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UNIVERSITY OF NEW HAMPSHIRE



GRADUATE SCHOOL

Catalog 1997-1999

University of
New Hampshire
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UNIVERSITY OF NEW HAMPSHIRE

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GRADUATE EDUCATION AT UNH

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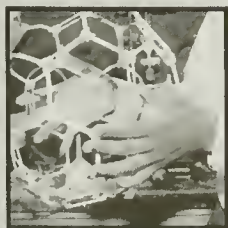


UNH is a full-scale research university set in the town of Durham along the Oyster River.



"... where the average person sees just rocks, I can reconstruct many thousands, even millions of years of the geological record of that area."

Steve Allard
(see page 8)

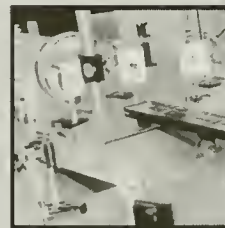


"So I look and look and look."

James Mack (see page 19)

"The neat thing about what I'm doing is that no one's been able to measure this in three dimensions before and turbulence is three dimensional."

Barbara Pellicia
(see page 22)



The program has helped me develop skills to work in a group setting, which is absolutely necessary in the current business world.

—Jianhua Li (see page 21)

"... in the long run, what I'm discovering may have economic applications or implications for other areas of science."

*Jianhua Li
(see page 17)*



"... you are apt to work with history, art history, women's studies, and cultural studies."

Heather Wood (see page 29)

"I found I was a lot more interested in why people had ended up in court and what could be done to help them,"

Jenny Burke (see page 13)



**Teaching, research,
and public service —
the university's
threefold mission as a
public, land-grant
institution.**

**Graduate School
University of New Hampshire
Thompson Hall
105 Main Street
Durham, NH 03824-3547
(603) 862-3000
<http://www.gradschool.unh.edu>**

Master of Arts

Counseling
Economics
English
 Language and Linguistics
 Literature
 Writing
History
Music
Political Science
Psychology
Sociology
Spanish

Master of Science

Animal and Nutritional Sciences
Biochemistry
Biology
Chemical Engineering
Chemistry
Civil Engineering
Communication Disorders
Computer Science
Earth Sciences
 Geology
 Oceanography
Electrical Engineering
Family Studies
 Marriage and Family Therapy
Genetics
Hydrology
Kinesiology
Mathematics
 Applied Mathematics
Mechanical Engineering
Microbiology
Music Education
Natural Resources
 Environmental Conservation
 Forestry
 Soil Sciences
 Water Resources
 Wildlife
Nursing
Occupational Therapy
Ocean Engineering
Physics
Plant Biology
Resource Administration and
 Management
Resource Economics
Zoology

Master of Arts in Teaching

Elementary Education
Secondary Education

Master of Education

Administration and Supervision
Counseling
Early Childhood Education
 Special Needs
Elementary Education
Reading
Secondary Education
Special Education

Master of Science for Teachers

Chemistry
College Teaching
English
Mathematics

Master of Business Administration

Master of Health Administration

**Master of Adult and Occupational
Education**

Master of Arts in Liberal Studies

Master of Public Administration

Master of Social Work

**Certificate of Advanced Graduate
Study**

Educational Administration and
 Supervision

Doctor of Philosophy

Animal and Nutritional Sciences
Biochemistry
Chemistry
Computer Science
Earth Sciences
 Geology
 Oceanography
Economics
Education
Engineering
English
Genetics
History
Mathematics
Mathematics Education
Microbiology
Natural Resources
Physics
Plant Biology
Psychology
Reading and Writing Instruction
Sociology
Zoology

The University

The University of New Hampshire is a land-grant institution made possible by the Morrill Act of 1862, which helped states develop institutions to better serve all the people. The institution was originally founded in 1866 in connection with Dartmouth College as New Hampshire College of Agriculture and the Mechanic Arts. At that time, the school's mission was to train young men and women for service to the state in the fields of agriculture and technology. In 1893, New Hampshire College 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. The university awarded its first Ph.D. in 1896, placing it among the early American universities to award that degree. Doctoral programs in their present form began in the 1950s.

In 1980, UNH and the University of Maine were designated jointly as a Sea Grant College by the National Oceanographic and Atmospheric Administration (NOAA). In 1991, the university was designated a Space Grant College together with Dartmouth College. The university is composed of the College of Liberal Arts, College of Engineering and Physical Sciences, School of Health and Human Services, College of Life Sciences and Agriculture, Whittemore School of Business and Economics, Thompson School of Applied Science, Division of Continuing Education, University of New Hampshire at Manchester, the Nashua Center, and the Graduate School. The University System of New Hampshire, of which UNH is a member, also includes Keene State College, Plymouth State College, and the College for Lifelong Learning.

The university enrolls more than 12,000 students in Durham and has a full-time faculty of more than 600. The student body includes more than 2,000 graduate students.

Graduate Education

Graduate education at UNH is supervised by five hundred graduate faculty members. The Graduate School, in turn, is led by the dean, who implements the policies

of the graduate faculty. The dean is advised by the Graduate Council, which is composed of elected faculty members and graduate student representatives.

One of the basic tenets of graduate education at UNH is that for quality graduate education to thrive, research must coexist with, and enhance the process of, classroom teaching. Faculty members of the Graduate School, while dedicated to teaching, carry on active research programs. Their research serves many vital purposes. First, it supports graduate education by developing new knowledge in areas of scholarly interest. Second, it provides training opportunities for graduate students in residence. Moreover, these programs fulfill the university's obligations as a land-grant, sea-grant, and space-grant institution by conducting research and disseminating information to the public in areas affecting the nation's welfare.

As the state's only public university, UNH occupies a unique role. It is the primary institution within the University System of New Hampshire responsible for providing graduate programs that meet state, regional, and national needs—and the only one at which doctoral programs are offered. Other units of the university system do offer some master's programs.

Master's Programs

The master's degree programs, which the university offers in a wide variety of disciplines, 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 many programs, students can elect options that will permit them 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 coursework in lieu of a thesis.

Doctoral Programs

The university offers doctoral programs in those disciplines that have both the faculty and facilities to support high-quality advanced graduate education.

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 on teaching led by experienced faculty members. After receiving a dual grounding in the development and communication of knowledge, graduates from UNH doctoral programs have gone on to find excellent teaching and research positions.

Interdisciplinary Programs

The Graduate School encourages interdisciplinary study within its existing programs and has adopted procedures for the faculty to develop interdisciplinary options within established doctoral programs. However, independent, self-designed graduate programs are not available at the university. Formal interdisciplinary degrees are offered in the genetics program, which involves geneticists from many departments in both master's and doctoral programs; the natural resources Ph.D. program, which draws on the university's strength in environmental and earth sciences, life sciences, social sciences, and policy studies to provide interdisciplinary research opportunities in the broad area of natural and environmental research management; the engineering Ph.D. program and the ocean engineering M.S. program, which are cooperative, interdisciplinary efforts of the electrical and computer engineering, civil engineering, mechanical engineering, and chemical engineering departments; the biology program, which makes the resources of the biological science departments available to students interested in a general nonthesis master's program; and the resource administration and management program, which involves faculty in the natural resources area.

Opportunities for interdisciplinary study and research are also available through the Institute for the Study of Earth, Oceans, and Space and through the Marine Program. Additional interdisciplinary opportunities are listed with the individual program descriptions.

ADMISSION AND REGISTRATION

Applying for Admission

Persons holding a baccalaureate degree from an accredited college or university and wishing to take graduate-level courses at the university as part of a graduate degree program must apply for admission to the Graduate School. Admission to the Graduate School is both limited and competitive and is based solely upon academic qualifications and potential.

Application procedures are included with the application packet, which is available from the Graduate School, University of New Hampshire, Thompson Hall, 105 Main Street, Durham, NH 03824-3547. Specific program information and admission and degree requirements are outlined in the program descriptions of this catalog. The completed application for admission to graduate study also serves as the application (for new students) for assistantships and for full-time scholarships supported through the Graduate School.

Applicants to programs that lead 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) completion of three years of teaching experience, or (3) current employment in a full-time teaching position.

All application materials become part of the permanent records of the University of New Hampshire and will not be returned. Access to this material is limited under the Family Rights and Privacy Act of 1974. Applicants who are not admitted, or who are admitted and do not register in the Graduate School, do not have access to their application files. Materials received as part of the application process will not be duplicated for personal use by the applicant nor forwarded to a third party. Materials received from applicants who do not complete their application, who are not admitted, or who are admitted and do not register are held for one year before being destroyed.

Applicants from Foreign Countries

All applicants from non-English-speaking countries must, in addition to all of the above, provide TOEFL (Test of English as a Foreign Language) scores. A minimum TOEFL score of 550 is required for admission. TOEFL test scores are valid for only two years. A financial statement on official university forms is also required.

Applications from residents of foreign countries will be considered only for regular admission.

Application Deadlines

Applications must be completed by December 1, for the spring session; by April 1, for the summer session; and by July 1 (although, April 1 is recommended), for the fall session. There is no guarantee that applications completed after these deadlines can be acted upon in time to permit registration in the desired session. **Many programs have earlier application deadlines that are published with the application packet and will fill available openings before the above deadlines.** Applicants for financial assistance (assistantships and scholarships) should complete their applications prior to February 15 to ensure consideration for the following academic year.

Foreign applicants who are not currently residing in the United States will be considered for admission for the fall session only and must have their applications completed by April 1. Foreign applicants currently residing in the United States should have their applications completed at least four months prior to the session for which they are applying.

Programs that consider applications only for a specific session or that have special deadlines are noted on the "Instructions for Application for Admission to Graduate Study" included with the application packet.

Incomplete Applications Applications that remain incomplete after the first day of classes of the term for which admission was desired will be placed in an inactive status. A written request is required to reactivate an application.

Application Review

Once an application is complete, it is reviewed by faculty members of the appropriate program. All materials that are submitted as part of the application receive careful consideration. The review is normally conducted by an admissions committee 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. While applicants with bachelor's degrees may apply directly to certain doctoral programs, the Graduate School reserves the right to offer these applicants admission at the master's degree level.

Admission Categories

Official offers of admission from the Graduate School are made for a specific term and year in one of the following categories. Offers of admission—regular, provisional, or conditional—to applicants who are in the final year of an undergraduate or, in some cases, a graduate degree program are *contingent* upon the successful completion of that degree program. An official final transcript showing grades and the awarding of the degree must be received by the Graduate School before the student may enroll for the graduate program.

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

Provisional Admission Provisional admission may be offered to applicants whose academic records and supporting documents indicate that they are qualified to undertake graduate study, but whose undergraduate preparation was not in the intended field of graduate study. Applicants offered provisional ad-

mission must meet the specific criteria, usually undergraduate coursework, stated at the time of their admission before being changed to regular graduate student status.

Conditional Admission Conditional admission may be offered to those applicants whose academic records indicate deficiencies but suggest some promise of success in graduate study. Students offered conditional admission must meet the specific requirements stated at the time of their admission in order to remain in the Graduate School. Conditionally admitted students are not eligible for assistantships and scholarships offered through the Graduate School until the conditional status is removed.

Deferred Admission Applicants who cannot enroll in the term for which admission was offered may request to have their admission deferred for up to one year. Such requests must be in writing and will be considered only once. Because enrollments are limited and competition for admission may vary from year to year, such requests may not be granted. **Applicants who have received approved deferment of their admission cannot register for graduate coursework as special students at the university during the period of deferment.**

Early Admission—University of New Hampshire Seniors Qualified senior students at the University of New Hampshire may be admitted to the Graduate School provided they have followed normal application procedures; they must have been admitted for the semester in which they wish to enroll in courses for graduate credit. A 3.20 cumulative grade-point average is normally required to be considered for early admission. Such seniors are normally admitted prior to the start of their last undergraduate semester. Seniors who have been admitted under early admission may register for a maximum of two courses for up to 8 graduate credits. (See also dual credit on page 16.)

