programs. 2 cr.

795. SPECIAL STUDIES IN MUSIC LITERATURE

Presumes a sound musical background. Barring duplication of material, this course may be repeated for credit. Prereq: permission of instructor. 1-4 cr.

796. ORGANIZATION AND ADMINISTRATION OF SCHOOL MUSIC GROUPS

Problems of organizing and administering school orchestras, bands, glee clubs, choruses, and small ensembles; objectives, motivation, schedule, discipline, equipment, programs, finances, rehearsal techniques, contests and festivals, materials, personnel selection, and grades. 4 cr.

883. INSTRUMENTAL LITERATURE AND ITS PERFORMANCE

Exploration of representative solo and ensemble music for string, wind, and percussion instruments. Typical literature from each period of music is studied. As much as is possible, live performance is included; recordings are used as required. Detailed attention given to interpretation. Project required. 3 cr.

884. CHORAL LITERATURE AND ITS PERFORMANCE

Analysis, discussion, and conducting of excerpts from choral masterpieces from all major periods and styles. Students will have the opportunity to act as assistant conductors for some of the choral organizations on campus. Evaluation of current high school and college repertoires. 3 cr.

895. SPECIAL PROJECTS IN MUSIC EDUCATION

Independent study, investigation, or research in music education. Creative projects may be included. Prereq: permission of instructor. 1-4 cr.

Occupational Education (OcEd)

Chairperson: William H. Annis

PROFESSOR: William H. Annis

ASSOCIATE PROFESSOR: Richard Barker

ASSISTANT PROFESSOR: Nicholas L. Paul

THOMPSON SCHOOL PROFESSOR: Paul A. Gilman

THOMPSON SCHOOL ASSOCIATE PROFESSOR: Lewis Roberts, Jr.

The Master of Occupational Education degree is designed for teachers and administrators of occupational education, County Cooperative Extension Service personnel, and others in adult education. Applicants must submit scores achieved on either the Graduate Record Examination, Aptitude Section, or Millers Analogies Test. All students are required to complete Occupational Education 785 and 786. The remainder of the 30 credits required to complete the degree program will be selected in consultation with the student and advisers according to the student's career plans, needs, and goals. Students may elect the thesis option. Candidates completing a thesis will be required to complete an oral examination. Students following the nonthesis option will be required to complete both written and oral examinations. For further information contact Chairperson W.H. Annis.

700. WORKSHOPS IN OCCUPATIONAL EDUCATION

Modularized instruction for inservice education of teachers of vocational education and others in occupational education. May be repeated up to 8 credits. 1-2 cr.

750. SHOP ORGANIZATION AND CONTROL METHODS

Efficiency in the control of instruction, equipment, and materials. 4 cr.

783. PREPARATION FOR CONDUCTING AND SUPERVISING ADULT-EDUCATION PROGRAMS

Techniques of needs identification, program planning; teaching methods, supervision, and evaluation. Prereq: Princ of Occupational Ed or permission. 4 cr.

784. THE COMMUNITY-JUNIOR AND VOCATIONAL-TECHNICAL COLLEGES

Rise and development of community-junior colleges and two-year vocational-technical colleges in American education; their history, potential, philosophy, and functions. 4 cr.

785. ADVANCED METHODS AND MATERIALS OF INSTRUCTION

Organization of instruction to meet student needs; development and use of resource files and instructional materials; evaluation. Open to teachers of vocational-technical education and others by permission of instructor. 4 cr.

786. CONCEPTS OF OCCUPATIONAL EDUCATION

Development of vocational-technical education in the U.S.; socio-economic influences responsible for its establishment. Federal and state requirements for secondary and postsecondary schools. Coordination of programs with general education and other vocational fields. 4 cr.

787. ADMINISTRATION AND SUPERVISION OF VOCATIONAL EDUCATION

A study of the forces which require special competencies to supervise and administer vocational education. An examination of operating philosophies for supervision and administration in the several areas of vocational education. 4 cr.

791. PLANNING FOR TEACHING

Organization of materials of instruction to meet group and individual needs. Techniques of instruction, planning for teaching, the function of consulting committees, working with youth groups, program evaluation. Course is scheduled concurrently with student teaching. Prereq: Micro Teaching. 4 cr.

796. INVESTIGATIONS IN OCCUPATIONAL EDUCATION

1) Career Education, 2) Secondary Education, 3) Postsecondary Education, 4) Adult Education, 5) Extension Education, 6) Exemplary Programs, 7) Cooperative Education Programs, 8) Disadvantaged and Handicapped Education programs. Student-selected problems in one of the areas listed. Elective after consultation with the instructor. Hours to be arranged. May be repeated. 2 to 4 cr.

798. OCCUPATIONAL EDUCATION SEMINAR

Discussion of current issues, problems, and research and development in occupational education. Students, faculty, and other personnel are utilized as discussion leaders. Required of majors and minors. 0 cr.

802. METHODS OF TEACHING POWER AND MACHINERY IN OCCUPATIONAL EDUCATION

The servicing and maintenance of the agricultural power and machine complex as it relates to the production and nonproduction phases of vocational agriculture. The development of teaching plans, techniques of instruction, and the development of multimedia teaching units will be stressed. 3 cr.

804. PROGRAM PLANNING IN OCCUPATIONAL EDUCATION

A systematic approach to the development of course materials for occupational education. Topics included are: occupational analysis, establishing performance objectives, selection of content, development of supplemental material, and evaluation. Prereq: a course in teaching methods or permission of instructor. 4 cr.

805. THE DEVELOPMENT OF COOPERATIVE EDUCATION PROGRAMS IN OCCUPATIONAL EDUCATION

Topics included are: relationship with community; student selection and development of individual programs; the supervision and evaluation of these programs. 4 cr.

807. ORGANIZATION AND SUPERVISION OF YOUTH ORGANIZATIONS

The purposes and organization of youth organizations, establishing the local organization, planning and developing a program of work, ways and means of improving the local organization, and methods of evaluation. 4 cr.

809. COMMUNITY ORGANIZATION AND PUBLIC RELATIONS

The composition, purposes, and objectives of the various social and economic organizations operating in local communities. The importance of their membership to the general welfare of the area and the development of a public relations program. 4 cr.

811. INTERNSHIP IN OCCUPATIONAL EDUCATION

Internship in a field of occupational education either in methodology of teaching or technical subject matter. Students may elect internship only after completing the qualifying examinations for the master's degree with permission of the candidate's major adviser. 0-8 cr. May be repeated up to 8 cr.

Physical Education

812. INTRODUCTION TO RESEARCH

The course is designed to develop a knowledge and understanding that will contribute to the effective use of research in teaching and administering occupational education. The research process will be examined in terms of selection and formulation of research problems, design, techniques of data collection, analysis, and inter-relation of data and reporting. 4 cr.

895. INDEPENDENT STUDY IN OCCUPATIONAL EDUCATION

Individual study problems in various phases of occupational education. Prereq: permission of staff. 2-6 cr. May be repeated.

899. MASTER OF OCCUPATIONAL EDUCATION THESIS

6-10 cr.

Physical Education (PhEd)

Chairperson: Robert Kertzer

ASSOCIATE PROFESSORS: Katherine Amsden, Gavin H. Carter, Phyllis A. Hoff, Robert Kertzer, D. Allan Waterfield, Robert E. Wear, Walter E. Weiland

DIRECTOR OF GRADUATE PROGRAM: Walter E. Weiland

The Department of Physical Education, in the School of Health Studies, offers a graduate program leading to the degree of Master of Science. Admission evaluation is based on undergraduate preparation, academic record, Graduate Record Examination scores (student must submit GRE scores for the aptitude test), and letters of recommendation. An applicant must be an above-average student and have had a minimum of 24 credits of undergraduate theory work in physical education. Applicants who have not majored in physical education as undergraduates, or who have not met specific course prerequisites, should expect to take additional undergraduate work without receiving graduate credit.

A student may satisfy program requirements for the master's degree through either thesis or nonthesis program options. Physical Education 801 and Natural and Environmental Resources 701, or a comparable statistics course (upon approval of graduate adviser) are required of all degree candidates.

Thesis Option: A minimum of 30 approved graduate credits including a thesis (24 graduate course credits plus 6 thesis credits) are required in the thesis option. Two courses, in addition to Natural and Environmental Resources 701, must be taken outside the Department of Physical Education. An oral defense of the thesis is also required.

Nonthesis Option: A minimum of 32 approved graduate credits are required in the nonthesis option. Four credits of either Physical Education 895 or 896 (Advanced Studies) are required. A student may take Advanced Studies courses only after having completed at least 20 approved graduate credits, including Physical Education 801 and Natural and Environmental Resources 701. All course work may be taken within the Department of Physical Education; however, approval may be granted to take relevant courses outside the department.

The program emphasizes the areas of 1) exercise physiology and 2) motor learning. In addition to these two areas of program emphasis, courses are offered in curriculum planning and in the historical, cultural, and social foundations of human movement and sport. Thesis topics need not be restricted to the two areas of program emphasis. The program is sufficiently flexible to satisfy professional interests and special abilities of the student. With the help of the graduate adviser, the student's program will be individually planned.

702. ADVANCED ATHLETIC TRAINING

Assessment, rehabilitative treatment, preventive strapping, and protective equipment used in athletic training. Training room facility administration. Lab. Prereq: PhEd 502. 4 cr.

703. LABORATORY PRACTICE IN ATHLETIC TRAINING

150 hours of experience in UNH athletic training room under N.A.T.A. certified trainer. Prereq: PhEd 502. 600 clock hours necessary for N.A.T.A. certification. May be repeated up to 8 credits. 2 cr.

720. INTERPRETATION AND ASSESSMENT OF PHYSICAL FITNESS

Planning and implementation of programs of conditioning and fitness in the general program of education in the school. Personal fitness; components of physical fitness and conditioning; current tests; rehabilitation of individuals of all ages, particularly in college and adult programs. Prereq: PhEd 620 or equivalent. 4 cr.

730. CURRICULUM PLANNING IN PHYSICAL EDUCATION

Criteria and factors involved in planning and construction of school programs. 4 cr.

740. PERCEPTUAL MOTOR DYSFUNCTION

Theoretical rationale and clinical perceptual-motor training programs of Ayres, Kephart, Cratty, Barsch, and Getman, as they relate to sensory-motor integration and the remediation of learning disabilities. Prereq: PhEd 775, PhEd 540, or permission of instructor. 4 cr.

775. PERCEPTUAL MOTOR LEARNING

Variables affecting the learning and performance of skilled activity; ability and motivational characteristics of the learner; processes for skill acquisition. Prereq: Psych 401. 4 cr.

780. PSYCHOLOGICAL FACTORS IN SPORT

Factors of outstanding athletic achievement; psychological variables in competition; the actions and interactions of sport, spectator, and athlete. Prereq: Psyc 401 or PhEd 775. 4 cr.

791. HISTORY OF PHYSICAL EDUCATION

From ancient Egypt to modern times. Influences of Greece, Rome, the Renaissance and Reformation periods, and modern European Nationalism. Analysis of events and the beliefs of leaders in the development of systems of physical education. 4 cr.

801. RESEARCH METHODS IN PHYSICAL EDUCATION

Research techniques and methodology, hypothesis formulation, format of research report, and critical reading of current research. Prereq: INER 701 or equivalent. 4 cr.

831. CONDITIONING FOR MAXIMUM PERFORMANCE

Examination of the anatomical and physiological factors related to maximum physical performance. Evaluation of present programs of training. Prereq: PhEd 620 or equivalent. 4 cr.

841. SOCIAL DIMENSIONS OF SPORT

Sport viewed from a social-cultural, action-system frame of reference and studied on the level of cultural values and their related social structures. Prereq: Soc 400 or equivalent. 4 cr.

850. SEMINAR IN MOTOR LEARNING

Theoretical models of skill acquisition, motor skill taxonomies, and current issues in motor learning research. Prereq: PhEd 775 or equivalent. 4 cr.

895,896. ADVANCED STUDIES

Provides advanced work either on a group-seminar or an independent-study basis. Investigation, presentation, and discussion of recent studies of special concern to physical education. 2-6 cr.

899. MASTER'S THESIS

6 cr.

Physics (Phys)

Chairperson: Robert E. Houston, Jr.

PROFESSORS: Roger L. Arnoldy, L. Christian Balling, Edward L. Chupp, Robert E. Houston, Jr., Richard L. Kaufmann, Robert H. Lambert, John A. Lockwood, Lyman Mower, John E. Mulhern, Jr., William R. Webber

ASSOCIATE PROFESSORS: John F. Dawson, Harvey K. Shepard, Robert E. Simpson, John J. Wright

ASSISTANT PROFESSOR: Barry J. Harrington

GRADUATE ADVISER: William R. Webber

The physics department offers courses leading to three graduate degrees: Master of Science for Teachers, Master of Science, and Doctor of Philosophy. Graduate students entering in the Master of Science and Doctor of Philosophy programs are expected to demonstrate a proficiency in undergraduate work equivalent to that of the senior year in physics at the University of New Hampshire.

All Ph.D. candidates in physics are required to take a preliminary, comprehensive, written qualifying exam at the beginning of the fall semester of their second year. Exceptions are possible by petition only. This exam will emphasize quantum mechanics, electricity and magnetism, and classical mechanics at the undergraduate and first-year graduate level. It will be given on two days, each part being approximately four hours in duration. Students who fail to qualify at either level must take the written examination a second time in February of the same academic year. Students are allowed two attempts to pass the qualifying exam. Ph.D. students qualifying in the written exam will be required to take an oral exam within one month of passing the written examination.

Master of Science for Teachers

The degree of Master of Science for Teachers is offered for candidates who satisfy the general admission requirements (see page 15) or who hold a secondary school teacher certification in physics or in general physical science. The courses leading to this degree will normally be chosen so as to improve the candidate's ability to teach physics or general physical science at the secondary school level. These courses should total at least 30 semester hours and should be chosen in consultation with the graduate adviser in physics.

M.S.T. students are not required to take the qualifying examination. Persons interested in this degree should confer with the department chairperson or graduate adviser.

Physics

Master of Science Degree

For admission to graduate study in physics leading to a Master of Science degree, the student should have completed 24 to 30 semester hours of undergraduate courses in physics. Suitable undergraduate preparation in mathematics is essential to graduate study in physics and should include differential equations, linear algebra, and advanced calculus. Candidates for admission are also required to take the Graduate Record Examination (both the aptitude test and the advanced test in physics). The results of this examination will be used in conjunction with transcripts to evaluate the applicant's undergraduate training. The courses required for a Master of Science degree include Physics 833, 839, 841, and 843. Candidates may select one of the following two options:

1) Complete 30 semester hours of courses chosen in consultation with the graduate adviser.

2) Complete 24 semester hours of courses chosen in consultation with the graduate adviser, complete a thesis representing the equivalent of 6 semester hours work, and pass an oral examination on the thesis.

Doctor of Philosophy Degree

For admission to graduate study in physics leading to a Doctor of Philosophy degree, the student should satisfy the same general admission requirements as for a Master of Science degree. In addition, the student is expected to demonstrate an outstanding proficiency in undergraduate physics. Admission to candidacy for the degree is based on demonstrated ability in formal course work, satisfaction of the language requirement, experience in teaching equivalent to at least half-time for one year, and the passing of a written and oral qualifying examination as specified above. Finally, upon completion of a thesis, the doctoral candidate will take an oral examination based on the area of research.

The courses required for a Doctor of Philosophy degree consist of: 1) 831-832, 833, 835, 839, 841-842, 843-844; and 2) any additional five full courses at the 800 level, excluding 889-890, 897-898, 899, and 999. (For students doing Ph.D. research in space physics, one of these five courses must be 850 or 852.) Note that 895 may be taken more than once for credit.

The language requirement consists of demonstrating a reading ability in one of the following foreign languages: German, French, or Russian. This requirement may be satisfied by any one of the following methods:

1) Satisfactory performance on the Educational Testing Service foreign language examination.