Admission to the 3/2 Program Undergraduate UNH students may be admitted to one of the approved five-year combined bachelor's degree/master of business administration programs, which normally commence during the fall semester of their senior year. Approved undergraduate programs include the B.S. programs in chemical engineering, civil engineering, electrical engineering, or mechanical engineering in the College of Engineering and Physical Sciences; the B.A. programs in French, history, philosophy, or psychology in the College of Liberal Arts; the B.S. program in plant biology in the College of Life Sciences and Agriculture; and the B.A. program in economics in the Whittemore School. Application to the Graduate School is made during the second semester of the junior year. Interested students should contact the Whittemore School for specific information.

Additional Information

Special Students Individuals holding baccalaureate degrees may register for graduate courses on campus through the Division of Continuing Education, or for graduate courses off campus through the University of New Hampshire at Manchester, the Nashua Center, or the College for Lifelong Learning. These individuals are designated as "special students." Special students are not required to file an application for admission to the Graduate School and are not candidates for a graduate degree. Special students are not normally permitted to register as full-time students. (See special-credit rule on page 16.)

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. Reapplication is not encouraged.

Registration

Academic Year

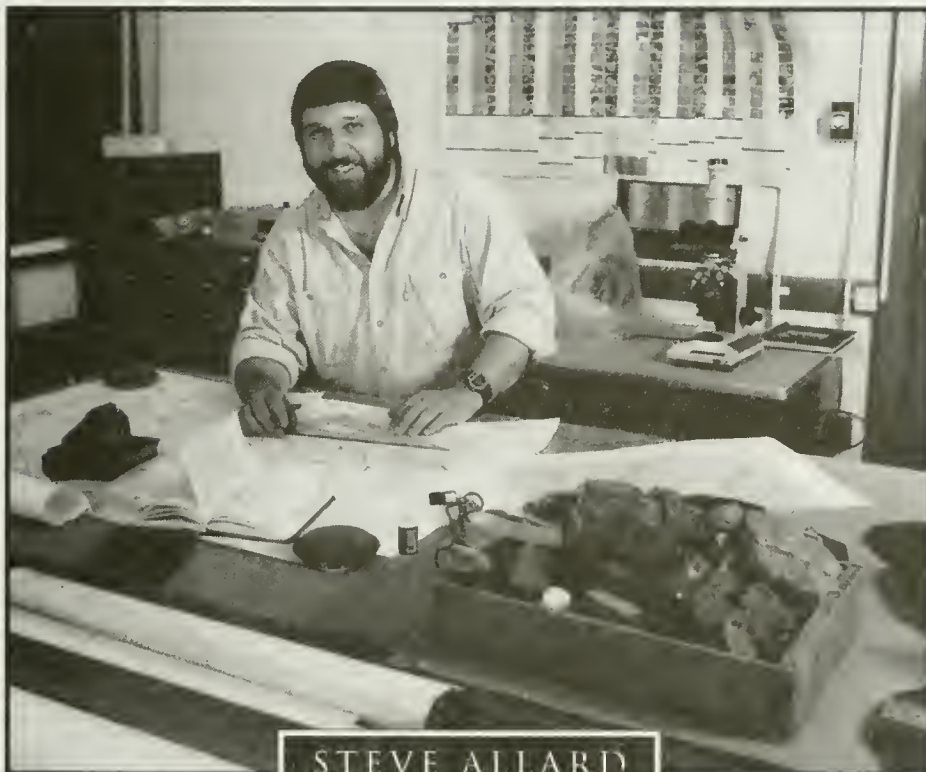
Registration information and the *Time and Room Schedule* may be obtained from the Registrar's Office or the Graduate School.

Continuous Registration Unless a leave of absence is granted, graduate students are required to maintain continuous enrollment each semester of the academic year until their degree is formally awarded by registering for course credits, research, or continuing enrollment. Master's students must enroll for course credits, thesis credits, Master's Continuing Research (GRAD 900), or Continuing Enrollment (GRAD 800). C.A.G.S. students must enroll for course credits or Continuing Enrollment (GRAD 800). Pre-candidacy doctoral students must enroll for course credits, Doctoral Research (999), or Continuing Enrollment (GRAD 800). All doctoral candidates must register for Doctoral Research (999) each semester after advancement to candidacy until their degree is conferred, even if the minimum requirement (two semesters) has been met. Students enrolled in summer only programs—currently, Math M.S.T. and English M.S.T.—are required to enroll in course credit or GRAD 800 each summer until their degree is formally awarded.

Full-Time Students Graduate students registered for 9 or more credits, Master's Continuing Research, or Doctoral Research are classified as full-time students. Students holding assistantship appointments are also considered full time and must register for a minimum of 6 credits, Master's Continuing Research, or Doctoral Research each semester.

Three-Quarter-Time Students Graduate students not on an assistantship and registered for 7 or 8 credits are classified as three-quarter-time students.

Half-Time Students Graduate students not on an assistantship and registered for 5 or 6 credits are classified as half-time students.



STEVE ALLARD
M.S. student, geology

STEVE ALLARD knew that there must be more to life than managing a lumber yard. His awakening came at the age of thirty when he took a year off to explore national parks and his own priorities. He discovered that he wanted to spend the rest of his life working out of doors, far from the inner city of Manchester, New Hampshire, where he grew up. When a friend casually suggested that he consider geology, Allard became interested and decided to look into the University of New Hampshire's geology department. Impressed with the quality of the faculty and the department's facilities, Allard enrolled in enough undergraduate geology courses to qualify for graduate school. Now in his second year, he is working toward a master's degree.

Not far from the Durham campus is a rock formation where gneiss and granite are juxtaposed in a way that leads Allard to believe that a massive block fault occurred, causing one set of rocks to move vertically for hundreds of meters against the other with unimaginable force. To the untrained eye, this event is unrecognizable after more than a hundred thousand years of erosion. Establishing how this fault happened is the basis of Allard's thesis.

"It's not very fashionable anymore to be a 'hard rock' geologist, but to me it's like being a detective with just a few clues to work with," says Allard. "Where the average person sees just rocks, I can reconstruct the geological record of that area for many thousands, even millions, of years."

Allard plans to go on for a doctorate, and eventually, he'd like to teach.

Maximum Load The maximum graduate load allowed is 16 credits (12 credits for a student on a full assistantship). 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 graduate program coordinator and the approval of the dean of the Graduate School.

Dropping and Adding Courses Graduate students may add or drop courses in accordance with the procedures and deadlines published by the Registrar's Office in the *Time and Room Schedule*. Deadlines are also published annually in the Graduate School calendar.

Auditing Courses A graduate student may, with the approval of his or her adviser and the faculty member concerned, audit courses. The deadline for requesting an audit is Friday of the third week of classes. Subsequent requests for change to audit require a petition form and must be approved by the course faculty member, the student's adviser and graduate program coordinator and the dean of the Graduate School.

Change of Name or Address It is the responsibility of the student to complete a change of name or address form whenever a change is made. Forms are available in the Registrar's Office and the Graduate School.

Summer Session

Although many graduate-level courses are offered during the summer session, the university does not guarantee that any particular course will be offered. The availability of individual faculty members to supervise research or to participate in qualifying examinations and final examinations or defenses during the summer session varies from year to year.

Course information and registration materials may be obtained from the UNH Summer Session Registration, Stoke Hall.

Maximum Load The maximum graduate load allowed is 12 credits for the entire summer session. A student will be allowed to exceed this limit only by petition with the recommendation of the

student's adviser, graduate program coordinator, and the approval of the dean of the Graduate School.

Student Load for Veterans Benefits

Graduate students eligible for V.A. benefits during the summer receive benefits according to the following schedule of average credit registrations: $\frac{1}{2}$ credit/week or more = full time; $\frac{3}{8}$ credit/week or more = $\frac{3}{4}$ time; $\frac{1}{4}$ credit/week or more = $\frac{1}{2}$ time; less than $\frac{1}{4}$ credit/week = tuition and fees only.

Nonregistration

Leave of Absence Students who, because of unforeseen circumstances, are unable to pursue their graduate program may request a leave of absence for a maximum of one calendar year. Such circumstances may include medical reasons, military obligation, family emergencies, or hardship. The procedure for an approved leave of absence requires that students submit a petition, available at the Graduate School, along with appropriate documentation, prior to the term for which the leave is requested. The dean of the Graduate School, upon recommendation of the student's adviser and graduate program coordinator, will review the petition. If the request for a leave is granted, the time limit for completion of the student's program will be extended appropriately. Students on an approved leave of absence are exempt from paying the continuing enrollment fee. Graduate students who do not return from a leave of absence will have their degree status discontinued.

Withdrawal A student may withdraw from the Graduate School during any semester by obtaining a withdrawal form from the Graduate School. This form should be signed by the student's adviser and the dean of the Graduate School. Students who formally withdraw are required to apply for readmission if they subsequently desire to resume their academic program.

Degree Status Discontinued Students who do not formally withdraw and do not register and pay for course credits, research, or continuing enrollment by the appropriate registration deadline, or do not return from an approved leave of absence, will have their degree status discontinued. Students are notified by the Graduate School when this administrative action is taken and are required to apply for readmission or reinstatement if they subsequently desire to resume their academic program.

Administrative Withdrawal for Reasons of Health The dean of the Graduate School, in consultation with professional University Health Services officials, may temporarily suspend a graduate student from the university without prejudice for reasons of seriously impaired physical or mental health and/or in consideration of the physical health, safety, and well-being of members of the university community. Such action shall be taken only for bona fide health and safety emergencies and should not be used as a means of excluding qualified students with disabilities.

The dean or designee shall provide the student with a written statement of the reasons for the temporary suspension. The student may request a hearing with the dean or designee to dispute the reasons. The student may be represented at the hearing by a member of the university community. If the student fails to request such a hearing within ten days of beginning the temporary suspension, or if the temporary suspension is upheld at the hearing, the temporary suspension shall be changed to an administrative withdrawal.

Readmission is contingent upon receipt by the directors of counseling and/or health services, or their agents, of a medical release from a licensed attending medical authority; an evaluation by University Health Services; and a personal interview with the dean of the Graduate School, who, on the basis of the information received, will either approve or disapprove the application.

Readmission

Students who withdraw, who have their degree status discontinued, or whose time limit has expired and subsequently desire to resume their academic program are required to apply for readmission. Readmission forms are available at the Graduate School. Students who are applying for readmission are required to pay an application fee plus, if readmitted, any accumulated continuing enrollment fees for the period during which they have been inactive. Students are not guaranteed readmission and may be evaluated in competition with current applicants to the program.

Reinstatement

Students who have their degree status discontinued for failure to register and pay for course credits, research, or continuing enrollment may petition the Graduate School to be reinstated for the term in which the action to discontinue their status was taken. Such a petition requires a reinstatement fee, plus payment of current semester charges and late fees.

Change in Degree

Students who wish to pursue a degree program other than the one for which admission was granted originally must complete the appropriate application for a change in degree. This includes students enrolled in UNH master's programs who intend to pursue the Ph.D. in the same department in which they were admitted for the master's degree. These forms are available from the Graduate School. The dean of the Graduate School will notify the student of the decision after consulting with the appropriate departments.

FEES AND FINANCIAL AID

Residency

Each graduate student is classified as a resident or nonresident for tuition purposes at the time of admission to the university. The decision, made by the Graduate School, is based upon information furnished by the student's application and any other relevant information. Nonresident undergraduates continuing directly to the Graduate School will be classified as nonresidents.

All applicants claiming New Hampshire residency are required to 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 for enrolled students as well as appeals are reviewed by the Registrar's Office and 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 in the application for admission package; all students are bound by them.

New England Regional Student Program

The University of New Hampshire participates in the New England Regional Student Program administered by the New England Board of Higher Education. Under this program, admitted graduate students from New England may qualify for regional tuition rates (New Hampshire resident tuition, plus fifty percent)

if the program to which they are admitted is one that is not available at their home state university. Inquiries and requests for further information may be directed to the Dean of the Graduate School, UNH, Thompson Hall, 105 Main Street, Durham, NH 03824-3547, or to the New England Board of Higher Education, 45 Temple Place, Boston, MA 02111.

Sub-Degree Exchange Program

The Graduate School of the University of New Hampshire participates in a sub-degree exchange program sponsored by the New England land-grant universities. The program is designed to provide any admitted student at one of the six land-grant universities access to the full range of talent and resources available in the region. Under the agreement, graduate students may, with the approval of the dean of the Graduate School at UNH and the graduate dean of the host university, take advantage of courses or other special resources not available at UNH. Specific information about the program may be obtained from the Dean of the Graduate School, UNH, Thompson Hall, 105 Main Street, Durham, NH 03824-3547.

Tuition and Fees

Tuition and fees are established by a vote of the Board of Trustees. Approval normally occurs between April and July. The current academic year rates are published annually in the Graduate Application. Mandatory fees for all students include a Memorial Union fee, which funds the personnel, programs, and maintenance of the building; a health and counseling fee, which funds University Health Services and the Counseling Center; and a recreation fee, which funds recreational sports facilities. The services and facilities are available to all—the extent to which each student uses them cannot be the factor by which assessment is determined. Tuition and fees are payable by the published deadline, and students are not considered registered until they have been paid. Graduate tuition and fees apply to

admitted graduate students enrolling for courses, graduate or undergraduate, at the university during the academic year. Admitted graduate students planning to enroll for UNH courses off campus through executive programs or during the summer session should consult the relevant publications for information regarding tuition and fees.

Special Fees

Continuing Enrollment Fee Students registered for Continuing Enrollment (GRAD 800) will pay \$100. This fee will be waived for students who subsequently register for course credits or research.

Master's Continuing Research Fee Master's students registered for Master's Continuing Research (GRAD 900) will pay \$300 plus full mandatory fees.

Doctoral Research Fee Doctoral students in residence and registered for Doctoral Research (999) will pay \$500 plus full mandatory fees. Students who register for coursework in addition to Doctoral Research will pay the appropriate additional tuition charges up to the appropriate maximum tuition rate for full-time students. Doctoral candidates not in residence who are conducting their research away from the Durham campus may petition the Graduate School for a waiver of the mandatory fees.

Differential Tuition Full-time resident and nonresident students majoring in engineering or computer science will be charged a tuition differential of \$87.50 per semester. Full-time students majoring in business administration or economics will be charged a tuition differential of \$150 per semester. Students in these programs who are registered for Doctoral Research (999) or Master's Continuing Research (GRAD 900) are considered full time and pay the full tuition differential. Students in engineering or computer science programs (both resident and nonresident) who register for fewer than 9 credits pay a differential tuition of \$5 per credit hour. Students in business or economics (both resident and

nonresident) who register for fewer than 9 credits pay a differential tuition of \$10 per credit hour.

Tuition Waiver for Senior Citizens

Any New Hampshire resident senior citizen who submits evidence of being 65 years of age or over, and whose participation is not intended for economic improvement, will be allowed to take courses at UNH with the tuition waived. Such waivers shall cover the cost of tuition only and are limited to a maximum of 8 academic credits per semester for each eligible individual. Admission into particular courses will be granted on a space-available basis, at the discretion of the graduate dean. All other costs of attendance are to be borne by the student.

Other Charges and Fees

Overload Graduate students are charged full tuition plus the appropriate course charge for each credit beyond 16 if registered for more than 16 credits thirty days after the semester has begun. (No refund will be made if a student subsequently drops a course, reducing his or her course load to 16 or fewer credits.) Tuition waivers awarded with assistantships and scholarships do not cover charges for overload.

Zero-Credit Seminars Seminars for 0 credit are billed as if they were for 1 credit.

Audit Charges for auditing a course are the same as those for taking it for credit.

Late Fees A \$25 late registration fee is charged to students who register after the last day scheduled for graduate registration. Late fees are also charged for changes in registration as follows: A \$25 fee is charged for each course dropped after the third Friday of classes; a \$25 fee is charged for each course added after the third Friday of classes. The late-add fee is charged in addition to the reinstatement fee when students register after the third week of classes. 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 \$25 drop fee will still apply for the drop portion of the late section change.

Reinstatement Fee A \$50 reinstatement fee is charged to any student who has his or her degree status discontinued and subsequently petitions to be reinstated during the same semester that the action to discontinue the degree status was taken. This fee will not be waived.

Registration Fee Part-time students (i.e., registering for 1 to 8 credits) pay a nonrefundable registration fee.

Student Accident and Sickness Insurance The university strongly urges all students to be insured against illness or injury that may arise in the course of the academic year. International students are required to have insurance. A student accident and sickness insurance policy is available for all students. Graduate students may enroll in this insurance program on a voluntary basis during graduate registration or through University Health Services. The cut-off date for enrollment is the second Friday following graduate registration. Insurance coverage is also available for the spouse or children of a student, provided the student is also enrolled in the plan. For information on student and/or dependent insurance, call University Health Services at (603) 862-1530.

Refunds

Tuition during the academic year is refundable in accordance with the calendar published in the *Time and Room Schedule* and the Graduate School calendar. Students receiving federal financial aid will have their refund calculated in accordance with the U.S. Department of Education regulations in effect at the time of their withdrawal. Specific details regarding the regulations are available in the UNH Financial Aid Office. *Mandatory fees* are nonrefundable.

Financial Aid

There are several forms of financial assistance available to graduate students through the Graduate School and individual departments, most of which are awarded for an academic year commencing

in the fall. To be eligible for any assistance, the student must first be admitted to the Graduate School. The Graduate School normally administers and awards the fellowship and scholarship programs. Assistantships and associateships are normally awarded by the individual graduate programs. The application for admission with supporting documents serves as the application for new graduate students for the scholarship and assistantship programs available to them and should be completed by February 15 for awards for the following academic year.

The Tax Reform Act of 1986 (TRA '86) made all scholarships and fellowships taxable income to the recipients, except for that portion used by degree candidates for the payment of tuition and course-required fees, books, supplies, and equipment (as opposed to other expenses like room and board). Compensation for service, which includes assistantship stipends and work-study awards, is fully taxable. Tuition waivers awarded to graduate students on assistantships are considered to be nontaxable scholarships.

Scholarships and Fellowships

Graduate Scholarships for Merit The Graduate School maintains a limited number of scholarships to reward students for outstanding potential and/or performance in a graduate program. Availability and criteria for award of these scholarships are announced annually by the Graduate School.

Full-Tuition Scholarships Students may be granted academic-year or semester tuition scholarships. These awards provide for waiver of tuition and are subject to the maintenance of a high scholastic record in the Graduate School. Application is made to the student's department or program.

Part-Time Tuition Scholarships Students may be granted part-time tuition scholarships. These awards provide a partial waiver of tuition charges and are awarded each semester of the academic year. Applications are available at the Graduate School. University employees or family members who are eligible for staff benefits are not eligible to receive part-time tuition scholarships.

Dissertation Fellowships Dissertation fellowships for a maximum tenure of one academic year are available on a competitive basis to doctoral students who have been advanced to candidacy. These awards include a stipend and a waiver of the doctoral research and mandatory fees for the period of the award. Application is made to the dean of the Graduate School.

Summer Fellowships for Teaching Assistants A limited number of summer fellowships are awarded to students who have held graduate assistantships involving teaching during a previous academic year. These awards are in the form of a stipend for a period of two months in the summer. Application is made to the dean of the Graduate School.

Assistantships

Graduate appointments are made to postbaccalaureate students who have been admitted to the Graduate School and who have been recommended by the appropriate department or program and approved for appointment by the Graduate School. Appointments are normally for one academic year and may be renewed provided that funds are available and that the student's academic performance, as well as performance in carrying out the responsibilities of the appointment, is satisfactory. Students are normally involved in assistantship activities for twenty hours a week during the academic year unless otherwise specified in the appointment. All graduate students holding appointments must be enrolled as students in order to hold an appointment during the academic year. Assistants, associates, fellows, or lecturers must register for a minimum of 6 course/thesis credits, Master's Continuing Research or Doctoral Research during each semester in which they hold their appointments. Interns/trainees must register according to terms specified in their contracts. Students holding only a nonstatus appointment must register for course/thesis credits (no minimum), Master's Continuing Enrollment (GRAD 800) and are not eligible to hold an appointment. Students holding summer appointments have no required enrollment unless specified by their appointment.

Inquiries regarding assistantships should be addressed to the chairperson or graduate coordinator of the

appropriate department or program. Appointments may be made in the following categories.

Graduate Assistants Graduate assistants are students who provide instructional or administrative support as specified by the appointing department and are normally supported by university funds. Graduate assistants are also eligible to receive tuition waivers for the period of their appointment and the following summer.

Graduate Research Assistants Graduate research assistants are students who are appointed to conduct research on grants supported by the Agricultural Experiment Station. Graduate research assistants are also eligible to receive tuition waivers for the period of their appointment.

Project Assistants Graduate project assistants are students who are appointed to conduct research normally in support of external grants or contracts. Project assistants, depending upon the terms of the grant, may also receive tuition waivers to cover the in-state portion of their tuition during the period of their appointment. Project assistants are also eligible to receive waivers to cover the out-of-state portion of their tuition during the period of their appointment.

Graduate Project Associates Graduate project associates are doctoral candidates who because of their advanced standing and experience are appointed to conduct research normally in support of external grants or contracts. Project associates may be able to receive a tuition waiver during the period of their appointment.

Graduate Associates Graduate associates are doctoral candidates who because of their advanced standing and experience are appointed to teach one or two courses per semester and are normally supported by university funds. Graduate associates may be eligible to receive a tuition waiver during the period of their appointment.

Graduate Part-time Lecturers Graduate part-time lecturers are master's, C.A.G.S., or precandidacy doctoral students who because of their specific expertise are appointed to teach one or two

courses per semester, and are normally supported by university funds. Tuition waivers are not usually provided.

Graduate Interns/Trainees Graduate interns/trainees are students who are assigned to a specific project or subject area to acquire additional learning experiences and are normally supported by external funds. Tuition waivers may be awarded in accordance to the terms of their appointment.

Graduate Fellows Graduate fellows are students who have been awarded a fellowship normally through an external grant to the University of New Hampshire or directly to the student. Appointment will normally not exceed one fiscal year and may be renewed in accordance with the terms of the fellowship program. Tuition waiver may be awarded according to the terms of the fellowship.

Graduate Nonstatus Appointments Graduate nonstatus appointments are appointments made to students during the academic year under one of the above categories. Such appointments may supplement regular appointments for up to an average of five hours per week (twenty hours per week when classes are not in session), or may be appointments with responsibilities of less than those of regular graduate appointments in terms of level of service, level of stipend, or both.

Graduate Summer Appointments Graduate summer appointments are appointments made to students during the summer in one of the above categories. Students on summer appointments may work for up to forty hours per week. Graduate students working full time on research or combined teaching and research for the entire summer earn 2/3 of their prior academic year stipend. Appointments for less than the maximum time are prorated.