2) Satisfactory performance on the reading examination administered by the department.

3) After two attempts at either 1) or 2), the requirement may be satisfied only by the completion of a one-year course in the language.

607. PHYSICAL OPTICS

Electromagnetic theory of light, interference, diffraction polarization, related phenomena, and nonlinear optics. Prereq: multidimensional calculus. 4 cr.

701-702. INTRODUCTION TO QUANTUM MECHANICS I AND II

Nonrelativistic Schrodinger Equation, the Hydrogen atom, applications to atomic and molecular structure; nuclear reactions and scattering; models of the nucleus; cosmic rays. Prereq: Calculus I; Calculus II; permission of instructor. 4 cr.

703-704. ELECTRICITY AND MAGNETISM I AND II

Foundation of electromagnetic theory; electrostatics, dielectric theory, electromagnetism, magnetic properties of matter, alternating currents, Maxwell's field theory, and an introduction to electrodynamics. Prereq: differential equations; multidimensional calculus; permission. 4 cr.

831-832. MATHEMATICAL PHYSICS

Complex variables, differential equations, asymptotic methods, integral transform, special functions, linear vector spaces and matrices, Green's functions, integral equations, variational methods, numerical methods, and tensor analysis. 3 cr.

833. EXPERIMENTAL PHYSICS I

Modern research techniques, including discussion and laboratory exercises in fundamental measurements in optics, electromagnetism, nuclear and atomic phenomenon. Prereq: passing an electronics proficiency test or experimental physics I. 3 cr.

834. EXPERIMENTAL PHYSICS II

Modern research techniques. Prereq: Phys 833. 1-3 cr.

835. STATISTICAL PHYSICS I

A review of thermodynamics and kinetic theory, followed by an introduction to classical and quantum statistical mechanics. Microcanonical, canonical and grand canonical ensembles, ideal Fermi and Bose gases are among the topics discussed. Prereq: Phys 831; Phys 843;/or permission. 3 cr.

836. STATISTICAL PHYSICS II

Basic formulation and application of statistical mechanics to selected physical problems. Prereq: Phys 844. (Offered on request.) 3 cr.

839. THEORETICAL MECHANICS

Newtonian, Lagrangian, and Hamiltonian formulation of the classical mechanics of particles and rigid bodies, with particular attention to those topics that serve as background for the study of modern physical theories. 3 cr.

841-842. ELECTROMAGNETIC THEORY

The formulation and detailed application of electromagnetic theory to physical problems. Prereq: permission. 3 cr.

843-844. QUANTUM MECHANICS

Wave mechanical and Dirac formulations of nonrelativistic quantum mechanics. Prereq: permission. 3 cr.

850. PLASMA PHYSICS I

Topics to be discussed will be selected from the following: magnetohydrodynamics and plasma flow, waves, shocks and discontinuities, instabilities, and adiabatic motion of charged particles. (Not offered every year.) 3 cr.

852. PLASMA PHYSICS II

Topics to be discussed will be selected from the following: kinetic theory of plasmas, plasma waves, instabilities, and nonlinear plasma phenomena. Offered on request. Prereq: Phys 835; /or permission. 3 cr.

861-862. ADVANCED QUANTUM MECHANICS

Relativistic wave equations, propagator theory and Feynman diagrams, quantum theory of radiation, second quantization, introduction to quantum field theory and related topics. Prereq: Phys 839; Phys 844. (Not offered every year.) 3 cr.

863-864. NUCLEAR PHYSICS

Introduction to nuclear processes, including nuclear forces, nuclear structure and models, static properties, beta and gamma emission, and nuclear reactions. Selected topics in experimental methods. Prereq: Phys 844. (Not offered every year.) 3 cr.

865-866. SOLID STATE PHYSICS

Development of quantum mechanical theory of solids, transport phenomena, etc. Prereq: Phys 843; Phys 835. (Not offered every year.) 3 cr.

887. COSMIC PHYSICS I

Topics will be selected from the following: ionospheric physics; magnetospheric physics; interplanetary physics; solar physics; cosmic ray physics; radio, x-ray, and gamma-ray astronomy; motion, transport, energy loss, origin, and acceleration of charged particles in the magnetosphere, interplanetary medium, and galaxy; cosmological problems. (Not offered every year.) 3 cr.

888. COSMIC PHYSICS II

Extended investigation of one or more of the topics introduced in Cosmic Physics I. Offered on request. 3 cr.

889-890. SPACE PHYSICS SEMINAR

Lectures and discussions of current research in the physics of fields and particles in space. 1-3 cr.

891,892. PROBLEMS IN THEORETICAL PHYSICS

May be taken more than once. Offered on request. 3 cr.

893,894. PROBLEMS IN EXPERIMENTAL PHYSICS

May be taken more than once. Offered on request. 3 cr.

895,896. SPECIAL TOPICS

Any special fields of study not covered by the above courses may be included. Topic choices in previous years: astrophysics; elementary particles; lasers/masers; many-body theory; relativity; group theory; atomic physics; quantum theory of light. May be taken more than once. 1-3 cr.

897-898. COLLOQUIUM

Required of all graduate students. Topics to be selected. No cr.

899. MASTER'S THESIS

6 cr.

999. DOCTORAL RESEARCH

Plant Science (PISc)

Chairperson: Lincoln C. Peirce

PROFESSORS: Gerald M. Dunn, Lincoln C. Peirce, Owen M. Rogers, Douglas G. Routley

ASSOCIATE PROFESSORS: George O. Estes, Yun-Tzu Kiang, J. Brent Loy, James E. Pollard, Jerry Warren, Otho S. Wells

ASSISTANT PROFESSOR: David W. Koch

ADJUNCT ASSISTANT PROFESSOR: Merrill B. Hoyle

The graduate research program in plant science is concerned with solving basic and applied problems associated with growth of crop plants and their response to the environment. Facilities include laboratories, greenhouses, growth chambers, and two experimental farms.

The program emphasizes two principal disciplines: 1) breeding and genetics; and 2) physiology and biochemistry. Research and teaching in plant genetics, cytogenetics, and plant breeding are major strengths complemented by University programs in genetics and statistics. A strong research and teaching program is also available in plant physiology, including advanced courses in plant nutrition, metabolism, and growth and development. An increasing number of research projects in the department involve both geneticists and physiologists.

Plant Science

Undergraduates should obtain adequate background in the biological and physical sciences, including botany and chemistry. Students lacking these requirements may be admitted on condition that certain courses be completed without graduate credit. GRE (verbal and quant.) required for application.

Candidates for the Master of Science degree will be required to prepare a thesis and to pass an oral examination. Candidates for the Ph.D. degree must take a written and/or oral qualifying examination and a final oral examination on the dissertation, in which the student must demonstrate ability to do original research in the area of specialization. Supervised teaching or its equivalent is required for each master's and doctoral student.

Advanced Plant Physiology

708. PLANT NUTRITION

Nutritional aspects of higher plants; uptake, translocation, and metabolic role. Prereq: plant physiology; soils. (Not offered every year.) 4 cr.

762. PLANT METABOLISM

Function, occurrence, synthesis, and degradation of plant constituents; respiration and photosynthesis; metabolism of nitrogenous and aromatic compounds; biochemical mechanisms in seed dormancy, fruit ripening, and disease resistance. Prereq: introductory biochemistry. (Not offered every year.) 2 or 4 cr.

863. PLANT GROWTH AND DEVELOPMENT

Biochemistry and physiology of growth and development; current research; independent laboratory projects. Prereq: Plant Physiology; Biochemistry. (Not offered every year.) 4 cr.

Advanced Genetics (See Genetics Program)

705. POPULATION GENETICS

Population growth and regulation; distribution of genes; factors affecting gene frequency; genetic load; cost of natural selection; ecological genetics. Prereq: introductory genetics; introductory statistics; or permission. (Not offered every year.) 4 cr.

732. PLANT DEVELOPMENTAL GENETICS

Gene action in relation to development in plants; isozymes and differentiation; chromosomal proteins and gene regulation; temporal specificity of gene action; nuclear-cytoplasmic interactions; chemical gradients and gene activation. Prereq: introductory genetics; physiology. (Not offered every year.) 4 cr.

740. EVOLUTIONARY BIOLOGY

The synthetic theory of evolution in the origin of life, species, and higher groups; sources of genetic variability; population structure; causes of evolution; evolution of communities; molecular evolution and rates of evolution. Prereq: introductory genetics or permission. (Not offered every year.) 4 cr.

773. METHODS AND THEORY OF PLANT BREEDING

Plant breeding systems for qualitative and quantitative plant improvement. Prereq: introductory genetics; introductory statistics; or permission. (Not offered every year.) 3 cr.

851. PLANT GENETICS

Linkage, euploidy, aneuploidy, cytoplasmic inheritance, mutation, and genetics of disease resistance. Prereq: genetics. (Not offered every year.) 3 cr.

853. CYTOGENETICS

Chromosome aberrations and their behavior. Effect of radiation on chromosomes. Mapping and laboratory techniques in cytogenetic analysis. Prereq: genetics; cytology. (Not offered every year.) 3 cr.

General Offerings and Independent Studies

776. RADIOISOTOPE TECHNIQUES FOR LIFE SCIENCES

Application of radioisotopes to biological systems; detection and measurement, liquid scintillation spectrometry and autoradiography, gamma-ray spectrometry, radiochromatogram scanning, and tissue distribution of radioisotopes. Prereq: inorganic chemistry; physics. 4 cr.

795,796. ADVANCED TOPICS IN PLANT SCIENCE

Independent research, study, or group discussion in the areas of physiology, genetics, or plant utilization. Prereq: permission. 2-4 cr.

877. SUPERVISED TEACHING FOR GRADUATE STUDENTS

Planning and presenting classroom and laboratory material. Biweekly seminars discuss teaching technique and problems. One credit or its equivalent required of each plant science master's and Ph.D. candidate. Plant science graduate students only. Prereq: permission. 1 cr. Cr/F.

895-896. RESEARCH IN PLANT SCIENCE

Advanced investigations in a research subject, exclusive of thesis. 1-4 cr.

897-898. GRADUATE SEMINAR

Library research and discussion of current topics of plant science. Required of all graduate students majoring in plant science. 1 cr.

899. MASTER'S THESIS

A thesis requiring study in depth of a phase in plant science. Required of all master's candidates in plant science. 6-10 cr.

999. DOCTOR OF PHILOSOPHY THESIS

Dissertation reflecting independent research in a phase of plant science is required. Credit received upon completion.

Political Science (Polt)

Chairperson: Lawrence W. O'Connell

PROFESSORS: Robert B. Dishman, Bernard K. Gordon, George K. Romoser, Allan A. Spitz

ASSOCIATE PROFESSORS: John R. Kayser, David L. Larson, David W. Moore, Lawrence W. O'Connell, B. Thomas Trout, Susan O. White, Frederic W. Wurzburg

ASSISTANT PROFESSORS: Robert E. Craig, Warren Brown, George K. Lagassa

A candidate for admission to graduate study in the Department of Political Science normally is expected to have majored either in political science or a field closely related, and to have achieved an undergraduate academic record of some distinction. In unusual and exceptional cases and where undergraduate preparation has been insufficient, a candidate may be admitted provided that s/he follows without credit a program of study approved by the chairperson. In all cases the Graduate Record Examination is required of candidates who seek to be considered for admission. The department offers the Master of Arts in political science and the Master of Public Administration.

Master of Arts (M.A.) in Political Science

The program leading to the Master of Arts in political science is normally to be completed in a single calendar year (an academic year plus the following summer) and is based on three elements: the development of advanced knowledge in at least three fields of the discipline in which the department offers its courses and seminars; the ability to conduct and complete an individual program of research at a high level; and familiarization with modern methodology in the discipline. Accordingly, every candidate will complete a suitably arranged program consisting of eight

courses and seminars (32 credits) and a master's thesis (which carries 4 credits), for a total of 36 credits. Of the eight courses, one must be Political Science 899, Sec. 1, Directed Research and Study, normally to be taken in the second semester of the candidate's residence. The master's thesis is expected to be within the field in which the candidate has undertaken Directed Study and Research, and generally is expected to derive from the same topic. Topics must be approved by a committee selected by the chairperson.

An essential requirement is that each candidate must arrange his/her program so that it includes at least one seminar (Political Science 897, 898) in each of three fields of the discipline emphasized by the department (political thought, American politics, comparative politics, and international politics). The remaining courses may be chosen according to the candidate's interests and needs, and two may be taken in a related field outside the department. Where a candidate lacks proficiency in tools of quantitative analysis or a foreign language essential to the program of study and research, s/he will be required to attain and demonstrate to the thesis adviser proficiency in the needed skill.

Master of Public Administration (M.P.A.)

The Master of Public Administration is an interdisciplinary degree designed principally for individuals intending to pursue careers in local, state, or national government service in the U.S. or other governments. Candidates will be expected to complete eight full courses (32 credits) and a six-week internship program, normally during the summer after the completion of formal course work. Candidates who have had prior appropriate responsibility in public administration may apply for a waiver of the internship requirement. A recreation and parks option which draws upon the resources of that department is offered as an interdisciplinary program for the degree. Students pursuing this option are held to the general degree requirements, and usually take courses in recreation and parks to fulfill the requirements for work outside the political science department. The internship is served with an appropriate recreation and parks agency.

Of the eight courses, at least three shall be chosen from the courses and seminars in public administration offered by the department, and two from other political science courses offered by the department according to the needs and interests of the candidate. The remaining three courses may be chosen from outside the department in such related fields as economics, administration, resource economics, sociology, and recreation and parks.

Each candidate will be required to take Political Science 806: Theories and Processes of Public Administration; Political Science 807: Cases in Public Management; and Political Science 805: Methods of Policy Analysis. Candidates for the advanced degrees are expected to take courses at the 800 level in political science, and to maintain a passing grade (B-) in all courses.

Political Science

American Politics and Public Administration

702/802. PUBLIC PLANNING AND BUDGETING

Analysis, goal setting, and strategic planning in a governmental setting, with particular emphasis on budgetary processes as a means for controlling policy effectiveness. 4 cr.

703/803. URBAN AND METROPOLITAN POLITICS

Planning and management of the urban community, inter-governmental relations, administrative functions, and general urban policy problems. 4 cr.

797,798/897,898. SECTION 1: SEMINAR IN AMERICAN POLITICS 4 cr.

797,798/897,898. SECTION 2: SEMINAR IN PUBLIC ADMINISTRATION 4 cr.

805. METHODS OF POLICY ANALYSIS

Research design, survey methods, experimental techniques, and aggregate data analysis applied to public policy settings. 4 cr.

806. THEORIES AND PROCESSES OF PUBLIC ADMINISTRATION

Theories of organization and bureaucracy, the implications of bureaucratization, and the major processes of public administration including budgeting, personnel, policy making, as well as attention to contemporary policy issues including collective bargaining, affirmative action, citizen participation. 4 cr.

807. CASES IN PUBLIC MANAGEMENT

Examination of policy case studies emphasizing politics, organizational structure, and interorganizational behavior; management case studies emphasizing behavior, human relations, personality, and intraorganizational dynamics; and simulation and role-playing exercises. 4 cr.

Political Thought

720/820. PERSPECTIVES ON POLITICAL SCIENCE

Examination of different views on the study and meaning of politics. The perspectives of political scientists, political philosophers, and political activists. 4 cr.

721/821. ECONOMIC THOUGHT AND POLITICS

Economic theories seen from the perspective of political thought. Economic activity and resource distribution in relationship to historical

and contemporary issues such as freedom, equality, authority, community, democracy, and quality of life. 4 cr.

797,798/897,898. SECTION 3: SEMINAR IN POLITICAL THOUGHT 4 cr.

Comparative Politics

741/841. POLITICS OF INDUSTRIALIZED STATES

Impact of modern industrialism and its organization upon political life and the conduct of government. 4 cr.

742/842. COMPARATIVE COMMUNIST SYSTEMS

Interests, demands, and decision-making in communist governments. Examination of ideological issues, political behavior within communist international organizations, intraparty relations, distinctions between ruling and nonruling communist parties. 4 cr.

797,798/897,898. SECTION 4: SEMINAR IN COMPARATIVE POLITICS 4 cr.

International Politics

760/860. THEORIES OF INTERNATIONAL POLITICS AND INTEGRATION

General explanation of the behavior of nations; the theory and practice of supernational integration; theories of peace and security and community building at the international level; concepts and experience in arms limitation and conflict resolution. 4 cr.

761/861. INTERNATIONAL LAW

Formalized processes for regularizing state behavior; development of norms based on custom, precedent, and formal institutions, as in treaties and cases. Arms reduction and limitation arrangements; inspections; and other formal procedures designed to preserve peace. 4 cr.

778/878. INTERNATIONAL ORGANIZATION

Collective security and other forms of cooperation among nations through international organizations such as the United Nations and its predecessors, and through regional bodies. 4 cr.

797,798/897,898. SECTION 5: SEMINAR IN INTERNATIONAL POLITICS 4 cr.

899. SECTION 1: DIRECTED RESEARCH AND STUDY

899. SECTION 2: MASTER'S THESIS

Related Courses in Recreation and Parks

870. ADMINISTRATIVE INTERNSHIP

Practical administrative experience in an area of professional interest. Prereq: MPA candidate — specialization in recreation and parks and permission of instructor. CR./F. 4 cr.

885. COMPREHENSIVE PLANNING

Leisure and tourist planning — local, county, and regional. Recreation programming and resource development. Legislative aspects, court decisions, administrative organization, zoning, land use, and other master planning considerations. Prereq: permission of instructor. 4 cr.

890. SPECIAL TOPICS AND PROJECTS

Advanced study in specific areas; may involve formal classes, seminars, or independent projects. Prereq: permission of instructor. 4 cr.

Psychology (Psyc)

Chairperson: Ronald E. Shor

PROFESSORS: Raymond L. Erickson, Eugene S. Mills, John A. Nevin, Ronald E. Shor

ASSOCIATE PROFESSORS: Lance K. Canon, Robert G. Congdon, James R. Davis, Peter S. Fernald, G. Alfred Forsyth, Earl C. Hagstrom, Daniel C. Williams

ASSISTANT PROFESSORS: E. Allan Lind, John E. Limber, David I. Schickedanz, Marty J. Schmidt, Stephen J. Weber, William R. Woodward

Doctor of Philosophy

The Department of Psychology offers a four-year program of study leading to the Doctor of Philosophy degree. The basic goal of the program is the development of behavioral scientists who can both carry out sound research in an area of specialization and teach effectively. Integral to the program is the development of specific skills required by the research psychologist who intends to become a college or university teacher. In order to develop these skills, each year the program required of all students includes a variety of research and instructional activities in addition to the usual academic work. In the third year, each student teaches small sections of introductory psychology under close staff supervision while concurrently enrolled in a teaching seminar that has among its objectives an increased appreciation of the goals and problems of teaching.

Areas in which the student may specialize are: history and theory, learning, physiological psychology, perception-cognition, and social psychology. The student's adviser will help the student to plan an effective graduate program. Core courses taken by all students include methodology, statistics, and the seminar and practicum in the teaching of psychology. Work outside the department also is included in each student's program. Depth in a particular area is obtained through participation in the graduate courses listed below and by independent study and research conducted under the supervision of a staff member. Psychology 895, 896, Reading and Research in Psychology, is specifically designed to serve this purpose.

Prior to the doctoral dissertation, the student will carry out original research that culminates either in a master's thesis or a paper of publishable quality. A master's degree may be awarded upon the successful completion of a program approved by the department and dean of the Graduate School including original research at the master's level. Detailed information concerning language requirements and the qualifying examination for advancement to candidacy for the Ph.D. degree can be obtained from the department.

A student admitted to graduate study must meet the requirements for admission to the Graduate School. In applying for admission to the department's program, candidates must submit Graduate Record Examination scores on the verbal and quantitative sections of the aptitude test and the score on the advanced test in psychology.

To be accepted into the program, the applicant must desire to pursue the doctoral degree and be deemed qualified to do so on the basis of initial selection procedures. The applicant need not necessarily have been an undergraduate major in psychology. However, before beginning a graduate career proper, the applicant must have completed a minimum of 15 undergraduate credits in psychology, including courses in elementary statistics and experimental psychology.

Graduate Curriculum in Psychology

The courses and seminars listed below provide the general framework within which the student will develop, with the counsel of the adviser, a program of research and study leading to the doctoral degree. The range and sequence of seminars will vary to some extent with each student, though there will be common features to all programs.

The 700-series courses are not normally taken for graduate credit, though a student may be advised to enroll in one of these courses as a way of improving background in the field. Graduate credit for a 700-series course is permitted only with the previous approval of the student's adviser.

The graduate courses are offered in a two-year cycle. All basic courses are offered each year and special courses and seminars are offered every other year. Consult the department for exact schedule.

Psychology

801-802. GRADUATE PROSEMINAR

Students and graduate faculty in psychology meet every two weeks for a mutual exchange on current issues in psychology. No cr.

805-806. RESEARCH METHODOLOGY AND STATISTICS I, II

A consideration of research techniques and problems of methodology in psychology. The first semester stresses the principles of statistical inference, correlational approaches, and their interrelatedness in design. Topics considered include probability theory, linear regression, function-free prediction, the theory underlying statistical inference, parametric and nonparametric tests of significance, and principles of analysis of variance. The second semester extends the correlational approach to the techniques and methodology of multiple regression and considers the appropriate use and theoretical bases of complex designs. Prereq: undergraduate statistics and experimental psychology. 3 cr.

807. RESEARCH METHODS AND STATISTICS III

The application of multivariate methods of data analysis in psychological research: multiple regression, Hotelling's T^2 , multivariate analysis of variance, discriminant analysis, canonical correlation, factor analysis. 3 cr.

808. MEASUREMENT AND ASSESSMENT

The nature of measurement in psychology, including both the techniques for evaluating various assessment procedures and the theory of data. Prereq: Psyc 807. 3 cr.

812. PSYCHOLINGUISTICS

The use and development of human language: the nature of explanation, contemporary linguistic theory, semantics, functions of language, speech perception and production, learning. 3 cr.

814. COGNITIVE PROCESSES

The complex mental processes which characterize man: concept formation, reasoning, problem-solving, symbol use, creative thinking, imagination, fantasy behavior, pathology of thought consciousness and its alternatives, and the relationship between cognition and effective behavior are among the topics examined in depth. 3 cr.

815. PSYCHOLOGY OF PERCEPTION

An information-processing approach to perception is taken. A study is made of the development of perceptual theory and its relationship to current perceptual research. Research and theory are examined as they pertain to issues such as: the definition of the stimulus, selective attention in perception, active vs. passive perception, the interactions between sense modalities in information-process, the development of perception in the individual, methodologies and problems of mea-

surement in perception, the role of adaptation in perception, parallel vs. serial processing of information, the role of peripheral and central mechanisms in perception, and the relationship of perception to other content areas in psychology. Opportunities are given for designing and running perception experiments. 3 cr.

816. INFORMATION FEEDBACK AND DECISION MAKING

A seminar devoted to the study of the roles of uncertainty and preference in purposive behavior. 3 cr.

817. SENSORY AND PERCEPTUAL PROCESSES

An introduction to the sensory psychology of visual and auditory perception. The course is intended to acquaint the student with the major problems of current interest in sensory psychology and provide basic skills necessary to begin sensory-perceptual research. Major topic areas: 1) physics of visual and auditory stimuli; 2) sensory physiology of visual and auditory systems; 3) basic visual auditory psychophysics; and 4) study of complex perceptual processes, including pattern vision, color vision and color theory, depth perception, and auditory localization. 3 cr.

831. PHYSIOLOGICAL PSYCHOLOGY I

A study of the research methods and current concepts in the neurosciences. 3 cr.

832. PHYSIOLOGICAL PSYCHOLOGY II

A continuation of Psyc 831. 3 cr.

833. ADVANCED PHYSIOLOGICAL PSYCHOLOGY

Devoted to an intensive examination of a specific topic in the neurosciences. Topics vary depending upon interests of instructor and students. Prereq: Psyc 831. 3 cr.

841. PSYCHOLOGY OF LEARNING

Topics include conditioning and other forms of learning, with emphasis on current experimental and theoretical literature. Undergraduate preparation in the area is not required. 3 cr.

842. STIMULUS CONTROL

Current research and theory dealing with the control of learned behavior by antecedent and current environmental stimuli. Prereq: Psyc 841 or equivalent. 3 cr.

843. INSTRUMENTAL CONDITIONING AND AVERSIVE CONTROL

Offered irregularly as student and faculty interests require. Prereq: Psyc 841 or equivalent. 3 cr.

844. SEMINAR IN HUMAN LEARNING

Offered irregularly as student and faculty interests require. Prereq: Psyc 841 or equivalent. 3 cr.

850. METHODS OF SOCIAL PSYCHOLOGICAL ANALYSIS

An examination of procedures, logic, inferential strength, and potential bias of the various methodologies for studying social behavior. Issues regularly introduced include experimental, quasi-experimental, and nonexperimental designs, the laboratory-field continuum, social psychological aspects of interviews and experiments, the nature of artifacts, and other current methodological issues. The course emphasizes the design of social psychological research rather than statistical analysis, though statistical matters regularly arise. Prereq: Psyc 805 or equivalent, or Soc 801 or equivalent. 3 cr.

851. SOCIAL PSYCHOLOGY

A seminar covering current topics in experimental social psychology including attitude change, power and influence, interpersonal perception and attraction, conformity, and social learning. 3 cr.

852. ATTITUDE AND ATTRIBUTION IN SOCIAL PSYCHOLOGY

An in-depth study of various approaches to attitudinal and attributional processes with particular emphasis upon current theoretical issues. Prereq: Psyc 851. 3 cr.

853. GROUP PROCESS AND SOCIAL INFLUENCE

An examination of the problems of the individual in the group and the group as a system with special emphasis on aspects of social influence. Prereq: Psyc 851 or permission of instructor. 3 cr.

854. SEMINAR IN SOCIAL PSYCHOLOGY

Intensive coverage of the experimental and theoretical literature in a selected area of basic or applied social psychology. Students will participate directly in the conduct of the seminar by means of individual topical discussions, development and/or execution of research designs, and critical assessment of the current state of the topic area under discussion. Illustrative topics: political behavior, paralinguistics and nonverbal communication, ethnic and racial prejudice, and environmental psychology. May be repeated for credit. Prereq: Psyc 851. 3 cr.

856. PSYCHOLOGY OF PERSONALITY

Analysis of major theories and research in personality. 3 cr.

871. SURVEY OF THE HISTORY OF PSYCHOLOGY

A general overview of the history of psychology from its beginnings to the present. 3 cr.

872. METHODS AND THEORIES IN HISTORICAL RESEARCH ON THE BEHAVIORAL SCIENCES

A survey of the main theories and methods employed in historical research with particular emphasis on those most directly applicable to the study of the behavioral sciences. Prereq: Psyc 871 or permission of the instructor. 3 cr.

873. SYSTEMS, SCHOOLS, AND SCIENTIFIC EXPLANATION

An analysis of the principal schools of psychological thought viewed within the context of the philosophy of science. Prereq: Psyc 871 or permission of the instructor. 3 cr.

874. PROBLEM AREAS IN THE HISTORY OF PSYCHOLOGY

In-depth studies of particular individuals, movements, and subfields. Topics vary, and students in the history of psychology program are expected to take the course more than once. Prereq: Psyc 871, 872, or permission of instructor. 3 cr.

875. ARCHIVAL RESEARCH AND THE MANAGEMENT OF MANUSCRIPT COLLECTIONS

A survey of the basic techniques of archival research including ethical and legal considerations. Training will be given in the organization and management of a small manuscript collection. Laboratory experience will be included. Prereq: Psyc 871, 872, or permission of instructor. 3 cr.

876. TOPICS AND METHODS IN THE HISTORIOGRAPHY OF PSYCHOLOGY

Quantitative methods of mapping psychology as a science on individual, instructional, and international levels, e.g. growth indicators, content analyses. The extension of psychological principles into the history of science will also be discussed. May be repeated. Prereq: Psyc 871, 872, or permission. 3 cr.

881. CHILD PSYCHOLOGY

Devoted to topics of current interest in child psychology. Core material will be followed by in-depth study in an area of student's interest. 3 cr.

891-892. PRACTICUM AND SEMINAR IN THE TEACHING OF PSYCHOLOGY

Practicum offers the student an opportunity to teach introductory psychology under close supervision from the staff. The seminar is coordinated with this experience and focuses on both practical and theoretical issues of significance in the teaching/learning process at the college level. Required of all doctoral students, typically during the third year. 5 cr.

Psychology

894. ADVANCED RESEARCH IN PSYCHOLOGY

Each student will design and conduct original research that culminates in a paper of publishable quality. Completion of either this course or Psyc 899 will satisfy the department's research requirement for the master's degree. Staff. May be taken for 3 cr. per semester in each of two semesters or 6 cr. in one semester. Maximum 6 cr.

895-896. READING AND RESEARCH IN PSYCHOLOGY

As part of the development as an independent scholar, the student is encouraged to plan: 1) broad reading in an area; 2) intensive investigation of a special problem; or 3) experimental testing of a particular question. Requires approval of both adviser and staff member directing project. May be repeated. 1) Physiological, 2) Perception, 3) History and Theory, 4) Learning, 5) Social, 6) Cognition, 7) Statistics and Methodology, 8) Psychopathology, 9) Developmental. 3-6 cr. per semester.

897-898. PROBLEMS AND ISSUES IN PSYCHOLOGY

Offered occasionally, the seminar will feature a problem which has been the subject of specialized research and study by a member of the staff. The personnel and topical focus will vary from year to year, and the course may be repeated by the student. 3 cr.

899. MASTER'S THESIS

Each student will carry out original research that culminates in a master's thesis. May be taken 3 cr. per semester in each of two semesters or 6 cr. in one semester. Maximum 6 cr.

999. DOCTORAL RESEARCH

Graduate Courses Offered Primarily for Students Enrolled in Other Graduate Programs

822. THERAPEUTIC PSYCHOLOGY

The course will orient itself around the following three areas: issues which include various aspects of the human condition, essential ingredients in the therapeutic process and in therapy outcomes, effective qualities of therapists, and a full range of ethical considerations; involvement through participation in a group for the presentation of a particular therapeutic approach, comparison of two or more therapists or kinds of therapy, or application of therapeutic psychology to a particular problem area of institutional setting; integration of personal reading, participation in class discussions, and comparison of group presentations. (Offered only in the summer.) 4 cr.

823. INDIVIDUAL TESTING

Training in administration, scoring, and behavioral observation necessary for interpretation of individual tests of intelligence with discussion and demonstration of certain other instruments for cognitive measurement. The focus will be on children rather than adults, and on technique rather than interpretation. Each student will be required to purchase one set of materials. Lab. Prereq: permission of instructor. (Student's background in statistics, measurement, exceptional child, and personality theory will be evaluated by the instructor.) 4 cr. to be granted only after the student has passed the companion course, Psyc 825.

824. PRACTICUM IN INDIVIDUAL INTELLIGENCE TESTING

Supervised experience in use of individual intelligence tests in elementary and junior high school settings. Prereq: Psyc 823 or equivalent; and permission of instructor. 2 cr. to be granted only after the student has passed Psyc 825 (may be taken concurrently or subsequently).