Other Forms of Aid

Limited amounts of aid from federal and state sources are available through the Financial Aid Office. This office distributes money from various sources to help students with financial need. Need is defined as the difference between what it costs to attend UNH and what the student and his/her family can contribute from their financial resources, including all other sources of assistance. The stu-

dent is expected to earn a portion of these resources. The Free Application for Federal Student Aid (FAFSA) should be submitted to the federal processor listed on the envelope as soon after January 1 as possible but prior to March 1 for priority consideration for the academic year. The FAFSA is required for all of the programs listed below with the exception of the Veterans Benefits. For further information or copies of the forms, contact the Graduate Financial Aid Coordinator, Financial Aid Office, Stoke Hall at (603) 862-3600.

Federal Perkins Loans Graduate students may borrow up to \$30,000, including any undergraduate loans. These loans have a simple interest rate of 5 percent annually. Minimum payments of \$40 per month are required, and the repayment period may extend up to ten years. Repayment and interest do not begin until six months after the student ends at least half-time study. To be eligible for consideration, students must carry at least 5 academic credits per semester, be citizens or permanent residents of the U.S., and establish need for a loan which is to be used for educational purposes only.

Federal 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. Students interested in summer work-study should apply (and send their FAFSA to the federal processor and submit a separate application for the Summer Federal Work-Study Program to the Financial Aid Office in Stoke Hall) as soon after January 1 as possible, but prior to March 1.

UNH Loans Students who are registered degree candidates are eligible for consideration for a UNH loan. Financial need must be demonstrated clearly, and loans may be used only for educational expenses. No interest is charged until separation from the university occurs. Interest is 5 percent on any unpaid balance and repayment begins nine months after separation from the university. The



JENNY BURKE
M.S.W. student, social work

ZONING CASES, bankruptcies, landlord-tenant disputes—Jenny Burke was a practicing attorney, but the work left her feeling like something was missing. “Even though I love law, that work was unfulfilling to me personally.”

So, she made an early career change and began working toward a Master of Social Work, hoping to do more to help the people she once saw in the courtroom.

Burke graduated from Duke University in 1988 with majors in history and French and received her law degree in 1993 from Case Western Reserve University. She worked for the public defender’s office in Cleveland and, after moving to New Hampshire in 1994, joined a private practice in East Kingston. “I found I was a lot more interested in why people had ended up in court and what could be done to help them,” she says.

She intends to keep her license to practice law active. After graduating, she sees herself working either with an agency or a hospital, but not practicing law. “So far I’ve found that the law degree is very complementary,” she says. That background gives her an understanding of some of the legal troubles her clients might face. “I think it fits nicely. Just having that training has been helpful.”

Eventually she is interested in a wider perspective, looking at societal structures. It’s a decision that runs in the family. Her father earned a law degree, but never became a practicing attorney. Instead he heads the Cleveland chapter of the American Suicide Foundation, a national organization that works to reduce the number of suicides.



KATHLEEN COSTELLO
M.Ed. student, counseling

AS A UNH STAFF PERSON with Educational Talent Search, Kathleen Costello works to encourage low-income high school students to continue with their educations. It's a job she likes and understands well on a personal level.

"Educational Talent Search has given me an opportunity to help young people think about their future. The concerns they face are ones that I faced also," says Costello, who grew up in a housing project in New York City and was the only one in her family to graduate from high school.

Nonetheless coming back to school fifteen years after graduating from UNH with a degree in social work, was a decision Costello made gradually. With encouragement from family, friends, and teachers such as Professor Dwight Webb, Costello tried one class and then another. By the third class, she applied for the M.Ed. in counseling program.

With the M.Ed. Costello will be eligible to apply for jobs as a high school guidance counselor. "When I analyzed my career strengths I realized that I could either be a teacher, an administrator, or a guidance counselor," says Costello. "This is a good direction for me."

For her counseling internship, Costello led a grief support workshop at Farmington High School. Several students there had experienced the loss of either a friend or family member. "Groups like this arise," says Costello, "depending on the needs of the school."

Being with peers in the program is inspiring for Costello. "As a small group we really get to know each other. Through the coursework, we become knowledgeable about different theories, but more importantly we learn what types of theories work for us. The program is very 'person-centered.'"

maximum amount granted to a student is \$1,000 during his or her undergraduate and/or graduate work.

Federal Stafford Loan Program A federal Stafford loan is a low-interest loan made to a student-borrower by a bank, credit union, or savings and loan association and is based on financial need. The interest rate varies between 7 and 9 percent. Graduate students may borrow up to \$8,500 per academic year. The total maximum debt for graduate study is \$65,000 including Stafford loans at the undergraduate level.

Borrowers have the interest on their loans paid by the federal government while attending college. Repayment begins six months after students cease at least half-time attendance.

Unsubsidized Federal Stafford Loan Program Unsubsidized federal Stafford loans are non-need-based Stafford loans for students who do not qualify in whole or part for the subsidized federal Stafford loan. The student borrower, *not the federal government*, is responsible for paying the interest that accrues while he or she is in school, and during grace and deferment periods. To apply for an unsubsidized Stafford loan, you must first submit a Free Application for Federal Student Aid (FAFSA) form even though this loan is not based on financial need. Graduate students may borrow up to \$18,500 per academic year in subsidized and unsubsidized loans. The total maximum debt for graduate study is \$65,000 including Stafford loans at the undergraduate level.

Veterans Benefits Veterans and their dependents should investigate their eligibility for veterans benefit payments. Questions may be addressed to any local Veterans Administration office or the UNH Veterans Coordinator, Registrar's Office at (603) 862-1595.

Satisfactory Academic Progress Satisfactory progress in a course of study must be maintained by all students who receive federal financial aid. The current standards for satisfactory academic progress are available upon request from the Financial Aid Office.

ACADEMIC REGULATIONS AND DEGREE REQUIREMENTS

It is the student's responsibility to become familiar with the academic regulations and degree requirements of the Graduate School as well as the special requirements of his or her own academic program. The general requirements of the Graduate School are found in the catalog. Individual program requirements may be found in the catalog or obtained from the respective department.

Academic honesty is a core value at the University of New Hampshire. The members of its academic community both require and expect one another to conduct themselves with integrity. This means that each member will adhere to the principles and rules of the university and pursue academic work in a straightforward and truthful manner, free from deception or fraud. The academic policy can be found in the annual publication *Student Rights, Rules, and Responsibilities*.

Graduate Courses

Graduate credits may be earned in courses numbered from 800 through 999. The faculty of each graduate program prescribes the courses that make up the degree program. In addition, the Graduate School has general requirements for master's and doctoral degree programs.

800- and 900-Level Courses These courses are offered for graduate credit only and therefore are open only to admitted or special graduate students.

700-Level Courses These are advanced undergraduate courses. Up to 12 credits earned in 700-level courses may be taken for graduate credit by a graduate degree student, provided such courses are approved by the student's adviser and graduate program coordinator and the dean of the Graduate School, and provided they are given in a program other than the one in which the student is seeking the degree. Such courses must be taken for a letter grade. Petition forms are available at the Graduate School.

Graduate Grading

Every instructor must be prepared to discuss and explain the basis for her or his evaluation of students. If, after consulting the instructor, a student still believes that he or she was treated unfairly, he or she has the right to seek redress from the chairperson of the department or program in which the course is offered. Under exceptional circumstances, a final appeal may be made to the dean of the college or school in which the program is offered.

The following grades are used at the university: A, A-, B+, B, B-, C+, C, C-, D+, D, D-, F. Graduate credit is normally granted only for coursework completed with a grade of B- or higher. Individual programs may have stricter requirements for major courses.

AF Grades An "AF" grade, Administrative F, is assigned for failure to either drop or complete the course. An AF is considered a failing grade.

C, C+ Grades The dean of the Graduate School may, under limited conditions, approve up to 8 credits of C or C+ grades for graduate credit. When a student's advisory committee or a student's 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, to the dean of the Graduate School within one month after conclusion of the course. Normally these courses will be elective courses outside the student's major area.

Credit/Fail Grades A "CR" grade is given for complete, approved theses and dissertations, as well as other approved courses and seminars.

A graduate student may petition to take graduate independent study courses (800/900 level), as well as undergraduate courses, on a credit/fail basis. Such a petition must be approved by the end of the add period for the term the course is taken. Courses at the 700 level approved for graduate credit cannot be taken for credit/fail.

Audit Grades An "AU" grade is assigned for completion of courses for which an audit was granted. No credit is earned.

Incomplete Grades An "IC" grade is assigned with the approval of the instructor for excused unfinished work only. The work must be completed and submitted to the instructor by the last day of classes of the semester immediately following the one in which the incomplete was granted (800- and 900-level courses only; midsemester for 400-, 500-, 600-, and 700-level courses). A petition requesting additional time within which to resolve the incomplete, approved by the instructor, the student's adviser and graduate program coordinator, may be submitted to the Graduate School by the appropriate deadline. An extension will be granted by the dean only under unusual circumstances. An incomplete grade automatically becomes an F if not resolved or if a petition for an extension is not approved within the allowed time period. This policy also applies to students who withdraw from the university or who are not in an approved leave of absence.

An "IA" grade is assigned for approved continuing courses such as thesis or doctoral research and remains on the record until the course requirements are completed.

W Grades If a student withdraws from school or drops a course prior to the fifth Friday of classes, the course(s) will not appear on the student's permanent record. If a student withdraws from school or, for compelling nonacademic reasons, submits an approved petition to drop a course after the fifth Friday of classes, a notation of "W" will be shown on the student's academic record. If the withdrawal or drop is after midsemester, a WP/WF is shown on the record. A WF is considered a failing grade.

Academic Standards

Grades below the B- level, including grades of C or C+ that may have been approved for graduate credit, will, for the purposes of determining academic standing, be considered failing grades. Failing grades (below B-) received in undergraduate courses taken while the student is enrolled in the Graduate School are counted in the cumulative total of failing credits. Repeating a course does not remove the original failing grade from the record.

Graduate students receiving failing grades in 9 or more credits will be dismissed from the Graduate School. Students on a conditional status must meet the conditions as stated in their letter of admission in order to remain in the Graduate School.

Each individual program may set and announce standards for coursework and research achievement that are more rigorous than the Graduate School standard. Thus, students may be dismissed if they accumulate less than 9 credits of failing grades and/or fail to make adequate progress in other aspects of their graduate program.

Dual Credit

UNH Seniors University of New Hampshire seniors who have been admitted to the Graduate School under early admission (see page 7) may, upon recommendation of the department and approval of the Graduate School, be allowed a maximum of two graduate-level courses for up to 8 credits, to count credits toward both a bachelor's and master's degree. Dual credit forms must be completed and approved by the dean of the Graduate School at the beginning of the semester for which dual credit is sought. Dual credit forms are available at the Graduate School.

Transfer Credit

Candidates for the master's degree and the Certificate of Advanced Graduate Study (C.A.G.S.) may request that a maximum of two courses, for up to 8 semester credit hours of resident courses completed on the campus of an accredited institution authorized to grant graduate degrees, be transferred to count toward their graduate program. All courses presented for transfer must have been completed with a grade of B or better and must have been taken for graduate credit. Courses cannot be transferred for credit if used in earning another degree. Transfer of credits must be recommended by the program faculty and approved by the dean of the Graduate School. Students taking courses at another university for transfer after enrolling at UNH should obtain approval of their adviser and the

graduate dean prior to enrolling in the course.

Special Student Credits

Special-Credit Rule A maximum of three courses for up to 12 credits completed by a special student in University of New Hampshire graduate courses may, upon recommendation of the program faculty and approval of the dean of the Graduate School, be applied to a student's degree program. The 12-credit limitation applies to all courses completed or in process on the date when the official letter of admission is written. This number could be reduced if transfer credits are also applied.