825. USE OF INDIVIDUAL INTELLIGENCE TESTS

Interpretation and use of individual intelligence test results in relation to the cognitive functioning of the child within the school setting. Emphasis will be on taking into account background factors such as culture, emotional status, meaning of the test to the child, and on ethical and administrative problems connected with interpreting test results to parents and school personnel. Students will have an opportunity to discuss case material from their actual daily work. Prereq: Psyc 823; Psyc 824, which may be taken concurrently; permission of the instructor. 4 cr.

Sociology (Soc)

Chairperson: Richard E. Downs

PROFESSORS: Melvin T. Bobick, Walter Buckley, Richard S. Dewey, Bud B. Khleif, Stuart Palmer, Solomon Poll, Murray Straus
ASSOCIATE PROFESSORS: Thomas R. Burns, Peter Dodge, Richard E. Downs, Arnold S. Linsky, Fred Samuels, Howard M. Shapiro
ASSISTANT PROFESSORS: Charles Bolian, Loren Cobb, Gary Hume, Barbara Larson, Stephen P. Reyna
DIRECTOR OF GRADUATE STUDIES: Arnold S. Linsky

The Department of Sociology and Anthropology offers M.A. and Ph.D. degrees in sociology. The master's program emphasizes theory and methodology. Doctoral students are expected to select from areas of departmental specialization one major area — and, from areas of expertise found among the faculty, one minor area — for intensive study and

examination. Four major substantive areas for possible specialization are: deviance, conflict, and control; social psychology; comparative institutional analysis; family. In addition, students may propose to the graduate committee other major areas of specialization which fall within the faculty's competence.

Proficiency in theory, statistics, and methods, and in the major and minor areas of study is determined by examination. Details about the examination can be found in the Graduate Student Handbook which is sent to all students requesting information about the program. Within the context of a curriculum organized largely in the form of seminars and research, the student is expected to select from departmental specializations one major area for intensive study, and also with the approval of the student's adviser and the graduate committee to design a minor area suited to his/her specific interests from the balance of the curriculum offered by the department — including anthropology courses. In addition, evidence of satisfactory performance is required in an extradepartmental field that has been approved as appropriate to his/her professional development. The design of a program most suitable to the individual will take into consideration both the student's past experience and intellectual goals, and, given the guidelines sketched above, flexibility will be emphasized. Selection of thesis and dissertation topics is thus limited only by the areas of expertise available among departmental faculty members.

Students are responsible for remaining informed about any modifications in the requirements of the degree program in which they are enrolled.

Master of Arts candidates must: 1) Complete satisfactorily at least one full year (24 credit hours) of graduate-level course work in sociology including Sociological Methods I and II (801 and 802) and Sociological Theory I or II (811 or 812). 2) Register for one credit of thesis work during the second semester of residence and submit a draft of a proposal to the thesis committee by the end of the semester. The proposal or an abstract must be circulated to all department faculty. 3) Submit for approval a report of an original research endeavor to the thesis committee. This report may be in the form of either a) a thesis, or b) a paper in the form outlined in the publication format of any major sociological journal.

To be awarded the Doctor of Philosophy degree the candidate must fulfill the residence requirement of three years' work after the bachelor's degree including: 1) A minimum of 12 courses in sociology, other than thesis or dissertation research, including Sociological Theory I and II (811 and 812), Sociological Methods I and II (801 and 802), and one other course in methods or statistics (which would normally be 803); three courses in a major area, and two in a minor area of sociology. 2) A minor in a field other than sociology, consisting of three related courses. 3) Pass written examination in the major and minor areas of sociological specialization and in advanced theory and methodology. 4) Make an oral presentation of the dissertation proposal or other scholarly work to the department. 5) Demonstrate reading level proficiency in a foreign language or a research tool appropriate to the student's program. Examples

of research tools include computer programming, symbolic logic, historiography, econometric techniques, and mathematical statistics. At the time they are admitted to the Ph.D. program, students must submit for approval by the graduate committee a statement indicating how they intend to meet the language/research tool requirement. 6) Fulfill the research and/or teaching requirement described below. 7) Write and defend an acceptable doctoral dissertation.

In planning the program of study the student will be advised at first by an assigned faculty member and, subsequently, in the case of doctoral students, by a guidance committee. Specially appointed committees will be organized for the direction and assessment of the thesis and dissertation. Under such supervision the student is expected to go considerably beyond the minimal common requirements of the graduate program to establish a knowledgeability and competency peculiarly his/her own but the student will be permitted to take courses outside the department or below the 700-level within the department only with the express permission of the student's adviser.

In all cases, a student having knowledge equivalent to any of the required courses may substitute an examination to be given by the faculty member responsible for the course.

An important part of the graduate program is the opportunity to learn from participation in the teaching and research activities of the department faculty. All candidates for doctoral degrees are therefore expected to assist a member of the department in teaching and/or research. Assignments to work with a specific member will be made by the graduate committee on the basis of the student's experience, the needed areas of training, and the interests and preferences expressed by the students and faculty members.

Applicants for graduate study in sociology must meet all general Graduate School requirements and must present Graduate Record Examination scores on the verbal and quantitative sections of the aptitude test and his/her score on the advanced test in sociology. Applicants for the Ph.D. should make available a copy of their master's thesis to be reviewed by the Graduate Committee. Undergraduate majors in other fields may be admitted. However, if the student's undergraduate work has not included an introductory course in sociological theory, research methods, statistics, and two other sociology courses, these five courses must be taken — or equivalent knowledge demonstrated through examination — in addition to the requirements outlined above.

All students entering the program must first complete the M.A. before admission to the Ph.D. program. The department welcomes both applicants who plan to continue for the Ph.D. and students planning for the M.A. only.

Sociology

720. CURRENT DEVELOPMENTS IN SOCIOLOGY OF THE FAMILY

A current topic will be selected each semester, such as stratification and the family, intrafamily communication, power structure of the family, kinship in modern societies. Critical review of the literature; class or individual research project will usually be carried out. Prereq: 8 credits of sociology; Soc 520 recommended. 4 cr.

721. FAMILY INTERACTION

Influence of family interaction on human behavior. Self, interactionist, and role approach. Analysis of research. Prereq: 8 credits of sociology and/or psychology; Soc 500 recommended. 4 cr.

735. COMPLEX ORGANIZATIONS

Comparative study of the structure and dynamics of complex, formal organizations (business, military, political and governmental, educational, medical). Power and social control in formal systems; organizational processes, performances, and effectiveness; impact of complex, formal organizations on persons and societies. Prereq: permission of instructor. 4 cr.

740. CULTURE CHANGE

Various types of society; development of theory. Descriptive studies of institutional as well as theoretical materials selected from the writing of Comte, Marx, Spencer, Durkheim, Spengler, Sorokin, Redfield, and others. Prereq: Soc 400. 4 cr.

741. SOCIAL CHANGE AND SOCIETAL DEVELOPMENT

Comparative, interdisciplinary approach. Interrelationships among economic, political, and social factors in determining the structure, dynamics, character, and level of development of societies. Prereq: permission of instructor; Soc 740 recommended. 4 cr.

745. SOCIAL STRATIFICATION

The pattern of distribution of economic, honorific, and political variables within the populations of complex societies; the allocation of personnel to the roles in question, notably through occupational mobility; and the impact of such processes upon behavior, both individual and social. Prereq: Soc 400. 4 cr.

757. SOCIAL INSTITUTIONS OF LATIN AMERICA AND THE CARIBBEAN

Selected analysis of distinctive institutions and social systems, with particular attention to social aspects of the process of modernization. Prereq: permission of instructor. 4 cr.

761. POPULATION DYNAMICS

Major population trends including changes in birth and death rates, population characteristics, mobility, migration, world population growth, population problems, and policies of countries at different stages of economic development. Interrelationship of population and society. 4 cr.

770. CULTURE, PERSONALITY, AND SOCIETY

A cross-cultural view of the development of personality as emergent from genetic, situational, and sociocultural determination; analysis of the dynamic interplay of sociocultural and psychological behavior systems. Prereq: prior courses in sociology, anthropology, or psychology. 4 cr.

780. SOCIAL CONFLICT

The nature of social conflict, especially of war. The setting and initiation of conflict, its dynamics, and the factors affecting its course and outcome. Prereq: permission of instructor. 4 cr.

785. THE STUDY OF WORK

Understanding society through the structure of work. Case studies, in an ethnographic manner, of high-status and low-status occupations to provide understanding of social processes and interrelationships in the social structure. Prereq: for graduate students: permission of instructor. 4 cr.

790. APPLIED SOCIOLOGY

1) Current level of use of sociological knowledge; 2) the advocate, consultant, and researcher roles in applied settings; 3) techniques of applied research; 4) implications of applied sociology, including ethical problems. Each student will focus on a social problem and write a paper covering the above issues. Applied projects where possible. Prereq: Soc 601. 4 cr.

801. SOCIOLOGICAL METHODS I. INTERMEDIATE SOCIAL STATISTICS

Application of descriptive and inferential statistical methods to the analysis of sociological data, including sampling distributions, statistical decision-making, analysis of variance, correlation and regression, and nonparametric measures. Prereq: Soc 602, Statistics, or permission of instructor. 4 cr.

802. SOCIOLOGICAL METHODS II. RESEARCH DESIGN

Systematic investigation of each step in the design and implementation of sociological research. Selected techniques of data collection and analyses will be pursued. Prereq: Soc 601, Methods of Social Research; Soc 602, Social Statistics; or their equivalents;/or permission of instructor. 4 cr.

803. SOCIOLOGICAL METHODS III. SPECIAL PROBLEMS IN METHODS AND STATISTICS

The focus of this course is alternated between special problems in sociological research such as measurement, multivariate analysis and field methods. Prereq: Soc 802. 4 cr.

811. SOCIOLOGICAL THEORY I

The content, presuppositions, and implications of the body of sociological theory, exemplifying the full range of sociological inquiry. Prereq: Soc 611, History of Social Theory; Soc 612, Contemporary Sociological Theory; or their equivalents. 4 cr.

812. SOCIOLOGICAL THEORY II

The content, presuppositions, and implications of contemporary sociological theory. The student will engage in theory construction and analysis, and in this endeavor will be encouraged to develop his/her particular interests in substantive areas. Prereq: Soc 811. 4 cr.

813. SOCIOLOGICAL THEORY III

A seminar of intensive study of topics in sociological theory. Sample topics include: exchange theory, functionalism, systems theory, theory construction, pioneering theorists. Prereq: Soc 611, History of Social Theory; Soc 612, Contemporary Sociological Theory; or their equivalents. 4 cr.

821. DEVIANT BEHAVIOR

A seminar in which attention is directed to the relationships among cultural, subcultural, and personality variables and deviant behavior. Special emphasis is placed on the following forms of deviant behavior: invention, crime, alcoholism, and emotional illness. Prereq: permission of instructor. 4 cr.

830. THE SMALL GROUP

Sociological and social psychological perspectives on interaction within small groups. Prereq: courses in sociology and social psychology, or permission of instructor. (Not offered every year.) 4 cr.

838. SOCIOLOGY OF EDUCATION: SOCIAL ORGANIZATION OF SCHOOLS AND COMMUNITY

Schools in their socio-cultural contexts and as part of the institutional network of society. Relation to stratification and social control. Teaching as a religious occupation and as an emergent profession. (Also offered as Educ 838.) 4 cr.

850. METHODS OF SOCIAL PSYCHOLOGICAL ANALYSIS

An examination of the logic, inferential strength, and potential bias of the various methodologies for studying social behavior. Issues include experimental and nonexperimental designs, the social-psychological aspects of laboratory and field research, the nature of artifacts, etc. Emphasis is on research design rather than statistical analysis, but graduate-level sophistication in statistics is assumed. (Also offered as Psyc 850.) 4 cr.

851. SEMINAR IN SOCIAL PSYCHOLOGY

A survey of some of the major themes in social-psychological theory, including social structure and personality, socialization, small-group processes, and interaction analysis. Students will be expected to read and evaluate selected empirical research. 4 cr.

852. SOCIALIZATION AND ABNORMAL BEHAVIOR

A survey of those orientations that relate socialization to abnormal behavior; synthesizes the major concepts into current sociological and social psychological frame of reference. Prereq: at least one course in social psychology or permission of instructor. 4 cr.

854. SOCIOLOGY OF RELIGION

Critical analysis of the reciprocal relationship of religion and culture; the function of religion in society; the contributions of sociological research; the relationship between religion and other social institutions; religion and social change; and the problem of church and state. 4 cr.

861. DEMOGRAPHY

Current problem areas in demography including population theory, formal demography, social epidemiology, social indicators, use of demographic sources and techniques in sociological investigation. Prereq: Soc 761 or permission of instructor. 4 cr.

870. COMPARATIVE INSTITUTIONAL ANALYSIS

Theory and methods of cross-national approaches, including: history, variations in objectives and methods, problems of translation and conceptual equivalence of behaviors and indexes, and field techniques. Prereq: permission. 4 cr.

Zoology

875. FAMILY AND BEHAVIOR PROBLEMS

Analysis of the approaches used in the sociological study of families. Emphasis on the distinct contributions and the overlaps among such approaches as social structure and socialization. Theoretical statements and empirical studies utilizing these approaches will be discussed. Specific focus will be directed to the use of various models, conceptualizations, etc., for research on families with behavior problems (broadly defined). Issues concerning familial etiology of the response to behavior problems as well as the family's transactions with the wider community will be dealt with in reference to particular types of problems. 4 cr.

885. OCCUPATIONS AND PROFESSIONS

Professionalization as adult socialization, an acquisition of a new identity. Professions as ideologies, markets, and extended families. Research perspective of the Chicago School of Sociology. 4 cr.

888. SOCIOLOGY OF EDUCATION: THE CULTURES OF POVERTY AND AFFLUENCE

The schooling of "culturally deprived" and "culturally endowed" pupils. Problems of social and geographic mobility and immobility. Rise of the counseling and healing trades. (Also offered as Educ 888.) 4 cr.

889. SOCIOLOGY OF EDUCATION: RACE AND ETHNIC RELATIONS IN SCHOOLS AND SOCIETY

Ethnic stratification inside and outside the school. The schooling of whites and nonwhites. Issues of bilingualism, culture, and identity. (Also offered as Educ 889.) 4 cr.

895,896. READING AND RESEARCH IN SOCIOLOGY AND ANTHROPOLOGY

A student prepared by training and experience to do independent work under the guidance of an instructor may register for one or more of the following sections: 1) communications, 2) criminology, 3) cultural/social anthropology, 4) culture change, 5) culture and personality, 6) deviant behavior, 7) prehistoric archaeology, 8) family, 9) population, 10) rural-urban, 11) social control, 12) social differentiation, 13) social movements, 14) social psychology, 15) social research, 16) social theory, 17) anthropological linguistics, 18) social welfare. Prereq: 16 graduate hours of sociology and permission of instructor. Hours and credit to be arranged.

897,898. SPECIAL TOPICS SEMINAR

Under the direction of members of the department on the basis of rotation and interest, seminars are offered in those fields listed under Soc 895, 896. Prereq: permission of instructor. 4 cr.

899. MASTER'S THESIS

Usually 6 cr. but up to 10 cr. when the problem warrants.

999. DOCTORAL RESEARCH

Anthropology (Anth)

731,732. AREA STUDIES IN ARCHAEOLOGY

Offered as staff is available and student needs dictate. 1) South America; 2) Mesoamerica. Prereq: Anth 412; Anth 514; or permission of instructor. 4 cr.

747. AREA STUDIES IN SOCIAL AND CULTURAL ANTHROPOLOGY

1) South America, 2) Mesoamerica, 3) North America, 4) Oceania, 5) Southeast Asia, 6) Africa, 7) Other. Offered as staff is available and student needs dictate. Characteristic ecological, historical, and socio-cultural factors. Analysis of selected societies and institutions. Prereq: Anth 411 or permission of instructor. 4 cr.

752. SOCIAL PROBLEMS IN MODERN AFRICA

Problems of change and development in Africa considered from the anthropological perspective. Prereq: Anth 411 or permission of instructor. 4 cr.

Zoology (Zool)

Chairperson: Philip J. Sawyer

PROFESSORS: Arthur C. Borrer, Wilbur L. Bullock, Philip J. Sawyer, Emery F. Swan, Paul A. Wright

ASSOCIATE PROFESSORS: Robert A. Croker, John E. Foret, Larry G. Harris, James F. Haney, Frank K. Hoornebeek, Marcel E. Lavoie, John J. Sasner, Edward K. Tillinghast

ASSISTANT PROFESSORS: Edward N. Francq, Roderick M. Smith, Charles W. Walker

The graduate program in zoology is intended for the student who aspires to a professional career within or outside the area of college teaching and research. Degrees can be earned with emphasis in behavior, development, ecology (freshwater and marine), endocrinology, genetics, invertebrate zoology, mammalogy, biological oceanography, parasitology, and physiology.

To be admitted to graduate study in zoology, a student ordinarily must have completed an undergraduate major in biology or zoology. A basic array of courses including general biology, development, general ecology, genetics, morphology, and physiology is normally required.

Additionally, a background in chemistry through organic chemistry and a semester each of calculus and physics is necessary. Students who are deficient in any of these requirements may sometimes be admitted to graduate status but may be required to remedy their deficiencies by taking courses which do not give graduate credit.

Each newly accepted graduate student will be interviewed during the second week of classes of the first semester. This interview will be conducted at a specified time by a committee composed of the student's temporary academic adviser plus two additional faculty members. The purpose of this committee is to advise the student in constructing a program of study and to correct such academic deficiencies as may exist. The committee will have available transcripts, letters of recommendation, and the results of the diagnostic exam described below. The committee will then enter its evaluation and recommendations in the student's permanent record.

All incoming graduate students will take a diagnostic exam before classes begin. This will include questions from the areas of behavior, biochemistry and physiology, development, ecology, evolution and systematics, genetics, morphology, parasitology, and general biology. No student is expected to do uniformly well in all areas, but rather a high level of competence is expected in those areas relevant to the student's particular program. Should the interview committee, on the basis of this exam, consider that a deficiency exists, this may be remedied either by a formal course or by an oral examination upon recommendation of the committee. Such oral examinations will be given during the week immediately following the spring vacation.

A candidate for the Master of Science degree in zoology, in addition to the requirements mentioned above, will ordinarily complete a special problem (Zoology 895 or 896) or a thesis that is acceptable to the guidance committee.

All doctoral students must pass a written examination to certify their proficiency in one foreign language. Some fields of pursuit may require more languages and this need will be determined by the student's guidance committee.

After the successful completion of the language requirements and of all required courses, the student who wishes to be admitted to doctoral candidacy must demonstrate a broad basic knowledge of his/her major and minor fields in an oral qualifying examination, administered by the guidance committee. In addition, the student must convince his/her proposed major professor and doctoral committee, in whatever way the committee finds acceptable, of his/her superior capacity to carry out basic research in biology. Normally, the student may accomplish this by presenting to the committee a research proposal in which the soundness, originality, and feasibility of the investigative ideas are clearly revealed, and which — when approved — should serve as the basis of the doctoral dissertation.

704. COMPARATIVE ENDOCRINOLOGY

Endocrine organs; relationship to control of the internal environment, growth, development, and adaptation to the external environment. Prereq: vertebrate anatomy and physiology; organic chemistry. 4 cr.

706. GENETICS LABORATORY

Experiments and demonstrations in classical, developmental, and population genetics and cytogenetics, using a wide range of organisms and techniques. Pre- or coreq: principles of genetics or permission of the instructor. 2 cr.

707. HUMAN GENETICS

Inheritance patterns; gene and chromosome mutation rates and effects; linkage and gene frequency. Prereq: principles of genetics or permission of the instructor. (Not offered in 1977-78.) 4 cr.

711. NATURAL HISTORY OF COLD-BLOODED VERTEBRATES

Classes of poikilothermic vertebrates; their habits, habitats, and life histories in eastern North America. Prereq: general zoology; Vertebrate Morphology. 4 cr.

712. MAMMALOLOGY

Origins, diversification, reproduction, ecology, behavior of mammals. Identification of local forms. Prereq: Principles of Zoology; Vertebrate Morphology. 4 cr.

713. ANIMAL BEHAVIOR

Individual and social behavior. The role of anatomy, physiology, ecology, and prior experience. Techniques and practical application. Prereq: one year of zoology. 4 cr.

715. NATURAL HISTORY OF MARINE INVERTEBRATES

Field and laboratory course; inshore marine invertebrate metazoan animals of northern New England. Identification, classification, habitat preferences, and behavior. Work (collection and observation) constitutes a major part of the course. Some travel expense. Prereq: general zoology. Summer only. 4 cr.

717. GENERAL LIMNOLOGY

Special relationships of freshwater organisms to the chemical, physical and biological aspects of the aquatic environment. Factors regulating the distribution of organisms and primary and secondary productivity of lake habitats. Prereq: General Ecology or equivalent. 4 cr.

Zoology

719. FIELD LIMNOLOGY

Freshwater ecology examined through laboratory exercises with freshwater habitats. Methods to study freshwater lakes; interpretation of data. Seminars and occasional Saturday field trips. Prereq: present or prior enrollment in Bot 717 or Zool 717, or equivalent; /or permission. 4 cr.

721. PARASITOLOGY

Introduction to the more important parasites causing disease in man and animals. Living materials will be used as far as possible. Prereq: one year of zoology. (Not offered every year.) 4 cr.

723. CELL PHYSIOLOGY

Principles of chemistry and physics applied to understanding cell structure and function. Metabolic reactions and their control in relation to cell organization; genesis and function of specialized cells. Prereq: Organic Chemistry. 4 cr.

724. MARINE PARASITOLOGY

Diseases and parasites of marine fishes and shellfish; emphasis on the local estuarine environment. Prereq: one year of zoology. (Not offered every year.) 4 cr.

728. DEVELOPMENTAL BIOLOGY OF THE INVERTEBRATES

Principles of animal reproduction and development as seen in selected invertebrate phyla. Modern and classical studies of gametogenesis, fertilization, cleavage, gastrulation, and larval development will be considered. Prereq: Intro Invertebrate Zoology or permission of instructor. 4 cr.

729. DEVELOPMENTAL BIOLOGY OF THE VERTEBRATES

Principles of animal reproduction and development with emphasis on selected vertebrate types. Embryogenesis, metamorphosis, ontogenesis, and regeneration will be among the topics considered. Prereq: Vertebrate Morphology; Vertebrate Physiology; Principles of Genetics. 4 cr.

730. VERTEBRATE HISTOLOGY

Microscopic anatomy of vertebrate tissues and organs at the light microscope level; emphasis on mammalian histology but with some comparative study of lower vertebrates. Lab. Prereq: Human Anatomy and Physiology; Vertebrate Morphology or equivalent. 4 cr.

732. SOIL ZOOLOGY

Faunal communities of terrestrial soils, their ecology and natural history. Effects of animal activities on soil processes and composition. Collection, extraction, and study methods. Independent projects. Prereq: General Ecology. (Not offered every year.) 4 cr.

772. FISHERIES BIOLOGY

Information and techniques used by fisheries biologists. Emphasis on fish life history, ecology, and economics as related to management techniques. Prereq: Zool 711 or equivalent; /or permission. 4 cr.

774. INTRODUCTION TO MARINE SCIENCE

Daily lectures; laboratory, and field work. Offered at the Isles of Shoals in cooperation with Cornell and the State University of New York. Summers only. Prereq: at least a full year of college biology. 5 cr.

775. INVERTEBRATE EMBRYOLOGY

A comparative study of aspects of reproduction and early development in selected invertebrates, providing a classical approach to morphology of gonads, fertilization, cleavage, gastrulation and formation of larvae. Prereq: UNH Zoology 774 or Cornell Univ. Biol Sci 364 or Invertebrate Zoology. Daily lectures, labs and field work; guest lecturers. Summer only. 4 cr. CR/F.

795,796. SPECIAL PROBLEMS IN ZOOLOGY

1) Biological Oceanography, 2) Ecology, 3) Endocrinology, 4) Evolution, 5) Developmental Biology, 6) Genetics, 7) Histology, 8) History of Zoology, 9) Invertebrate Zoology, 10) Physiology, 11) Vertebrate Zoology, 12) Zoogeography, 13) Zoological Techniques, 14) Parasitology, 15) Histochemistry, 16) Protozoology, 17) Systematics, 18) Animal Behavior, 19) Teaching Practices. May elect one or more sections for advanced study. Reading, laboratory work, organized seminars, and/or conferences. Prereq: permission of staff. (Limit of 12 credits from the sections of this course.) 2 or 4 cr.

803. MARINE ECOLOGY

Marine environment and its biota, emphasizing intertidal and estuarine habitats. Includes field, laboratory, and independent research project. Prereq: General Ecology and permission of instructor; marine invertebrate zoology, Oceanography, and Statistics are desirable. (Not offered every year.) 4 cr.

806. BIOLOGICAL OCEANOGRAPHY

Ocean as an environment for life; oceanic populations, their interrelationships and adaptations. Prereq: permission of instructor. (Not offered every year.) 4 cr.

808. STREAM ECOLOGY

Ecological relationships of organisms in flowing water. Lectures on physical and chemical features of streams, floral and faunal communities, and factors controlling populations of benthic invertebrates. Emphasis on study of the streams as ecosystems. Laboratory exercises employ both field and laboratory experimental techniques. Occasional Saturday field trips. Weekly seminars on original research papers. (Not offered every year.) 4 cr.

811. FRESHWATER ZOOPLANKTON ECOLOGY

Methods of sampling populations; factors regulating temporal and spacial distribution; trophic interactions of communities, role in nutrient cycle of lakes. Experimental techniques employed in field trips to freshwater habitats. Seminars examine current research. Prereq: General Ecology and Limnology, Zool 717, or equivalent; and permission of instructor. (Not offered every year.) 4 cr.

815. POPULATION ECOLOGY

Evolution, genetic theory, differentiation, and functioning of animal populations. Prereq: permission of instructor. (Not offered every year.) 4 cr.

817. ZOOPLANKTON

Oceanic and estuarine populations: zoogeography, interrelationships, and adaptations to pelagic life. Prereq: Invertebrate Zoology; instructor's permission. (Not offered every year.) 4 cr.

820,821. ADVANCED INVERTEBRATE ZOOLOGY

Morphology, phylogeny, and natural history of the major invertebrate phyla. Prereq: Introduction to Invertebrate Zoology or equivalent. (Not offered every year.) 4 cr.

822. PROTOZOOLOGY

General biology of protozoa; morphology, physiology, natural history, and economic importance. Prereq: Zool 721 or 820 or permission of instructor. (Not offered every year.) 4 cr.

826. COMPARATIVE PHYSIOLOGY

A study of the nutrition, metabolism, neural function, reproduction and homeostatic mechanisms of animals, especially invertebrates. Prereq: Zool 723 and instructor's permission. (Not offered every year.) 4 cr.

828. EXPERIMENTAL EMBRYOLOGY

Cellular differentiation during embryonic development. Laboratory techniques in experimental morphogenesis. Prereq: Zoo 728 or 729 or equivalent. (Not offered every year.) 4 cr.

895,896. ADVANCED STUDIES IN ZOOLOGY

Course sections for advanced work, individual or group seminar. May include reading, laboratory work, organized seminars, and conferences. Prereq: permission of department chairperson and staff concerned. (Sections are the same as those listed under Zoology 795, 796.) 2 or 4 cr.

897,898. ZOOLOGY SEMINAR

Reports on recent zoological literature. Subject fields are those listed under Zool 795, 796; not all areas available every semester. Required of graduate students in zoology. Staff. No cr.

899. MASTER'S THESIS

Prereq: permission of department chairperson and prospective supervisor. 6 cr.

999. DOCTORAL RESEARCH

Open to students who have declared their intention of proceeding to candidacy for the Doctor of Philosophy degree.



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Associate Professor of Naval Architecture and Associate Director of Marine Program; M.S., University of New Hampshire, 1950; appointed 1958.

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Beckett, John A.

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Blickle, Robert L.

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Bogle, Alfred Linn

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Brown, Wendell S.

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Bullock, Wilbur L.

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Burns, Thomas R.

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Burt, John M., Jr.

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Burton, David M.

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Carnicelli, Thomas A.

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Carroll, John E.

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Carter, Gavin H.

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Casás, R. Alberto

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Celikkol, Barbaros

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Chesbro, William R.

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Clark, Charles E.

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Clark, Ronald R.

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Clee, Jan E.

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Corbett, Alan C.

Associate Professor of Animal Science; D.V.M., Michigan State College, 1940; appointed 1941.

Corcoran, Ellen P.

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Corell, Robert W.

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Crocker, Robert A.

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Crowson, Lydia L.

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Davis, James R.

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Davis, Richard S.

Dean of the College of Engineering and Physical Sciences and Professor of Materials Science; Ph.D., University of Toronto, 1954; appointed 1968.

Dawson, Carl

Professor of English; Ph.D., Columbia University, 1966; appointed 1970.

Dawson, John F.

Associate Professor of Physics; Ph.D., Stanford University, 1963; appointed 1968.

Deporte, Michael V.

Associate Professor of English; Ph.D., Stanford University, 1966; appointed 1972.

Desrosiers, Richard V.

Assistant Professor of Classics; Ph.D., University of North Carolina, 1969; appointed 1965.

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Associate Professor of Music; Ph.D., Princeton University, 1967; appointed 1968.

Dewey, Richard S.

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Assistant Professor of Water Management; Ph.D., Harvard University, 1970; appointed 1975.

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Professor of Political Science; Ph.D., Princeton University, 1948; appointed 1951.

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Associate Professor of Anthropology; Ph.D., University of Leiden, 1956; appointed 1962.

Draves, David D.

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Dunlop, William R.

Professor of Animal Science; D.V.M., V.S., Ontario Veterinary College, 1938; appointed 1950.

Dunn, Gerald M.

Professor of Plant Science and Genetics; Ph.D., Purdue University, 1951; appointed 1951.

Durgin, Owen B.

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Professor of Chemical Engineering; Ph.D., Stanford University, 1962; appointed 1962.

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Frost, Albert D.

Professor of Electrical Engineering; Sc.D., Massachusetts Institute of Technology, 1952; appointed 1957.

Gadon, Herman

Professor of Administration; Ph.D., Massachusetts Institute of Technology, 1957; appointed 1964.

Gaudette, Henri E.

Associate Professor of Geology; Ph.D., University of Illinois, 1963; appointed 1965.

Geeslin, William E.

Assistant Professor of Mathematics; Ph.D., Stanford University, 1972; appointed 1972.

Geoffrion, Leo D.

Assistant Professor of Education; Ph.D., John Hopkins University, 1975; appointed 1975.

Gerhard, Glen C.

Associate Professor of Electrical Engineering; Ph.D., Ohio State University, 1963; appointed 1967.

Gilmore, Robert C.

Associate Professor of History; Ph.D., Yale University, 1954; appointed 1952.

Glanz, Filson H.

Associate Professor of Electrical Engineering; Ph.D., Stanford University, 1965; appointed 1965.

Goffe, Lewis C.

Associate Professor of English; Ph.D., Boston University, 1961; appointed 1946.

Gordon, Bernard K.

Professor of Political Science; Ph.D., University of Chicago, 1959; appointed 1971.

Grant, Clarence L.

Professor of Chemistry; Ph.D., Rutgers University, 1960; appointed 1952-58, 1961.

Graves, Donald H.

Assistant Professor of Education; Ph.D., State University of Buffalo, 1973; appointed 1973.

Green, D. MacDonald

Professor of Biochemistry and Genetics; Ph.D., University of Rochester, 1958; appointed 1967.

Gress, David L.