Off-Campus Courses

Credits earned off campus will be applied toward a graduate degree only if recommended by the major program and approved by the Graduate School. UNH courses offered off campus that are not listed in the *Graduate Catalog* or specifically approved by the dean of the Graduate School will not be approved for graduate credit.

Twelve-Credit Off-Campus Rule A maximum of 12 credits, not including thesis, may be earned in UNH courses taken off the Durham campus. Credits earned off campus by a special graduate student will be counted as part of the 12 credits. Credits transferred from another university will also count as a part of the 12 credits allowed.

Exceptions to the 12-Credit Off-Campus Rule Students who are admitted to external graduate degree programs are exempt from the 12-credit off-campus rule. The programs that are currently approved as external degree programs include the M.S. programs in computer science, electrical engineering, and mechanical engineering at the Nashua Center and the programs in educational administration and supervision, and teacher education at UNH-Manchester.

Students who are admitted to all other graduate degree programs are subject to the 12-credit off-campus rule. Exceptions for these students may be granted on a

course-by-course basis. Courses taught by regular members of the graduate faculty of UNH may be approved for exception to the 12-credit off-campus rule. The Graduate School maintains a list of the approved courses. It is the responsibility of students who have reached the 12-credit maximum to check with their adviser to see if the desired course(s) can be applied toward their degree program, and with the Graduate School to see if the course has been approved for exception to the 12-credit off-campus rule.

Master's Degree Requirements

Credits A minimum of 30 graduate credits is required for all master's degrees. Many programs require substantially more than the minimum 30 credits. Individual program requirements are outlined in the program descriptions of this catalog. Graduate credits are normally earned in courses numbered 800–999. Up to 12 credits earned in courses numbered 700–799 may be taken for graduate credit by master's degree students provided the courses are approved by the dean of the Graduate School and given in a department other than the one in which the degree is sought. A maximum of 12 credits taken by a student prior to admission can be applied to a degree program.

Residency A student will normally spend at least one calendar year, or the equivalent, in satisfying the requirements for the degree.

Master's Continuing Research Master's students who have completed all course requirements and have previously registered for the maximum number of thesis or project credits and are in residence completing their master's program must register for Master's Continuing Research.

Time Limit All graduate work for any master's degree must be completed within six years from the date of matriculation (admission/enrollment) in the program. 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.

Nonthesis Option

Students who are in a nonthesis program may be required to pass a final examination. This 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 schedule 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 graduation date at 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.

Examining Committee Examining committees, when required, are appointed by the dean of the Graduate School, upon recommendation of the department or program concerned. Normally three members are required. The dean of the Graduate School is an ex officio member of all examining committees.

Thesis Option

Students who are in a thesis program are required to conduct independent research and prepare a scholarly paper for submission to the Graduate School. Each department will determine the date when the student must submit for approval a statement of the subject of the thesis and the date when the thesis must be completed. Students writing a thesis should obtain a copy of the *Thesis and Dissertation Manual* from the Graduate School. Students in thesis programs may also be required to pass a final examination. The regulations concerning this exam are the same as those in the nonthesis option. The thesis committee will normally also serve as the examining committee.

Thesis Credit A student completing a thesis must enroll for a minimum of 6 thesis (899) credits (8 credits in economics, mechanical engineering, and political science). A maximum of 10 thesis credits may be applied toward a master's degree. The exact number of credits within this range to be applied toward the degree will be determined by the faculty of the



JIANHUA LI
Ph.D. student, plant biology

IN TRUE DETECTIVE FASHION, Jianhua Li is on the trail of an ancient plant with fossil records dating back 110 to 120 million years. Witch hazel, the plant in question, is found throughout the world, from Australia and parts of Africa to South America and North America. Botanists do not know where the different species in this plant family originated or how they migrated. By examining DNA and other genetic characteristics of the various species, Li hopes to help solve these mysteries and perhaps even contribute to botanical evidence for the continental drift theory.

"In the short term," he explains, "my research is pure science, but in the long run, what I am discovering may have economic applications or implications for other areas of science."

Li's passion for unlocking the riddle of the witch hazel plant began in his native China, where he taught at Henan University in Hunan Province before enrolling in the plant biology program at UNH.

While at UNH, he has worked as a teaching assistant for the Introduction to Botany course. Recently, he received a fellowship from the Graduate School that has allowed him to focus exclusively on his dissertation. Li notes that the frequent seminars offered by his department have given him knowledge in a wide range of subject areas related to his field. He also credits the support he has received from his department and the university with helping him and his family make the adjustment to life in the United States.

"When I first arrived, the international students office introduced me to my host family, who invited me to their home and helped me get to know the area. This was very helpful. Everyone at UNH made me feel at home."

individual programs. No thesis credit shall be given until the completed thesis has been approved by the thesis committee and accepted by the Graduate School. Satisfactory acceptance of the thesis will be recorded as a credit (CR).

Thesis Committee 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 or graduate program coordinator and appointed by the dean of the Graduate School.

Submission of Thesis Two copies of the approved thesis, ready for binding, must be submitted to the Graduate School Office by the appropriate deadline as published in the Graduate School calendar. Binding fees will be paid at the Graduate School and are due upon submission of final copies. Most programs require one additional copy of the thesis.

Certificate of Advanced Graduate Study

Requirements for completion of the Certificate of Advanced Graduate Study are found under the program descriptions of the education department. A maximum of 12 credits taken by a student prior to admission to the C.A.G.S. can be applied to a C.A.G.S. program.

All graduate work for the C.A.G.S. must be completed within six years from the date of matriculation (admission/enrollment) in the program.

Doctoral Degree Requirements

The degree of doctor of philosophy is conferred on qualified candidates who have passed an oral or written examination(s) 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.

Credits Each program specifies the number of courses required for the Ph.D. degree.

Residency 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 would be advantageous.

Doctoral Research A minimum of two semesters of registration in Doctoral Research is required. However, doctoral students at candidacy must register for 999 each semester during the academic year, even if the minimum requirement has been met.

Guidance Committee A guidance committee is 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 assists the student in outlining a program and preparing for the qualifying examination, and administers the examination.

Qualifying Examination The qualifying examination is required and 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 chairperson of the student's program will communicate the examination results to the Graduate School dean.

Language/Research Proficiency Each doctoral program has its own language and/or research proficiency requirements. These requirements can be found in the individual program descriptions.

Degree Candidacy A doctoral student is advanced to candidacy for the degree

by the dean of the Graduate School upon recommendation of the graduate program coordinator after the student has passed the qualifying examination, met the language or proficiency requirements as are deemed desirable by the student's program, and declared a topic for dissertation research.

Doctoral Committee After the student has been advanced to candidacy, 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.

Time Limit All graduate work for the doctorate must be completed within eight years of the beginning of doctoral study, unless the student entered with a master's degree in the same field, in which case the doctorate must be completed within seven years. The beginning of doctoral study is defined as the beginning date of the earliest course applied to the doctoral record. The student must be advanced to candidacy within five years of the beginning of doctoral study or within four years if the student entered with a master's degree in the same field.

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. Students writing dissertations should obtain a copy of the *Thesis and Dissertation Manual* from the Graduate School.

Final Defense A copy of the completed dissertation must be made available to the members of the examining committee two weeks before the final examination date.

The final oral examination is conducted by the doctoral committee and is intended to give the candidate an opportunity to defend the 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 by the date listed in the Graduate School calendar. After consultation with the major program, the dean of the Graduate School 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.

Submission of Dissertation Three copies of the approved dissertation, ready for binding, must be submitted to the Graduate School Office by the appropriate deadline in the Graduate School calendar. Binding, microfilming, and copyright fees will be paid at the Graduate School and are due when the final copies are submitted. Most departments require one additional copy of the dissertation. Students should consult their advisers concerning dissertation requirements.

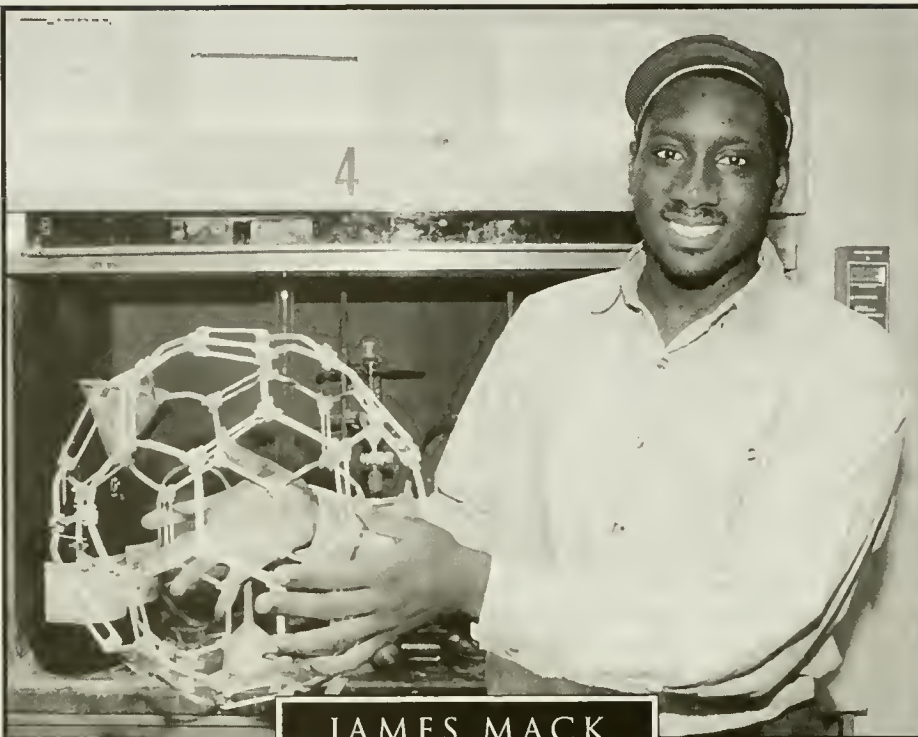
Publication of the dissertation by University Microfilms is required, and the student assumes the cost. Students may choose to copyright their dissertation at the time of microfilming. If the dissertation material is further published, it should be designated as having been accepted as a doctoral dissertation by the University of New Hampshire.

Graduation

Students must file an Intent-to-Graduate card with the Graduate School by the appropriate deadline specified in the Graduate School calendar. Specific information is available at the Graduate School.

All coursework completed prior to the official conferral of the degree will be applied only to that degree program.

Deadlines for graduation are listed in the Graduate School calendar and each semester's *Time and Room Schedule*. While graduation occurs three times a year, the annual commencement ceremony is held in May. Doctoral candidates must have completed all requirements for the Ph.D. degree including submission of the final copies of the dissertation by the deadline in order to participate in the ceremony.



JAMES MACK
Ph.D. student, chemistry

ONE DAY WHEN JAMES MACK was in the ninth grade, a guidance counselor appeared out of the blue, pulled him out of class, and put him back on track with a stern admonishment. He would not go to Stevenson High School just up the street where kids floated into class whenever they felt like it. He would go to Clinton High and take advantage of a program that placed inner-city kids like James in science programs at well-known colleges and universities.

And that is how James Mack, who grew up in the Bronx, went to Middlebury College in Vermont and chose UNH for a Ph.D. program in chemistry, studying a little known third form of elemental carbon named after Buckminster Fuller (because he designed the geodesic domes the molecule resembles).

Mack's research is focused on a soccer-ball shaped molecule called fullerenes, discovered just in the last decade. Mack first encountered fullerenes, also known as "Bucky balls," at Middlebury, and he was drawn to UNH in part because Assistant Professor of Chemistry Glen Miller was researching the subject.