Assistant Professor of Civil Engineering; Ph.D., Purdue University, 1976; appointed 1974.

Grishman, Alan

Associate Professor of Music; M.A., New York University, 1967; appointed 1967.

Grossman, Lois S.

Assistant Professor of Spanish; Ph.D., Rutgers University, 1972; appointed 1972.

Haendler, Helmut M.

Professor of Chemistry; Ph.D., University of Washington, 1940; appointed 1945.

Hageman, Elizabeth H.

Assistant Professor of English; Ph.D., University of North Carolina, 1971; appointed 1971.

Hagstrom, Earl C.

Associate Professor of Psychology; Ph.D., Brown University, 1957; appointed 1965.

Hall, Francis R.

Professor of Hydrology; Ph.D., Stanford University, 1961; appointed 1964.

Haney, James F.

Associate Professor of Zoology; Ph.D., University of Toronto, 1970; appointed 1972.

Hansen, Larry J.

Assistant Professor of Home Economics; Ph.D., Florida State University, 1973; appointed 1973.

Hapgood, Robert

Professor of English; Ph.D., University of California, 1955; appointed 1965.

Harrington, Barry J.

Assistant Professor of Physics; Ph.D., Harvard University, 1975; appointed 1975.

Harris, Larry G.

Associate Professor of Zoology; Ph.D., University of California, 1970; appointed 1969.

Harter, Robert D.

Associate Professor of Soil Chemistry; Ph.D., Purdue University, 1966; appointed 1969.

Hebert, David J.

Associate Professor of Education; Ph.D., Kent State University, 1967; appointed 1967.

Heilbronner, Hans

Professor of History; Ph.D., University of Michigan, 1954; appointed 1954.

Held, Warren H., Jr.

Professor of Classics; Ph.D., Yale University, 1955; appointed 1967.

Henry, William F.

Professor of Resource Economics; M.S., University of Connecticut, 1942; appointed 1952.

Herbst, Edward J.

Professor of Biochemistry; Ph.D., University of Wisconsin, 1949; appointed 1962.

Hettinger, Stanley D.

Assistant Professor of Music; M.M.E., VanderCook College, 1966; appointed 1965.

Hill, John L.

Professor of Wood Science and Technology; D.F., Yale University, 1954; appointed 1964.

Hochgraf, Frederick G.

Associate Professor of Materials Science; M.S., Cornell University, 1958; appointed 1958.

Hocker, Harold W., Jr.

Professor of Forest Resources and Genetics; D.F., Duke University, 1955; appointed 1955.

Hoff, Phyllis

Associate Professor of Physical Education; Ph.D., University of Southern California, 1967; appointed 1967.

Holder, Mary E.

Associate Professor of Home Economics; M.S., Michigan State University, 1949; appointed 1967.

Holter, James B.

Associate Professor of Animal Science; Ph.D., Pennsylvania State University, 1962; appointed 1963.

Hoornebeck, Frank K.

Associate Professor of Zoology and Genetics; Ph.D., Oregon State University, 1964; appointed 1964.

Horrigan, James O.

Professor of Business Administration; Ph.D., University of Chicago, 1967; appointed 1966.

Hosek, William R.

Professor of Economics; Ph.D., University of California at Santa Barbara, 1967; appointed 1967.

Houston, Robert E., Jr.

Professor of Physics; Ph.D., Pennsylvania State University, 1957; appointed 1957.

Howard, Cleveland L.

Associate Professor of Music; D.M.A., Boston University, 1969; appointed 1969.

Hoyle, Merrill C.

Adjunct Assistant Professor of Plant Science; Ph.D., University of New Hampshire, 1971; appointed 1972.

Hubbard, Colin D.

Associate Professor of Chemistry; Ph.D., University of Sheffield, 1964; appointed 1967.

Hudon, Louis J.

Professor of French; Ph.D., Yale University, 1943; appointed 1961.

Hume, Gary

Assistant Professor of Anthropology; Ph.D., University of Minnesota, 1972; appointed 1976.

Hurd, Richard W.

Assistant Professor of Economics; Ph.D., Vanderbilt University, 1972; appointed 1973.

Hylton, Walter E.

Assistant Professor of Animal Science; V.M.D., University of Pennsylvania, 1970; appointed 1976.

Ikawa, Miyoshi

Professor of Biochemistry; Ph.D., University of Wisconsin, 1948; appointed 1963.

Irwin, Manley R.

Professor of Economics; Ph.D., Michigan State University, 1963; appointed 1963.

Jacoby, Robb

Professor of Mathematics; Ph.D., University of Chicago, 1946; appointed 1961.

James, Marion E.

Associate Professor of History; Ph.D., Harvard University, 1955; appointed 1955.

Jansen, Edmund F., Jr.

Associate Professor of Resource Economics; Ph.D., North Carolina State University, 1966; appointed 1969.

Jellison, Charles A., Jr.

Professor of History; Ph.D., University of Virginia, 1956; appointed 1956.

Jenks, R. Stephen

Associate Professor of Organizational Behavior; Ph.D., Case Institute, 1966; appointed 1967.

Jensen, Kenneth G.

Assistant Professor of Botany; Ph.D., University of Iowa, 1974; appointed 1976.

Johnson, Richard E.

Professor of Mathematics; Ph.D., University of Wisconsin, 1941; appointed 1966.

Jones, Galen E.

Professor of Microbiology; Ph.D., Rutgers University, 1956; appointed 1966.

Jones, Paul R.

Professor of Chemistry; Ph.D., University of Illinois, 1956; appointed 1956.

Jones, William R.

Professor of History; Ph.D., Harvard University, 1958; appointed 1962.

Kaen, Fred R.

Associate Professor of Finance; Ph.D., University of Michigan, 1972; appointed 1973.

Kaufmann, Richard L.

Professor of Physics; Ph.D., Yale University, 1960; appointed 1963.

Kayser, John R.

Associate Professor of Political Science; Ph.D., Claremont Graduate School and University Center, 1969; appointed 1969.

Keener, Harry A.

Dean of the College of Life Science and Agriculture, Director of the Agricultural Experiment Station, and Professor of Animal Science; Ph.D., Pennsylvania State University, 1941; appointed 1941.

Kertzer, Robert

Associate Professor of Physical Education; Ph.D., Michigan State University, 1965; appointed 1965.

Khleif, Bud B.

Professor of Sociology and Education; Ph.D., Johns Hopkins University, 1957; appointed 1967.

Kiang, Yun Tzu

Associate Professor of Plant Sciences and Genetics; Ph.D., University of California, 1970; appointed 1970.

Kimball, Roland B.

Professor of Education; Ed.D., Harvard University, 1958; appointed 1963.

Kinerson, Russell S., Jr.

Assistant Professor of Botany; Ph.D., University of Washington, 1971; appointed 1973.

Klippenstein, Gerald L.

Associate Professor of Biochemistry; Ph.D., Northwestern University, 1967; appointed 1967.

Klotz, Louis H.

Associate Professor of Civil Engineering; Ph.D., Rutgers University, 1967; appointed 1965.

Koch, David W.

Assistant Professor of Plant Science; Ph.D., Colorado State University, 1971; appointed 1971.

Koldny, Annette

Assistant Professor of English; Ph.D., University of California at Berkeley, 1969; appointed 1974.

Komonchak, Bernadette

Assistant Professor of Spanish; Ph.D., University of Arizona, 1974; appointed 1976.

Korbel, John

Professor of Economics and Business Administration; Ph.D., Harvard University, 1959; appointed 1966.

Kuo, Shan S.

Professor of Computer Science; D. Eng., Yale University, 1958; appointed 1964.

Ladd, Dwight R.

Professor of Business Administration; D.B.A., Harvard University, 1956; appointed 1964.

Lagassa, George

Assistant Professor of Political Science; Ph.D., SUNY at Buffalo, 1976; appointed 1974.

Lambert, Robert H.

Professor of Physics; Ph.D., Harvard University, 1963; appointed 1955-56, 1961.

Langley, Harold E., Jr.

Associate Professor of Civil Engineering; Sc.D., Massachusetts Institute of Technology, 1957; appointed 1961.

Larson, Barbara K.

Assistant Professor of Anthropology; Ph.D., Columbia University, 1975; appointed 1976.

Larson, David L.

Associate Professor of Political Science; Ph.D., Fletcher School, Tufts University, 1963; appointed 1965.

Lavoie, Marcel E.

Associate Professor of Zoology; Ph.D., Syracuse University, 1956; appointed 1950-52, 1955.

Leighton, Charles H.

Professor of Spanish; Ph.D., Harvard University, 1961; appointed 1956.

Limber, John E.

Assistant Professor of Psychology; Ph.D., University of Illinois, 1969; appointed 1971.

Limbirt, David E.

Associate Professor of Mechanical Engineering; Ph.D., Case Western Reserve University, 1969; appointed 1969.

Lind, E. Allan

Assistant Professor of Psychology; Ph.D., University of North Carolina, 1973; appointed 1975.

Lindberg, Gary H.

Associate Professor of History; Ph.D., Stanford University, 1967; appointed 1974.

Linden, Allen B.

Associate Professor of History; Ph.D., Columbia University, 1969; appointed 1963.

Lindsay, Bruce E.

Assistant Professor of Resource Economics; Ph.D., University of Massachusetts, 1976; appointed 1976.

Lindzey, Frederick G.

Assistant Professor of Wildlife Ecology; Ph.D., Oregon State University, 1976; appointed 1976.

Linsky, Arnold S.

Associate Professor of Sociology; Ph.D., University of Washington, 1966; appointed 1966.

Lockwood, John A.

Associate Director of Research and Professor of Physics; Ph.D., Yale University, 1948; appointed 1948.

Loder, Theodore C., III

Assistant Professor of Earth Sciences; Ph.D., University of Alaska, 1971; appointed 1972.

Logan, Terence P.

Associate Professor of English; Ph.D., Harvard University, 1966; appointed 1968.

Long, David F.

Professor of History; Ph.D., Columbia University, 1950; appointed 1948.

Loy, James B.

Associate Professor of Plant Sciences and Genetics; Ph.D., Colorado State University, 1967; appointed 1967.

MacHardy, William E.

Assistant Professor of Plant Pathology; Ph.D., University of Rhode Island, 1970; appointed 1972.

Marshall, Grover E.

Assistant Professor of French and Italian; Ph.D., Princeton University, 1971; appointed 1965.

Mathieson, Arthur C.

Professor of Botany; Ph.D., University of British Columbia, 1965; appointed 1965.

Mathur, Virendra K.

Assistant Professor of Chemical Engineering; Ph.D., University of Missouri at Rolla, 1970; appointed 1974.

Mautz, William W.

Associate Professor of Wildlife Ecology; Ph.D., Michigan State University, 1969; appointed 1969.

Mayewski, Paul A.

Assistant Professor of Earth Sciences; Ph.D., Ohio State University, 1973; appointed 1974.

McCann, Francis D., Jr.

Associate Professor of History; Ph.D., Indiana University, 1967; appointed 1971.

Meeker, Loren David

Associate Professor of Mathematics; Ph.D., Stanford University, 1965; appointed 1970.

Melvin, Donald W.

Associate Professor of Electrical Engineering; Ph.D., Syracuse University, 1970; appointed 1957.

Menge, Carleton P.

Professor of Education; Ph.D., University of Chicago, 1948; appointed 1948.

Mennel, Robert M.

Associate Professor of History; Ph.D., Ohio State University, 1969; appointed 1969.

Merton, Andrew H.

Assistant Professor of English; B.A., University of New Hampshire, 1967; appointed 1972.

Messier, Victor

Associate Professor of Home Economics; Ph.D., Pennsylvania State University, 1973; appointed 1970.

Metcalf, Theodore G.

Professor of Microbiology; Ph.D., University of Kansas, 1950; appointed 1956.

Miaoulis, George

Assistant Professor of Marketing; Ph.D., New York University, 1973; appointed 1973.

Miller, Edmund G.

Professor of English; Ph.D., Columbia University, 1955; appointed 1951.

Mills, Eugene S.

President and Professor of Psychology; Ph.D., Claremont Graduate School, 1952; appointed 1962.

Mills, Richard L.

Associate Professor of Economics and Business Administration; Ph.D., Indiana University, 1967; appointed 1967.

Minocha, Subhash

Assistant Professor of Botany; Ph.D., University of Washington, 1974; appointed 1974.

Moore, Berrien, III

Associate Professor of Mathematics; Ph.D., University of Virginia, 1969; appointed 1969.

Moore, David W.

Associate Professor of Political Science; Ph.D., Ohio State University, 1970; appointed 1972.

Morris, Douglas E.

Adjunct Professor of Resource Economics; Ph.D., Oklahoma State University, 1972; appointed 1972.

Morrison, James D.

Professor of Chemistry; Ph.D., Northwestern University, 1963; appointed 1965.

Mosberg, William

Associate Professor of Mechanical Engineering; M.Eng., Yale University, 1960; appointed 1958.

Mott, Basil J.F.

Dean of School of Health Studies and Professor of Health Services Administration and Planning; Ph.D., Harvard University, 1967; appointed 1973.

Mower, Lyman

Professor of Physics; Ph.D., Massachusetts Institute of Technology, 1953; appointed 1957.

Mulhern, John E., Jr.

Professor of Physics; Ph.D., Boston University, 1954; appointed 1954.

Munroe, M. Evans

Professor of Mathematics; Ph.D., Brown University, 1945; appointed 1959.

Murdoch, Joseph B.

Professor of Electrical Engineering; Ph.D., Case Institute of Technology, 1962; appointed 1952.

Murray, Donald M.

Professor of English; B.A., University of New Hampshire, 1948; appointed 1963.

Nahin, Paul J.

Assistant Professor of Electrical Engineering; Ph.D., University of California, 1972; appointed 1975.

Nevin, John A.

Professor of Psychology; Ph.D., Columbia University, 1963; appointed 1972.

Nicoloff, Philip L.

Professor of English; Ph.D., Columbia University, 1959; appointed 1954.

Nielson, Melville

Associate Dean of the College of Liberal Arts and Associate Professor of Sociology; Ph.D., Ohio State University, 1955; appointed 1950.

Nordgren, Eric A.

Professor of Mathematics; Ph.D., University of Michigan, 1964; appointed 1964.

O'Brien, Dennis J.

Assistant Professor of Civil Engineering; Ph.D., University of Maryland, 1974; appointed 1974.

O'Connell, Lawrence W.

Associate Professor of Political Science; Ph.D., Syracuse University, 1968; appointed 1966.

Olson, David P.

Associate Professor of Wildlife Ecology; Ph.D., University of Minnesota, 1964; appointed 1968.

Ossenbruggen, Paul J.

Associate Professor of Civil Engineering; Ph.D., Carnegie-Mellon University, 1970; appointed 1975.

Owens, Charles W.

Associate Professor of Chemistry; Ph.D., University of Kansas, 1963; appointed 1963.

Palmer, Stuart H.

Professor of Sociology; Ph.D., Yale University, 1955; appointed 1955.

Paul, Nicholas L.

Assistant Professor of Occupational Education; Ed.D., North Carolina State University, 1973; appointed 1973.

Peirce, Lincoln C.

Professor of Plant Science and Genetics; Ph.D., University of Minnesota, 1958; appointed 1964.

Peterson, Nobel K.

Associate Professor of Soil and Water Science; Ph.D., Rutgers University, 1957; appointed 1957.

Petroski, Joseph J.

Associate Professor of Education; Ed.D., Harvard University, 1960; appointed 1966.

Pfanner, Helmut F.

Associate Professor of German; Ph.D., Stanford University, 1965; appointed 1969.

Pierce, Edward R.

Assistant Dean, School of Health Studies and Associate Professor of Health Studies and Genetics; Ph.D., University of Louisville, 1968; appointed 1974.

Pilar, Frank L.

Professor of Chemistry; Ph.D., University of Cincinnati, 1957; appointed 1957.

Pine, Gerald J.

Professor of Education; Ed.D., Boston University, 1963; appointed 1966.

Pistole, Thomas G.

Assistant Professor of Microbiology; Ph.D., University of Utah, 1969; appointed 1971.

Plager, Dean R.

Instructor of Administration; M.B.A., University of Denver, 1970; appointed 1975.

Pokoski, John L.

Associate Professor of Electrical Engineering; Ph.D., Montana State University, 1967; appointed 1967.

Polk, Keith

Associate Professor of Music; Ph.D., University of California at Berkeley, 1968; appointed 1964.

Poll, Solomon

Professor of Sociology; Ph.D., University of Pennsylvania, 1960; appointed 1964.

Pollard, James E.

Associate Professor of Plant Science; Ph.D., University of Florida, 1969; appointed 1970.

Potter, Hugh M., III

Assistant Professor of English; Ph.D., University of Minnesota, 1965; appointed 1962.

Prince, Allan B.

Vice Provost for Budget and Administration and Professor of Soil and Water Science; Ph.D., Rutgers University, 1950; appointed 1954.

Puth, Robert C.

Associate Professor of Economics; Ph.D., Northwestern University, 1967; appointed 1967.

Radlow, James

Professor of Applied Mathematics; Ph.D., New York University, 1957; appointed 1965.

Rasmussen, Mary H.

Associate Professor of Music; M.M., University of Illinois, 1952; M.L.S., University of Illinois, 1956; appointed 1968.

Reeves, Roger Marcel

Associate Professor of Entomology and Forest Resources; Ph.D., SUNY College of Forestry, Syracuse University, 1964; appointed 1964.

Repka, Frank J.

Assistant Professor of Animal Science; Ph.D., Cornell University, 1972; appointed 1972.

Reyna, Stephen P.

Assistant Professor of Anthropology; Ph.D., Columbia University, 1972; appointed 1973.

Rich, Avery E.

Associate Dean of College of Life Sciences and Agriculture and Professor of Plant Pathology; Ph.D., State University of Washington, 1950; appointed 1941-43, 1951.

Richardson, John C.

Professor of English; Ph.D., Boston University, 1959; appointed 1946.

Rogers, John E.

Associate Professor of Music; M.F.A., Princeton University, 1966; appointed 1967.

Rogers, Owen M.

Professor of Plant Science and Genetics; Ph.D., Pennsylvania State University, 1959; appointed 1959.

Romoser, George K.

Professor of Political Science; Ph.D., University of Chicago, 1958; appointed 1961-62, 1967.

Rosen, Sam

Nashua Corporation Professor of Economics; Ph.D., Harvard University, 1952; appointed 1957.

Rosenbush, Michael J.

Associate Professor of Russian; Ph.D., Université de Montreal, 1970; appointed 1972.

Ross, Shepley L.

Professor of Mathematics; Ph.D., Boston University, 1953; appointed 1955.

Rothwell, Kenneth J.

Professor of Economics; Ph.D., Harvard University, 1960; appointed 1963.

Rouman, John C.

Associate Professor of Classics; Ph.D., University of Wisconsin, 1965; appointed 1965.

Routley, Douglas G.

Professor of Plant Science; Ph.D., Pennsylvania State University, 1957; appointed 1957.

Russell, Robert D.

Assistant Professor of Mathematics; Ph.D., Stanford University, 1967; appointed 1975.

Rutman, Darrett B.

Professor of History; Ph.D., University of Virginia, 1959; appointed 1968.

Samuels, Fred

Associate Professor of Sociology; Ph.D., University of Massachusetts, 1966; appointed 1966.

Sasner, John J., Jr.

Associate Professor of Zoology; Ph.D., University of California, 1965; appointed 1965.

Savage, Godfrey H.

Professor of Mechanical Engineering; Ph.D., Stanford University, 1970; appointed 1965.

Sawyer, Albert K.

Professor of Chemistry; M.S., University of Maine, 1947; appointed 1949.

Sawyer, Philip J.

Professor of Zoology; Ph.D., University of Michigan, 1956; appointed 1952.

Schibanoff, Susan

Associate Professor of English; Ph.D., University of California at Los Angeles, 1971; appointed 1971.

Schickedanz, David I.

Assistant Professor of Psychology; Ph.D., University of Illinois, 1973; appointed 1973.

Schmidt, Marty J.

Assistant Professor of Psychology; Ph.D., Purdue University, 1972; appointed 1972.

Schneer, Cecil J.

Professor of Geology and the History of Science; Ph.D., Cornell University, 1954; appointed 1950, 1954.

Schreiber, Richard W.

Professor of Botany; Ph.D., University of Wisconsin, 1955; appointed 1957.

Schwab, Charles

Assistant Professor of Animal Sciences; Ph.D., University of Wisconsin, 1974; appointed 1975.

Schwarz, Marc L.

Associate Professor of History; Ph.D., University of California at Los Angeles, 1965; appointed 1967.

Seitz, W. Rudolf

Assistant Professor of Chemistry; Ph.D., Massachusetts Institute of Technology, 1975; appointed 1976.

Shapiro, Howard M.

Associate Professor of Sociology; Ph.D., University of Minnesota, 1969; appointed 1969.

Shar, Albert O.

Associate Professor of Mathematics; Ph.D., University of Pennsylvania, 1970; appointed 1971.

Shepard, Harvey K.

Associate Professor of Physics; Ph.D., California Institute of Technology, 1966; appointed 1969.

Sherman, James L.

Assistant Professor of German; Ph.D., University of Michigan, 1969; appointed 1967.

Shor, Ronald E.

Professor of Psychology; Ph.D., Brandeis University, 1960; appointed 1967.

Shore, Barry

Associate Professor of Administration; Ph.D., University of Wisconsin, 1968; appointed 1974.

Shore, Samuel D.

Associate Professor of Mathematics; Ph.D., Pennsylvania State University, 1964; appointed 1965.

Siddall, David V.

Assistant Professor of English; Ph.D., Indiana University, 1970; appointed 1965.

Silver, Judith A.

Assistant Professor of History; Ph.D., University of Michigan, 1973; appointed 1973.

Silverman, Robert J.

Professor of Mathematics; Ph.D., University of Illinois, 1952; appointed 1962.

Simic, Charles D.

Associate Professor of English; B.A., New York University, 1967; appointed 1973.

Simpson, Robert E.

Associate Professor of Physics; Ph.D., Harvard University, 1960; appointed 1963.

Sir, W. Niel

Associate Professor of Music; M.A., University of California, 1962; appointed 1970.

Sitkoff, Harvard

Assistant Professor of History; Ph.D., Columbia University, 1975; appointed 1976.

Sivaprasad, Kondagunta

Associate Professor of Electrical Engineering; Ph.D., Harvard University, 1963; appointed 1969.

Skoglund, Winthrop C.

Professor of Animal Science; Ph.D., Pennsylvania State University, 1958; appointed 1950.

Smith, Gerald L.

Associate Professor of Animal Science; M.S., Pennsylvania State University, 1951; appointed 1948.

Smith, Gordon D.

Assistant Professor of Quantitative Methods and Operations Management; Ph.D., Pennsylvania State University, 1976; appointed 1976.

Smith, M. Daniel

Associate Professor of Education; Ed.D., Harvard University, 1961; appointed 1967.

Smith, Elizabeth C.

Lecturer in Animal Science; Ph.D., Pennsylvania State University, 1958; appointed 1968.

Smith, James A.

Associate Dean of the College of Liberal Arts and Adjunct Associate Professor of Economics; Ph.D., Washington State University, 1967; appointed 1972.

Smith, Mark R.

Professor of English; B.A., Northwestern University, 1960; appointed 1966.

Smith, Roderick M.

Assistant Professor of Zoology; Ph.D., University of Massachusetts, 1969; appointed 1971.

Smith, Samuel C.

Professor of Animal Science and Biochemistry; Ph.D., Pennsylvania State University, 1962; appointed 1961.

Snell, Elizabeth A.

Associate Professor of Home Economics; Ph.D., Cornell University, 1971; appointed 1971.

Spitz, Allan

Dean of the College of Liberal Arts and Professor of Political Science; Ph.D., Michigan State University, 1964; appointed 1971.

Sprague, Linda G.

Associate Professor of Business Administration; D.B.A., Harvard University, 1973; appointed 1969.

Stackhouse, Larry L.

Associate Professor of Animal Science; Ph.D., Colorado State University, 1970; appointed 1970.

Steele, Donald E.

Professor of Music; M.A., Colorado College, 1952; appointed 1946.

Stewart, Glenn W.

Associate Professor of Geology and State Geologist; M.A., Harvard University, 1950; appointed 1938-39, 1941.

Stewart, James A.

Associate Professor of Biochemistry; Ph.D., University of Connecticut, 1967; appointed 1968.

Stone, Deborah E.

Associate Professor of Education; Ed.D., Boston University, 1971; appointed 1962.

Stotz, Kerwin C.

Associate Professor of Electrical Engineering; Ph.D., Rensselaer Polytechnic Institute, 1963; appointed 1964.

Straus, Murray A.

Professor of Sociology; Ph.D., University of Wisconsin, 1956; appointed 1968.

Strout, Richard G.

Professor of Animal Science; Ph.D., University of New Hampshire, 1961; appointed 1954.

Swan, Emery F.

Professor of Zoology; Ph.D., University of California, 1942; appointed 1952.

Swift, M. Robinson

Assistant Professor of Mechanical Engineering; Ph.D., University of New Hampshire, 1974; appointed 1975.

Taft, Charles K.

Professor of Mechanical Engineering; Ph.D., Case Institute of Technology, 1960; appointed 1967.

Teeri, Arthur E.

Professor of Biochemistry; Ph.D., Rutgers University, 1943; appointed 1938-40, 1943.

Thompson, Allen R.

Assistant Professor of Economics; Ph.D., University of Texas at Austin, 1973; appointed 1974.

Tillinghast, Edward K.

Associate Professor of Zoology; Ph.D., Duke University, 1966; appointed 1967.

Tischler, Herbert

Professor of Geology; Ph.D., University of Michigan, 1961; appointed 1965.

Trout, Ben T.

Associate Professor of Political Science; Ph.D., Indiana University, 1972; appointed 1969.

Uebel, J. John

Professor of Chemistry; Ph.D., University of Illinois, 1964; appointed 1964.

Ulrich, Gail D.

Associate Professor of Chemical Engineering; Sc.D., Massachusetts Institute of Technology, 1964; appointed 1970.

Urban, Willard E., Jr.

Associate Professor of Biometrics and Genetics; Ph.D., Iowa State University, 1963; appointed 1963.

Valentine, Russell L.

Associate Professor of Mechanical Engineering; M.S.M.E., Purdue University, 1953; appointed 1953.

Van Osdol, Donovan Harold

Associate Professor of Mathematics; Ph.D., University of Illinois, 1969; appointed 1970.

Verrette, Paul F.

Associate Professor of Music; M.A., Boston University, 1971; appointed 1962.

Vincent, Donald E.

Professor, Librarian; Ph.D., University of Michigan, 1974; appointed 1962.

Voll, John O.

Associate Professor of History; Ph.D., Harvard University, 1969; appointed 1965.

Vrooman, Jack R.

Associate Professor of French; Ph.D., Princeton University, 1965; appointed 1971.

Walker, Charles W.

Assistant Professor of Zoology; Ph.D., Cornell University, 1976; appointed 1976.

Wallace, Oliver P., Sr.

Associate Professor of Forest Resources; Ph.D., University of Michigan, 1954; appointed 1958.

Wang, Tung-Ming

Professor of Civil Engineering; Ph.D., Northwestern University, 1960; appointed 1961.

Warren, Jerry A.

Director of Academic Computer Activities, Associate Professor of Plant Science; Ph.D., Cornell University, 1960; appointed 1971.

Waterfield, D. Allan

Associate Professor of Physical Education; Ph.D., Ohio State University, 1976; appointed 1970.

Wear, Robert E.

Associate Professor of Physical Education; Ph.D., University of Michigan, 1955; appointed 1964.

Webb, Dwight

Associate Professor of Education; Ph.D., Stanford University, 1967; appointed 1967.

Webber, William R.

Professor of Physics; Ph.D., University of Iowa, 1957; appointed 1969.

Weber, Janes H.

Associate Professor of Chemistry; Ph.D., Ohio State University, 1963; appointed 1963.

Weber, Stephen J.

Assistant Professor of Psychology; Ph.D., Northwestern University, 1971; appointed 1971.

Weesner, Theodore W.

Associate Professor of English; M.F.A., University of Iowa, 1965; appointed 1966.

Weiland, Walter E.

Associate Professor of Physical Education; Ph.D., Pennsylvania State University, 1964; appointed 1964.

Wells, Otho S.

Associate Professor of Plant Science; Ph.D., Rutgers University, 1966; appointed 1966.

Wetzel, William E.

Associate Professor of Business Administration; M.B.A., Temple University, 1965; appointed 1967.

Weyrick, Richard R.

Associate Professor of Forest Resources; Ph.D., University of Minnesota, 1968; appointed 1970.

Wheeler, Charles M., Jr.

Professor of Chemistry; Ph.D., West Virginia University, 1951; appointed 1950.

Wheeler, Douglas L.

Professor of History; Ph.D., Boston University, 1963; appointed 1965.

White, Susan O.

Associate Professor of Political Science; Ph.D., University of Minnesota, 1970; appointed 1969.

Whitlock, John B.

Associate Professor of Music; Ph.D., State University of Iowa, 1958; appointed 1958.

Wicks, John D.

Professor of Music; Ph.D., Harvard University, 1959; appointed 1956.

Wight, Thomas

Assistant Professor of Animal Science; Ph.D., University of New Hampshire, 1972; appointed 1973.

Wilcox, Donald J.

Professor of History; Ph.D., Harvard University, 1967; appointed 1970.

Williams, Daniel C.

Associate Professor of Psychology; Ph.D., University of California at Santa Barbara, 1970; appointed 1970.

Williams, Thomas A., Jr.

Professor of English; M.A., University of New Hampshire, 1958; appointed 1958.

Willits, Robin D.

Professor of Business Administration and Organization; Ph.D., Massachusetts Institute of Technology, 1965; appointed 1965.

Wilson, John A.

Associate Professor of Mechanical Engineering; Ph.D., Northeastern University, 1970; appointed 1960.

Wing, Henry J., Jr.

Associate Professor of Music; Ph.D., Boston University, 1966; appointed 1970.

Winn, Alden L.

Professor of Electrical Engineering; S.M., Massachusetts Institute of Technology, 1948; appointed 1948.

Woodward, William R.

Assistant Professor of Psychology; Ph.D., Yale University, 1975; appointed 1975.

Wright, John J.

Associate Professor of Physics; Ph.D., University of New Hampshire, 1969; appointed 1970.

Wright, Paul A.

Professor of Zoology; Ph.D., Harvard University, 1944; appointed 1958.

Wrightsmann, Dwayne E.

Professor of Finance; Ph.D., Michigan State University, 1964; appointed 1964.

Wurzburg, Frederic W.

Associate Professor of Political Science; Ph.D., Columbia University, 1961; appointed 1963.

Wyman, Charles E.

Assistant Professor of Chemical Engineering; Ph.D., Princeton University, 1971; appointed 1974.

Yildiz, Asim

Professor of Mechanics; D.Eng., Yale University, 1959; appointed 1967.

Young, Sharon

Assistant Professor of Home Economics; Ph.D., Ohio State University, 1975; appointed 1976.

Yount, John A.

Professor of English; M.F.A., State University of Iowa, 1962; appointed 1962-64, 1965.

Zoller, J. Harold

Professor of Civil Engineering; Ph.D., University of Wisconsin, 1953; appointed 1958.