Fullerene research is still new, and Mack is out there with the others hunting for clues amid a vast world of questions. He identifies with the metaphor of the hunter, specifically one who has heard of the existence of a mythical beast. "I don't know if this animal is there, but I've heard it is. So I look and look and look. Then you have a lead. You might see some tracks. . . . Finally, you nail it down and bring it back."

In a chemist's case, that hunt can take years, even decades. It takes patience and an endless stream of questions. To date, Mack is enjoying the hunt for new information.

The university has many diversified research projects, ranging from highly specialized investigations in the physical and biological sciences to broad interdisciplinary studies. Graduate students are involved in research as project assistants working on research leading to master's theses and doctoral dissertations. Research and educational activities are conducted not only in individual departments but also in multidisciplinary research centers and institutes.

Research at UNH is ethically based following guidelines provided by professional associations and by the *Belmont Report*, a statement of basic principles governing research involving human subjects. The *Belmont Report* and other information maintained by the Office of Sponsored Research are available at <http://www.unh.edu/osr/>.

Some of the university's research units are listed here.

Agricultural Experiment Station

The Agricultural Experiment Station (AES), one of the largest research and service units at the university, is supported by the United States Department of Agriculture and State of New Hampshire appropriations. Scientists associated with the AES are legally mandated to solve important problems affecting agriculture and the economic and social well-being of the people of New Hampshire, the region, and the nation and to add to the store of knowledge. Projects are designed to achieve a balance between basic and applied research in areas concerned with agriculture and improving the quality of life, especially in rural communities. These projects vary from fundamental studies of cancer cells to community planning, resource management to genetic engineering, marine biology and aquaculture to production agriculture, and molecular biology to biotechnology. Scientists and graduate students from seven departments in the College of Life Sciences and Agriculture are involved in research through the AES.

Browne Center

The Browne Center serves as a focal point for research in the outdoor education option in the Department of Kinesiology. Located on 100 acres within the Great Bay Natural Research Reserve, it consists of several universally designed challenge courses and a seminar/research facility. Each year approximately 5,000 people are involved in Browne Center programs, including UNH groups, corporate teams, nonprofit and community organizations, and school groups from New Hampshire.

Areas of research have included the effectiveness of adventure programming with corporate groups, family therapy programming, adolescents who are emotionally challenged, and individuals who are physically challenged.

The Browne Center also serves as a focal point for graduate students for teaching, training, and research. The center also enjoys a number of professional alliances with other organizations (e.g., American Youth Foundation, Lawrence Public Schools) that serve to augment its research endeavors.

Center for Business and Economic Research

The Center for Business and Economic Research supports and conducts theoretical and applied research on business and economic affairs. The center helps affiliated researchers procure outside funding for their projects, encourages the formation of multidisciplinary teams to pursue specific projects, maintains a library of working papers and other research materials, and hosts visiting scholars from other universities and research institutions.

Child Study and Development Center

The Child Study and Development Center is a laboratory school for child development, providing training for both teachers and researchers in the fields of child development and early education. The center operates four programs: (1) an infant-toddler program, (2) a preschool

program, (3) a kindergarten program, and (4) a nursery school program. Four themes provide a foundation for the curriculum at the center: international perspectives, technology, health and safety, and respect. While affiliated with the Department of Family Studies, students from other disciplines such as education, psychology, occupational therapy, and communications disorders, also use the center as a laboratory for the study of children. Classrooms in the center are equipped with observation booths, which provide researchers with the opportunity to observe children in a natural context. Research projects have ranged from the effects of infant child care on attachment to the development of emergent literacy. All research projects are reviewed by the UNH Institutional Review Board and by the center's director.

Communication Disorders Clinic

The clinic provides speech-language services to the university and seacoast community. As part of a student education program the clinic offers a broad range of state-of-the-art diagnostic and speech-language therapies to individuals of all ages. The clinic also provides graduate students in communication disorders with valuable research and clinical experience.

Dairy Teaching and Research Center

The Dairy Teaching and Research Center is a key component in UNH's efforts to provide the state with a well-prepared agricultural work force. The center consists of a tie-stall barn for one hundred milking cows with many added features such as a milking parlor that permits electronic recording of milk weights and other data, a gravity-flow manure system, and natural ventilation. Graduate study is conducted on nutritional needs of dairy cows through the Department of Animal and Nutritional Sciences.

Institute on Disability

The mission of the Institute on Disability is to improve knowledge, policy, and practice as it relates to the economics and social participation of persons with disabilities. The institute provides a blend of program development, policy research, training, and technical assistance that addresses the needs of local schools, community services, and state and federal agencies. The institute's goal is to increase the ability of the State of New Hampshire to foster inclusion of persons with disabilities into New Hampshire communities. The institute receives state and federal grants in early intervention, education, housing, employment, and family support.

Institute for the Study of Earth, Oceans, and Space

The Institute for the Study of Earth, Oceans, and Space (EOS) is an interdisciplinary research institute devoted to the study of the Earth and its space environment. Particular emphasis is placed on studies that contribute to understanding the global, integrated behavior of this system. These studies involve phenomena that occur on large and small spatial and temporal scales. They include the development of advanced technology to probe physically inaccessible regions; they depend on both remote sensing and in situ observations; and they involve the development of theories and models, the use of laboratory experimentation, and questions of public policy.

Individual disciplines in the study of the Earth and space—such as physical, chemical, and biological ocean science; atmospheric science; and space science—are legitimate areas of specialization for education and research in their own right. Each is rooted in basic physics, mathematics, biology, and/or chemistry. Each has a large body of specialized knowledge developed over time that must be understood by students before they can become functional scientists in that field, and each presents a separate career opportunity.

The number of research problems requiring contributions from many different fields, as well as an understanding of the complex connections among different components, has grown substantially in recent years. For example, the changes in climate that can be expected from the worldwide consumption of fossil fuels, the influence of solar luminosity changes on the climate, the ongoing alterations in the Earth's albedo resulting from changing land use, the ability of the oceans to assimilate wastes, the sensitivity of stratospheric ozone to trace gases such as fluorocarbons, and the translation of scientific studies of these problems into public policy—these are all examples of fundamental issues that require a global, multidisciplinary approach.

Faculty members working in the Institute for the Study of Earth, Oceans, and Space are affiliated with academic departments through which graduate degree programs are offered. The degree programs currently offered are the physics degree with specialization in space science, the earth sciences degree with an option in oceanography or specialization in geochemical systems, the natural resources master's or interdisciplinary doctoral degree, and the zoology degree with marine specialization. Admission and degree requirements are set by the respective departments. In addition, EOS students are required to participate in an EOS interdisciplinary seminar. Specialized courses on the various components of the Earth and space system are offered by the institute and can be elected both to fulfill degree requirements and to broaden the education of students completing this program emphasizing a global perspective.

Students who wish to access the degrees in earth sciences, natural resources, physics, and zoology through EOS should have the desire to broaden their education beyond the specific requirements of these degrees by participating in the specialized courses offered by EOS. The latter are interdisciplinary in nature and are designed to enhance understanding of the global Earth, its environment in space, and the nature of global research. Interested students should see pages 49–50 for a description of these courses, and pages 50, 93, 102, and 116 for the admission and degree requirements for the graduate programs in earth sciences, natural resources, physics, and zoology.

Biogeochemical Systems Center

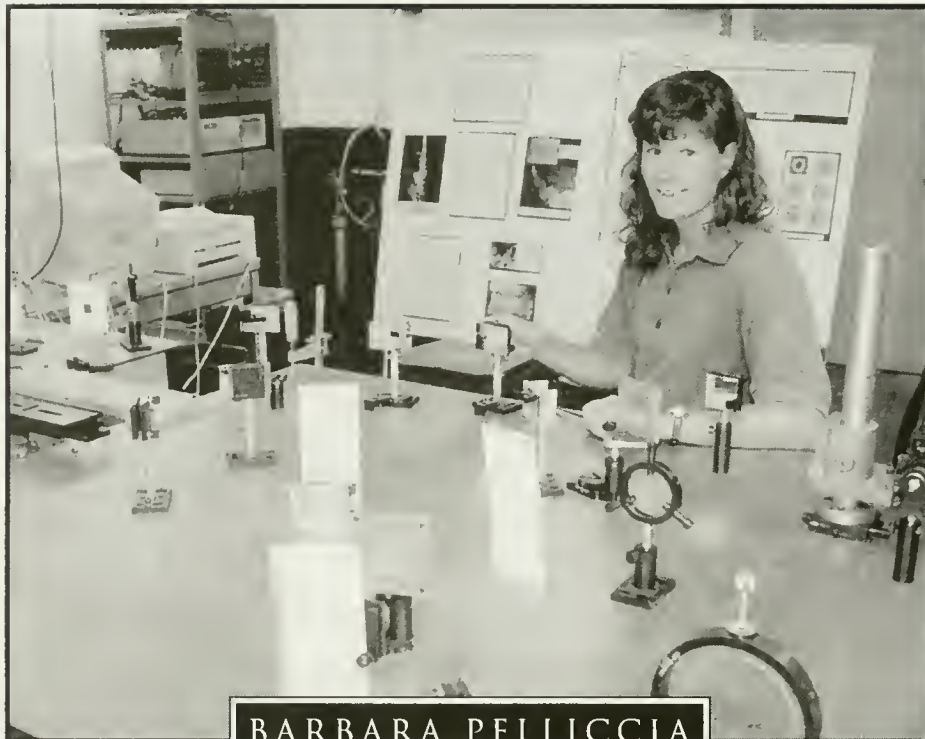
The Biogeochemical Systems Center uses geochemical methods in the study of crustal evolution, contamination of aquatic ecosystems, and marine and estuarine nutrient cycling. Topics of field and laboratory investigations include isotope geochemistry, nutrient dynamics in estuaries and regional marine systems, and heavy metal contamination of estuarine sediments. Faculty and students are members of the Department of Earth Sciences, offering degree programs specializing in oceanography or geochemical systems.

Climate Change Research Center (CCRC)

The Climate Change Research Center and the associated Glacier Research Group are devoted to the retrieval and interpretation of global change records that document climate (response and forcing), biogeochemical cycling, atmospheric chemistry, unique atmospheric phenomena (e.g., extreme events, volcanic events, biomass burning), and the influence of human activities on our environment. The faculty, research scientists, and graduate and undergraduate students in the center conduct a wide range of analytical measurements. Studies are conducted in the high polar latitudes (Antarctica, Greenland, Arctic Islands) as well as the mid and low latitudes (Himalayas, China, New Guinea). Faculty and students are affiliated with the Department of Earth Sciences and its degree program in geochemical systems.

Complex Systems Research Center

The Complex Systems Research Center investigates the effects of human disturbance on the Earth's biogeochemical processes. Utilizing satellite remote sensing, field and laboratory investigation, computer modeling, and policy analysis, Complex Systems Research Center faculty, staff, and students are currently examining the ocean's role in the global carbon cycle, forest decline and land-use change, nutrient cycling and decomposition in terrestrial ecosystems, processes contributing to changes in climate and



BARBARA PELLICCIA

Ph.D. student, mechanical engineering

WITH JUST A HIGH SCHOOL EDUCATION, Barbara Pelliccia was drawn back to continue her education, taking college classes at night for six years while working full-time for Digital Equipment Corporation in Merrimack. Once she got started, she wanted to learn more. The company allowed her to work part-time so she could take more advanced engineering classes at UNH during the day.

Eight years later, in 1990, she received her bachelor's degree in mechanical engineering. After she went back to work, designing computer interiors, she quickly realized she needed an even greater challenge. She returned to UNH.

Today Pelliccia is a Ph.D. candidate with a dissertation fellowship that allows her to pursue her research without the added demands of working as a teaching assistant.