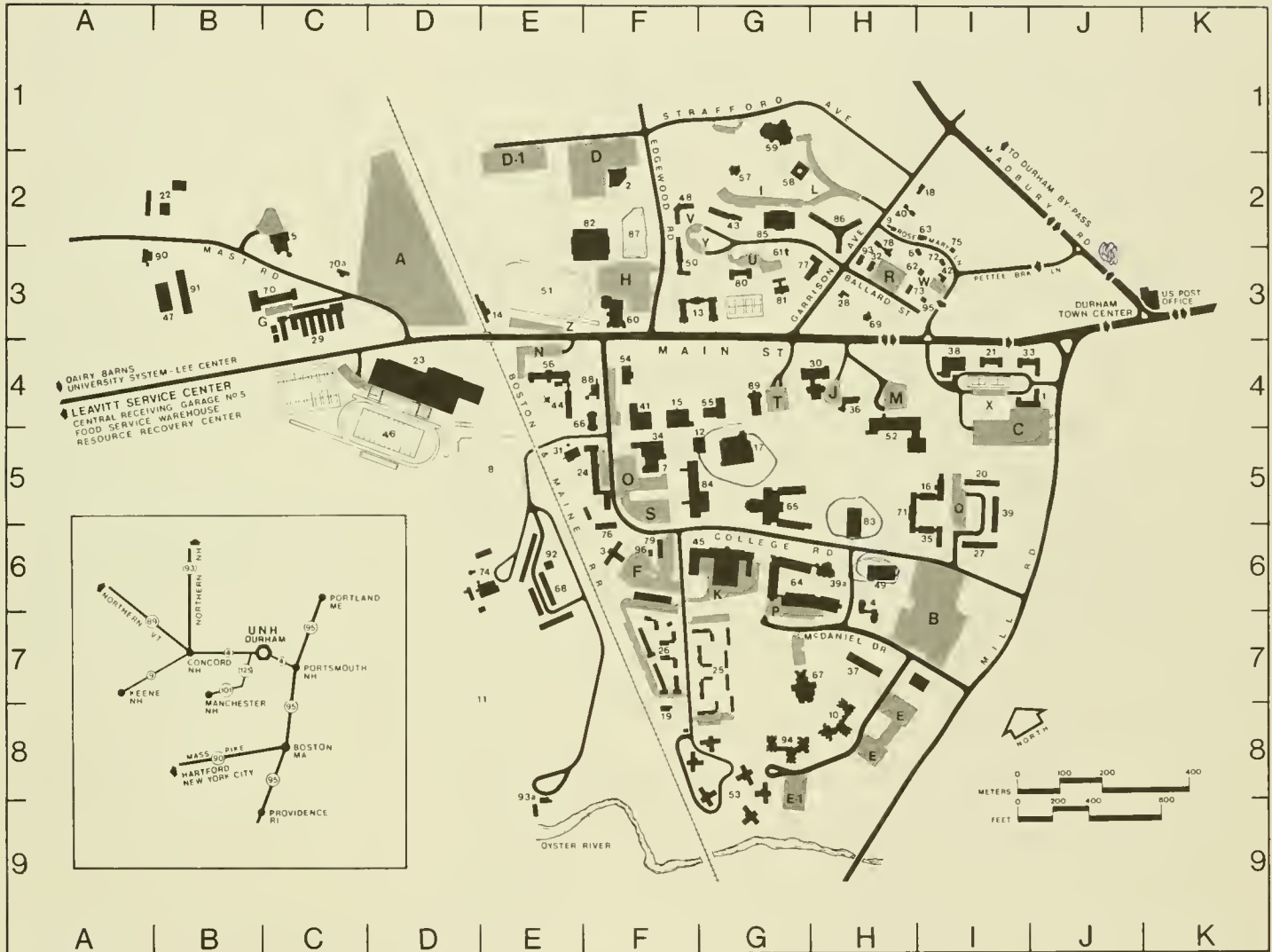
Zsigray, Robert M.

Associate Professor of Microbiology and Genetics; Ph.D., Georgetown University, 1969; appointed 1970.



Campus Map and Key

- Admissions Office (see 89)
- Agricultural Experiment Station (see 88)
- 1 Alexander Hall J4
- 2 Alumni Center F2
- 3 Art Annex F6
- 4 Babcock House H6
- 5 Barton Hall C2
- 6 Batcheller House H3
- 7 Bookstore F5
- 8 Brackett Field E5
- 9 Brook House H2
- Center for Industrial and Institutional Development (see 49)
- 10 Christensen Hall H8
- 11 College Woods E7
- Computer Center (see 45)
- 12 Conant Hall G5
- 13 Congreve Hall F3
- Cooperative Extension Service (see 88)
- Counseling and Testing (see 78)
- 14 Dairy Bar E3
- 15 Demeritt Hall F4
- 16 Devine Hall I5
- 17 Dimond Library G5
- 18 Elizabeth Demeritt House I2
- 19 Emergency Planning and Operations, Center for F8
- Engineering Design & Analysis Lab (see 45)
- Engineering & Physical Sciences, College of (see 45)
- 20 Englehardt Hall I5
- 21 Fairchild Hall I4
- 22 Farm Service Buildings B2
- 23 Field House D4
- Financial Aid (see 89)
- 24 Fire Station and Service Building F5
- 25 Forest Park Apartments I G7
- 26 Forest Park Apartments II F7
- 27 Gibbs Hall I6
- Graduate School (see 83)
- 28 Grant House H3
- 29 Greenhouses and Pesticide Laboratory C3
- 30 Hamilton Smith Hall H4
- Health Studies, School of (see 34)
- 31 Heating Plant E5
- Hennessy Theater (see 65)
- 32 Hersey House H3
- 33 Hetzel Hall I4
- 34 Hewitt Hall F5
- 35 Hitchcock Hall I6
- 36 Hood House H4
- 37 Hubbard Hall H7
- 38 Huddleston Hall I4
- 39 Hunter Hall I5
- 39a Iddles Auditorium H6
- Instrumentation Center (see 45)
- 40 International House H2
- 41 James Hall F4
- 42 Janetos House I3
- 43 Jessie Doe Hall G2
- Johnson Theater (see 65)
- 44 Kendall Hall E4
- 45 Kingsbury Hall G6
- 46 Lewis Field D5
- Liberal Arts, College of (see 55)
- Life Sciences & Agriculture, College of (see 88)
- 47 Livestock Activities Center B3
- 48 Lord Hall F2
- Marine Programs (see 45)
- 49 McConnell Hall H6
- 50 McLaughlin Hall F3
- Mechanics Research Laboratory (see 45)
- 51 Memorial Field E3
- 52 Memorial Union H5
- 53 Mini Dorms G8
- 54 Morrill Hall F4
- 55 Murkland Hall G4
- Natural & Environmental Resources, Institute of (see 41)
- 56 Nesmith Hall E4
- 57 New England Center — Adams Residential Tower G2
- 58 New England Center — Administration Building G2
- 59 New England Center — Kellogg Learning Center G1
- 60 New Hampshire Hall F3
- 61 Nursery School G3
- 62 O'Connell House H3
- 63 Palmer House I2
- 64 Parsons Hall G6
- 65 Paul Creative Arts Center G5
- 66 Pettee Hall E4
- 67 Philbrook Dining Hall H7
- 68 Poultry Plant E6
- 69 President's House H3
- Public Administration Service (see 83)
- 70 Putnam Hall C3
- 70a Racing Commission Stables C3
- 71 Randall Hall H5
- Registrar (see 89)
- Residence Office, housing (see 86)
- Resources Development Center (see 95)
- 72 Rice House I3
- 73 Richards House H3
- 74 Ritzman Nutrition Laboratory E6
- 75 Robinsan House I2
- 76 ROTC Building F6
- 77 Sawyer Hall G3
- 78 Schofield House H2
- 79 SCORE Building F6
- 80 Scott Hall G3
- 81 Smith Hall G3
- 82 Snively Arena F2
- 83 Social Science Center H5
- 84 Spaulding Life Science Center G5
- 85 Stillings Dining Hall G2
- 86 Stoke Hall H2
- 87 Swimming Pool F2
- 88 Taylor Hall F4
- 89 Thompson Hall G4
- Thompson School of Applied Science (see 5)
- Tickets, athletic (see 23)
- Tickets, cultural events (see 52)
- 90 Tirrell Classroom Building B3
- 91 Tirrell Light Horse Stable B3
- 92 Tumor Research Building E6
- 93 Verrette House H3
- Water Resources Research Center (see 66)
- 93a Water Treatment Plant E8
- WENH-TV (see 52)
- Whittemore School of Business and Economics (see 49)
- 94 Williamson Hall G8
- 95 Wolff House I3
- 96 Women's Center F6



Index

- Abbreviations 41
Academic Planning Committee 34
Academic regulations 24
Admission 15
Agricultural Experiment Station 9
Alumni Association 38
Ancient and Modern Languages and Literatures 42
Animal Sciences 45, 88
Anthropology 130
Application 15, 17
Applied Music 113
Assistantships 21
Associates 22
- Babcock House 35
Biochemistry 47
Biology 48
Botany and Plant Pathology 49
Business Administration 51
- Calendar 156
Campus 2, 31, 34, 35, 150
Career Planning and Placement 38
Center for Industrial and Institutional Development 9
Certificate for Advanced Graduate Study 69
Chemical Engineering 6, 55
Chemistry 56
Churches 38
Civil Engineering 6, 59
Committees of the Graduate School 136
Computer Center 10
Conditional students 17
Continuing Education 12, 17
Counseling and Testing Center 37
Course charges 19
Course descriptions 41
Credits 24, 25
Cultural activities 34
- Deadlines 17, 24
Degree candidacy 27
Degree programs 3
Diamond Island Ocean Engineering Station 10, 11, 12
Dining 37
Dissertation 27
- Diving program 10
Division of Continuing Education 17
Doctoral programs 3, 5, 6, 26
Doctor of Philosophy 3, 5, 26 See *also* specific departments
- Earth Sciences 52
Economics 64
Ecumenical ministry 38
Education 66
Electrical Engineering 6, 75
Employees, University 18
Engineering Design and Analysis Laboratory 9, 10, 11
Engineering Ph.D. Program 6, 79
English 81
Entomology 85
Environmental Resources, Institute of Natural and 6, 10, 95
Examinations 15, 16, 17, 25, 27, 28
- Facilities 9, 34
Faculty 138
Fees 19, 20
Fellowships 21, 23
Financial Aid 21
Foreign students 17
Forest Park 36
Forest Resources 88, 97
French 42
- Genetics 6, 86, 120
Genetics Program 6, 86
German 43
Grades 24
Graduate Council 31
Graduate School Office 35
- Health services 37
History 89
Home Economics 93
Honorary fellows 18
Hood House 37
Housing 35
Hydrology 98
- Incompletes 24
Independent study 24
- Industrial and Institutional Development, Center for 9
Institute of Natural and Environmental Resources 6, 10, 95
Instrumentation Center 9
Insurance 37
Intercollege Biological Sciences Organization 6, 48
Interdisciplinary programs 6, 10, 56, 79, 95
Interlibrary loan 12
Italian 42
- Jackson Estuarine Laboratory 9, 10, 11
- Leave of absence 28
Library 11
Loans 23
- Map 2, 150
Marine Program 9, 10
Marine science 9
Married students' housing 36
Master of Business Administration 51
Master of Arts 3, 5 See *also* specific departments
Master of Arts in Teaching 68, 69
Master of Education 67, 68, 69
Master of Occupational Education 114
Master of Public Administration 121
Master of Science 3, 5 See *also* specific departments
Master of Science for Teachers 3, 5 See *also* specific departments
Master's programs 3, 5 See *also* specific departments
Master's requirements 25
Master's thesis 26
Mathematics 100
Mechanical Engineering 6, 105
Mechanics Research Laboratory 10, 11
Media Services 11
Memorial Union 34
Merrimack Valley Branch 19, 31
Microbiology 88, 109
Ministry 38
Music 110
Music, applied 113
Music Education 113

Natural and Environmental
Resources 6, 10, 95, 96
New England Center for Continuing
Education 11
New England Regional
Student Program 5, 16, 17

Occupational Education 114
Ocean Engineering 11
Oceanography 9
Off-campus housing 36
Officers of administration 135

Ph.D. requirements 26
Physical Education 116
Physics 117
Placement service 38
Plant Science 88, 119, 120
Political Science 121
Psychology 6, 123
Public Administration Service 9

Recreation 34
Refund of course charges 23
Registration 28
Regulations, academic 24
Requirements, departmental 41-133
Requirements, doctor's degree 26
Requirements, master's degrees 25
Research 9
Research Council 34
Residences 35
Resident, nonresident status 19
Resource Economics 99
Resources Development Center 9
Ritzman Animal Nutrition Laboratory 9

Scholarships 21
Senate, University 34
Senior, University 18
Service facilities 9
Shoals Marine Laboratory 10, 11
Social activities 34
Social Psychology 6
Sociology 6, 126
Soil and Water-Chemistry Program 6
Soil Science 100
Space Science Center 9

Spanish 44
Special students 17
Stipends 21
Student life 31, 34, 35
Student services 35
Summer Fellowships 23
Summer Housing 36
Summer session 24

Teaching and Learning Council 34
Testing 37
Thesis 26
Thesis fees 20
Traineeships 23
Transfer of credits 25, 26
Trustees 135
Tuition 16, 19

Union, student 34
University System of New Hampshire 5, 17, 31

Water Resources Research Center 9
Withdrawal 28
Work-Study 23

Zoology 6, 88, 130

The University does not guarantee employment to its graduates, but their chances for employment are enhanced if they have begun career planning early in their undergraduate days. The University provides a career planning and placement service that is available to all students.

The University is in compliance with federal guaranteed student loan regulations and does supply information about the employment of its graduates who have majored in specialized degree programs, which normally lead to specific employment fields. This information is available upon request from the University's Career Planning and Placement Service.

The University provides full information pertaining to the Family Education Rights and Privacy Act of 1974 ("Buckley Amendment") in the annual student guide.

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Graduate School Calendar 1977-78

Semester I



September 4, Sunday
September 7, Wednesday
September 12, Monday
September 16, Friday
September 23, Friday
October 5, Wednesday

October 25, Tuesday

November 11, Friday
November 18, Friday
November 23, Wednesday
November 28, Monday
December 2, Friday

December 17, Saturday
December 18, Sunday
December 19, Monday
December 23, Friday

8 a.m. Residence Halls open
8 a.m. Classes begin
Graduate student registration
Last day to drop courses without \$10 late drop fee
Last day to add courses without \$10 late add fee
Last day to carry over 16 credits without surcharge,
or for partial tuition refund on withdrawal
MIDSEMESTER — Last day to drop courses or withdraw
without academic liability
Veterans Day holiday — no classes
Last day for final Ph.D. oral examination (December graduation)
Classes follow Friday schedule/7 p.m. Residence halls close
8 a.m. Classes resume
Last day for presenting final copies of dissertation or thesis
to the Graduate School for binding (December graduation)
Reading day
Commencement
8 a.m. Semester I final exams begin
Final exams end

Semester II



January 17, Tuesday
January 23, Monday
January 27, Friday
February 3, Friday
February 15, Wednesday

March 3, Friday
March 13, Monday
March 14, Tuesday

April 14, Friday
April 28, Friday

May 2-3, Tuesday-Wednesday
May 4, Thursday
May 12, Friday
May 14, Sunday

8 a.m. Classes begin
Graduate student registration
Last day to drop courses without \$10 late drop fee
Last day to add courses without \$10 late add fee
Last day to carry over 16 credits without surcharge,
or for partial tuition refund on withdrawal
7 p.m. Spring recess begins
8 a.m. Classes resume
MIDSEMESTER — Last day to drop courses or withdraw
without academic liability
Last day for final Ph.D. oral examination (May graduation)
Last day for presenting final copies of dissertation or thesis
to the Graduate School for binding (May graduation)
Reading days
8 a.m. Semester II final exams begin
Final exams end
Commencement

The University reserves the right to modify the calendar subsequent to printing.

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