Her dissertation looks at the structure of turbulence. By studying random data and using tomography to grab pictures of the turbulence much like an MRI takes pictures of the human body, she hopes to help better understand how turbulence occurs and how it can be controlled. "The neat thing about what I'm doing is that no one's been able to measure this in three dimensions before and turbulence is three dimensional."

Pelliccia has enjoyed her work as a teaching assistant and hopes to continue in academia. "I really believe in education and I really want to teach. I like to break things down so that students can understand them." She enjoys that moment when a student finally grasps a complex subject, and the students apparently appreciate her teaching style. One group recently put an apple on her desk.

atmospheric chemistry, and the impact of policy decisions on the global environment. Faculty and students are affiliated with either the Department of Natural Resources or the Department of Earth Sciences and their degree programs in natural resources or geochemical systems. The Ph.D. in Natural Resources is an interdisciplinary, interdepartmental program.

Ocean Process Analysis Laboratory (OPAL)

Research in the Ocean Process Analysis Laboratory focuses on a range of physical, geochemical, and biological processes in the Gulf of Maine, Gulf Stream, North Atlantic, and California Current. Current research topics include changes in global distributions of phytoplankton biomass and productivity documented with ocean color imagery, the use of molecular population genetic analysis to trace zooplankton dispersal in the coastal and open ocean, the dynamical role of the North Brazil Current in climate change, the relation of changes in water properties and circulation to external forcing in the Gulf of Maine, and the geochemistry of deep ocean ridge vent systems. The laboratory houses a pair of regional marine data and information management systems as well as the RIDGE Program Office which coordinates worldwide research on the global ocean rift system. Faculty and students are affiliated with the Departments of Earth Sciences or Zoology, and with degree programs in oceanography or marine ecology.

Space Science Center

The Space Science Center fosters research and graduate education in all of the space sciences, with studies ranging from the ionosphere, to the Earth's magnetosphere, to the local solar system, out to the farthest reaches of the universe. Investigations of the Earth's environment in the solar system utilize space as a laboratory for plasma physics. Both theoretical and satellite investigations are conducted of the solar-terrestrial radiation research. Faculty and students are members of the Department of Physics and with its graduate degree specialization in space physics/astrophysics.

Environmental Research Group

The Environmental Research Group (ERG), affiliated with the Department of Civil Engineering, conducts applied and fundamental research in the areas of environmental engineering and environmental science. Particular emphasis is placed on technology development in the three areas of water treatment, ground-water remediation, and waste utilization in engineered systems. The group is made up of faculty members with research interests in biological and physicochemical treatment processes, solid and hazardous waste management, environmental chemistry and microbiology, hydrogeology, technology development, and waste minimization.

Recent research sponsors include the National Science Foundation, the U.S. EPA, the U.S. DOE, the Department of Defense, Environment Canada, the American Water Works Association Research Foundation, numerous private sector companies, and state and local government. Frequently, research projects are multidisciplinary and involve host communities, regulatory agencies, and private sector companies. Representative projects include the development of membrane filtration and advanced oxidation treatment schemes for potable water production; the evaluation of alternative disinfectants for pathogen control in drinking water treatment; the characterization of microbial community interactions in groundwater contaminant plumes; the application of paper sludges to soils; and the use of waste materials in civil engineering construction applications.

One of the principal missions of the group is to conduct research in support of graduate and undergraduate education. ERG faculty members are from the civil engineering, microbiology, or chemical engineering departments. Most graduate students involved in ERG-related research are master's or doctoral students in the Department of Civil Engineering (see departmental requirements and course descriptions for civil engineering). Typically, research projects provide one to three years of support via stipends and tuition waivers. The presentation of thesis or dissertation results at conferences and in scientific journals is strongly encouraged. Graduates go on to work for

environmental engineering consulting firms, regulatory agencies, or academia.

Family Research Laboratory

Internationally recognized for its extensive and pioneering research on violence within the family and against children, the Family Research Laboratory also conducts studies on many other aspects of the family, including communication patterns, marital decision-making, and the family measurements. Laboratory work is supported by grants from the National Science Foundation, National Center on Child Abuse and Neglect, Department of Justice, and the National Institute of Mental Health. Graduate students are actively involved in the research activities of the laboratory.

Center for Health Promotion and Research

The Center for Health Promotion and Research was established in 1984 to strengthen the connections between health care organizations and UNH faculty members. The center serves health care providers, consumers, state agencies, community organizations, and health care institutions. It provides continuing education programs, a speakers bureau for community and professional organizations, research advisement, consulting services, and expert testimony in areas of health and human services. Research topics include families, interdisciplinary health and human services, and health care delivery systems.

Center for the Humanities

The Center for the Humanities acts as a forum for discussion and intellectual cross-fertilization regarding humanistic issues and perspectives; it fosters and supports creative research in the humanities; it assists faculty in their educational and curricular activities in general, and in the development of interdisciplinary

humanities courses and programs in particular; it serves the humanities faculty, students, programs, and community by assisting in the development and dissemination of educational and research materials; it fosters and develops relevant outreach activities in the humanities for the state and region; and it acts as a focus for the humanities within the university, the state, and the region.

Industrial Research Center

The center matches the intellectual and technical resources of the university with the needs of business and industry and New Hampshire state agencies. The center's primary resource is the faculty of the university and draws upon this resource to organize teams that study complex research problems.

The goal of the center is to establish research and development relationships between the private sector and the university. The center markets inventions developed at UNH and licenses such technology to the private sector. In addition, the center invites business and industry and individual inventors to submit proposals for joint participation in the development of inventions.

Marine Program

The UNH marine program supports research, education, and service projects involving the estuarine, coastal, and deep ocean environments. It is closely tied to graduate academic programs in a wide range of disciplines and gives special emphasis to interdisciplinary programs that enhance the strengths of academic units of the university. The marine program includes the Center for Marine Biology, the Center for Ocean Engineering, the Center for Ocean Sciences, the University Diving Program, university research vessels, and participation in the joint UNH/University of Maine Sea Grant College Program.

Center for Marine Biology

The Center for Marine Biology (CMB) serves the faculty based in five academic departments of the College of Life Sciences and Agriculture and along with

two other centers, comprises the UNH Marine Program.

The primary goals of the Center for Marine Biology are to foster marine biological research and graduate education, and to maintain a set of research laboratories and specialized facilities, such as the Image Analysis Lab and DNA Sequencing Lab. The center also provides the funding to support graduate student research projects and travel to scientific meetings.

Researchers associated with the Center for Marine Biology study diverse marine-related topics that are of importance to the state or region, or of national or international scope and significance. All faculty members are also affiliated with academic departments, through which marine-related graduate and undergraduate degree programs are available. Research by center members is currently supported by the National Science Foundation, by several NOAA agencies (including sea grant), and by various state agencies, as well as by private foundations and limited university funds. Some of the Center for Marine Biology's research is conducted through three of the Marine Program facilities.

The **Jackson Estuarine Laboratory** is located on Great Bay about five miles from campus and fourteen miles from the ocean via the Piscataqua River. The lab supports research in estuarine science including ecology, sedimentary geology, marine microbiology, and aquaculture of estuarine species. The Jackson Lab has five resident faculty members and also provides a site for the Center for Marine Biology.

The **Coastal Marine Laboratory**, a running seawater facility, is located about fifteen miles from campus at Fort Constitution, New Castle. It serves as a location for research involving living marine organisms or other studies requiring a reliable supply of clean ocean water.

The **Anadromous Fish and Aquatic Invertebrate Research Laboratory**, located on campus, is a running freshwater facility designed for the maintenance and rearing of anadromous fishes and freshwater invertebrates. It supports the research of several faculty members on freshwater species.

Center for Ocean Sciences

The Center for Ocean Sciences (COS) is composed of eleven faculty members from a variety of disciplines whose research addresses critical questions concerning the coupled atmosphere/ocean/land system. Physical, chemical, geological, and biological oceanographers join with ocean and atmospheric geochemists in research efforts that seek to unravel the complex processes that are important on estuary, coastal ocean, open ocean, and global Earth scales. For example, COS researchers are currently addressing questions related to how: circulation affects the distribution of sediments, nutrients, and plankton in the coastal and open oceans; deep ocean vent systems and the atmosphere affect the geochemistry of the ocean and the atmosphere; the variability in the tropical Atlantic is related to climate change in the Atlantic basin; and how the oceans are involved in the global carbon cycle.

The COS academic research programs involve graduate and undergraduate students. While they emphasize both the direct and remote observation of the marine environment, oceans, and atmosphere, there is a growing effort to integrate observations with relevant models. COS research also benefits from access to several modern laboratories including labs for ocean remote sensing, ocean process modeling, and automated DNA sequencing.

Center for Ocean Engineering

The Center for Ocean Engineering (COE) provides for an integration of academic and research missions in Ocean Engineering. Home to OE faculty and graduate students, this organization enables the graduate student to access the center's facilities as well as other learning opportunities and facilities found in the Marine Program, such as the diving program and research vessel fleet, achieving strong interdisciplinary flavor.

The research agenda is concerned with the effective and wise utilization of the coastal ocean, extending from the estuary out to the limits of the Exclusive Economic Zone, encompassing hydrodynamic modeling, fluid structure interaction, acoustics, measurement systems, and data analysis and interpretation. Specific topic areas include oil spill response planning, sediment transport, geoacoustics, geotechnics, pollution fate

modeling, oil boom deployment modeling, dynamics of open ocean aquaculture groud cages, bioacoustics in the fishing industry, and aides to navigation. In all areas the focus is on solving real engineering problems in the ocean.

Sea Grant College Program

The University of New Hampshire and the University of Maine form a joint Sea Grant College Program that provides support, leadership, and expertise for marine research, education, and advisory service in northern New England. As part of the National Sea Grant College Program, the UNH/Maine Sea Grant College Program is one of a network of twenty-nine in the nation. The program is dedicated to promoting the understanding, development, wise use, and conservation of ocean and coastal resources through university-based research, education, and advisory services. There is opportunity for graduate students to become involved in nearly all projects supported by Sea Grant.

The UNH/Maine Sea Grant College Program works with marine industries, government agencies, private organizations, and individuals to identify and solve problems associated with the conservation and development of the region's marine resources. Through its information, education, and public service efforts, the program increases awareness of marine and coastal issues and promotes responsible use of these resources.

University Diving Program

The diving program offers introductory and advanced instruction in SCUBA diving, supervises safety of diving operations by UNH students and staff members, and maintains a hyperbaric chamber for research use. This program provides the essential logistic support to all university sanctioned diving activities, both academic and research.

Research Vessels

The *R/V Gulf Challenger* is a 50-foot research vessel equipped for a wide variety of marine research activities in the estuary and near-coast waters. In addition, there are several outboard skiffs

available for research purposes which are berthed at the Jackson Estuarine Lab and the Coastal Marine Lab.

Manchester Manufacturing Management Center

Started with a grant from The Gruber Foundation, the Manchester Manufacturing Management Center is operated by the Whittemore School of Business and Economics. The center serves as a crucial link between the university and state manufacturers. It coordinates pockets of manufacturing expertise throughout the university, and then makes that information easily accessible to manufacturers who need it and can profit from it. The center generates action-based research and reports, and it organizes seminars, internships, and symposia at various sites throughout New Hampshire. The center also matches teams of students with manufacturers who have specific project needs. In this way, the center promotes a close working relationship between students and manufacturers to ensure that the best students consider careers in manufacturing.

New Hampshire Industries Group

This association of WSBE faculty members works together to identify and study those industries, clusters of industries, and firms that have made important contributions to the state's and region's welfare, principally by advancing productivity and by competing successfully in international markets. The group develops research strategies to explain how the region's leading and emerging industries, which are dominated by small- to medium-size firms, have performed so well. Opportunities exist for graduate students to work with faculty members on selected projects.



JOHN POWERS
M.B.A. student, business administration

IN 1996, JOHN POWERS was appointed vice-president and chief financial officer for WPI Group, Incorporated, a growing company with 650 employees and a sales revenue of \$100 million. Located in Manchester, New Hampshire, WPI sells handheld programmable computers, transformers, and power systems to customers worldwide.

"It became apparent as I went through the interview process that the skills I have learned in the M.B.A. program at UNH got me the job at WPI," Powers says. "You need to have a broad set of knowledge and skills to move ahead in any company today. The days of staying in one job throughout your working life are over."

Powers began his career as a C.P.A. in public practice. When he was appointed chief financial officer for a privately owned New Hampshire company in 1993, he quickly realized he could not continue to advance in the business world without an M.B.A. After eighteen years in the work force, he enrolled at UNH as a part-time student.

"The M.B.A. program is very challenging," says Powers, "yet the university does recognize that we are working full time while going to school. The best thing about the program is that it incorporates the real-world experience of students."

In courses such as Organizational Behavior and Advanced Organizational Theory, Powers acquired skills he believes are crucial in today's job market, including effective communication, efficient personnel management, and application of the latest technology. He has benefited in particular from group projects assigned in a number of classes. For one project, he spent five weeks studying the business practices of a New England company with classmates on site.

"Learning is a lifelong process," he adds. "If you're proactive about this process, you'll be in a better position to choose your career path. I am very impressed with the quality of the courses and professors at UNH. Most of all, the program has helped me develop skills to work in a group setting, which is absolutely necessary in the current business world."

New Hampshire Small Business Development Center

The New Hampshire Small Business Development Center counselors provide assessment, evaluation, advice, education, or referral to help promote small business success. The center works with a variety of public and private organizations to offer an extensive list of training programs at affordable costs. Students in the M.B.A. program may work directly with clients under the supervision of the center's counselors to provide feasibility assessment; business plan development; access to capital, market, and financial analysis; cash flow management; and operations and organizational planning. They may also work behind the scenes, assisting the center's counselors with research and analysis.

Institute for Policy and Social Science Research

The Institute for Policy and Social Science Research provides financial and administrative support for social and policy-related research at the university. It works to raise the contribution that UNH faculty and students can make to public decision makers in universities, communities, New Hampshire, and the Northeast.

The UNH Survey Center within the institute conducts public opinion studies for a wide variety of clients. Work of the institute is conducted within a set of broad themes. These reflect concern for sustaining natural environments, achieving peace and social equity, providing public education, implementing micro-computer decision support systems, and sustaining economic development. The institute helps faculty members secure external research funds, aids in the dissemination of results, and offers research facilities to house visitors and interdepartmental groups. With the School of Health and Human Services, the institute

administers the Browne Center, a 100-acre campus for action learning that conveys skills in teamwork and conflict resolution.

Office of Sustainability Programs

The Office of Sustainability Programs (OSP) was established in 1997 to manage university-wide programs and projects that define and integrate sustainability practices across all facets of the university. OSP collaborates with faculty, administrators, staff, and students to link the emerging values, science, and norms of sustainability to student and professional development. OSP-sponsored projects involve curriculum and research development, campus environmental practices, and partnerships with local, regional, and international communities.

Teaching Excellence Program

For graduate students who teach and are interested in preparing for an academic career, the Teaching Excellence Program provides formal academic programs and courses, seminars, and resources. The program receives funding from a variety of foundations and in 1995 received funding from FIPSE to develop a program in college teaching in cooperation with the Graduate School. In 1997, UNH was selected as one of fifteen doctoral universities to participate in Phase II of the Preparing Future Faculty (PFF) program. PFF is a national program of the Association of American Colleges and Universities and the Council of Graduate Schools sponsored by the Pew Charitable Trusts. The program provides the opportunity for graduate students to earn the Cognate in College Teaching to add to the Ph.D. and Master of Science for Teachers with a major in college teaching as a dual degree.

Other opportunities for graduate students include seminars on the academic career, topics related to college teaching, and opportunities to interact with faculty from other colleges and universities as part of an academic career development

plan. The program conducts applied research related to the development and hiring of new faculty.

Center for Venture Research

This multidisciplinary community of scholars and professionals is dedicated to the study and promotion of innovation, entrepreneurship, and economic development. The center pursues its objectives in three distinct ways: research, service, and education. University faculty members, graduate students, and professionals are involved in all aspects of the center and together address the equity financing needs of the entrepreneurial economy.

Water Resource Research Center

The Water Resource Research Center, supported by the United States Department of the Interior and the university, implements basic and applied research in freshwater and estuarine water resources issues. It is also involved in information dissemination activities and technology transfer programs that contribute to the solution of national water resources problems. Both undergraduate and graduate students are involved in the research projects supported by the center.

Writing Process Laboratory

This research center provides opportunities for graduate students, professors, and teachers to conduct research in reading-writing instruction and other areas of literacy. They currently conduct research on the relationship between reading, writing, and evaluation; inclusion; writing in math; multiple literacies; literacy, language and culture; service learning; and poetry. Various foundations support the laboratory's pioneering work.

The Campus

The home of the university is Durham—one of the oldest towns in northern New England. The town is semirural and still retains traces of its colonial past in both the architecture and small-town atmosphere. Graduate students have found Durham to be an ideal place to live while completing a graduate degree at UNH. For those interested in cultural pursuits, Boston is a quick 65 miles to the south. Outdoor enthusiasts will find skiing, hiking, and the scenery of the White Mountains 60 miles to the north and the sandy beaches and rocky coast of New Hampshire and Maine 10 miles east.

The university is sited on a 200-acre campus, surrounded by rolling fields, farms, and woodlands owned by the university. A 15-acre wooded tract, known as the Ravine, graces the center of the campus and provides members of the university community some natural quiet amid the seventy-four classroom, research, and service buildings and thirty-six residential buildings of the campus.

UNH Library

Scheduled for completion in 1998, the addition and complete renovation of the Dimond Library will provide the University of New Hampshire with a state-of-the-art library to support the campus in its information needs into the twenty-first century. The project increases space by one quarter, creates three light-filled grand reading rooms, supplies hook-ups for electronic equipment, adds a data center, a map room and a media room, and provides space for twenty years' growth in collections.

With approximately 1.1 million volumes, 6,500 periodical subscriptions, a million government documents, maps, sound recordings, compact disks, videocassettes, manuscripts, and other related material, the UNH Library has a wealth of resources for teaching, research, and personal needs. The library has several computerized periodical indexes available for free searching. Users can find citations for magazines, journal and newspa-

per articles, dissertations, and papers and conference proceedings on compact disks, and can print out those citations, article summaries, and sometimes even the entire article. The library's online catalog (OPAC) is a powerful system providing access not only to the library's holdings but also to other databases, indexes, and the Internet.

Government Documents receives 75 percent of U.S. Government publications including congressional hearings, federal regulations, departmental publications, and maps. The Listening Room has a variety of musical and spoken recordings in all formats for classroom and individual needs. Special Collections contains rare books, historical documents, and manuscripts; Archives maintains the university's records and papers. The branch libraries, specializing in scientific materials, contain CD-ROM periodical indexes as well as print indexes and journals related to the physical and biological sciences. The branch librarians provide (upon request) bibliographic instruction and assistance in these specialties.

Librarians in the reference, branch, documents, and special collections areas provide any needed assistance in locating materials. The reference and branch librarians can provide computerized online searches of all major databases. Tailored SDI services are available to keep graduate students up to date on their research fields. Interlibrary Loan can obtain materials that the library does not own. The library can lend or borrow from libraries world wide.

The library has a graduate study area with assignable locked book trucks. Check with the main desk for availability.

Information on the library can also be found on UNHinfo and <<http://www.library.unh.edu>>.

Computing and Information Services

All graduate students at UNH have access to mainframe computers and microcomputers.

Microcomputing UNH has three conveniently located microcomputer centers for use by students. They are equipped with Apple, Macintosh, and Dell comput-

ers and compatible printers. Each center has a library of software for word processing, spreadsheets, graphics, modeling, and statistical analysis. Some students use their own software or software provided by their instructors. The centers are staffed by student consultants who help users with questions or problems.

Mainframe Computing The university has three central system computers available for academic use. These computers run Ultrix and Digital UNIX and operate 362 days a year, 24 hours a day.

Any student may arrange for an account on the central system and may use these machines via terminals in any of three UNIX computing centers (or with terminal emulation programs in the small systems centers). The UNIX centers are staffed by student consultants during peak hours and have workstations adapted for wheelchair access.

There are approximately seventy-five remote terminals and graphics devices located in classroom buildings on campus. Students may also use electronic mail and the Internet.

Computing and Information Services supports a library of general-purpose software including statistical packages and graphics, and discipline-specific software in fields such as engineering, biochemistry, forestry, sociology, and computer science.

The university is an affiliate of three National Science Foundation supercomputing sites: the National Center of Supercomputing Applications (Urbana, Illinois), the Cornell National Supercomputing Facility (Ithaca, New York), and the University of Pittsburgh Supercomputing Center (Pittsburgh, Pennsylvania). These agreements permit UNH faculty, researchers, and students to use the most powerful computer technology in academic and research activities at UNH.

Computer Purchases Students who want to purchase their own computer may do so at the Tech Underground, the UNH computer store located in the MUB. The Tech Underground sells hardware from Apple, Dell, and Hewlett-Packard as well as an assortment of software packages at educational discounts. They also carry a wide range of computer

peripherals and supplies. Computer systems sold at the store are specifically selected to operate on UNH's network. The store is open weekdays and Saturdays through the academic school year. Call the Tech Underground at (603) 862-1328 or visit their website at <<http://www.utc.unh.edu>>.

Computer Repairs Warranty repair service and preventive maintenance for computers and printers is available through the Computer Service Center which is open weekdays at the CIS Center loading dock on College Road. Call them at (603) 862-1702.

Teaching and Learning Students can learn about computing through free, short courses offered every semester, many of which include hands-on training. The center also offers a library of instructional videotapes on many popular application programs. Additional support and training are available through course handouts, documentation and guides, UNIX online HELP, and on-disk tutorials.

UNHinfo UNHinfo is the campuswide information system with the address of <<http://www.unh.edu/>>. It has links to a wide variety of campus information including: athletics, academic departments, events, the library catalog, employment, student organizations, and much more.

Organizations

Graduate students are an integral part of the university community, yet they have needs and interests that differ from other university groups. The Graduate School, the university, and the Graduate Student Organization have worked in concert to provide graduate students with access to facilities and organizations that meet their diverse needs and interests.

Graduate School

The staff of the Graduate School is available to assist students in both academic and personal matters affecting their study at the university. Students are urged to contact the office with questions about academic policy, finan-

cial assistance, and university services available to graduate students. The offices of the Graduate School are located in Thompson Hall, <<http://www.gradschool.unh.edu>>.

Graduate Council

The Graduate Council, comprising ten graduate faculty members and three graduate students, advises the dean of the Graduate School on policies concerning graduate education and is responsible to the graduate faculty for recommendations concerning new graduate programs. Standing committees of the council include the doctoral program committee, the master's program committee, and the student affairs committee.

Graduate Student Organization

Graduate students play an active role in the life of the university community. The Graduate Student Organization (GSO) represents the interests of the graduate student body by providing a framework for graduate student participation in university governance. The GSO's goal is to foster the continual improvement of graduate student life at UNH. The GSO's purposes are: to provide a representative structure for the graduate student body; to serve as an advocate for graduate student concerns and to be a resource for graduate students; to establish and maintain an effective means of communication between graduate students, faculty, and administrators; to participate in the decision-making process for establishing university policies and/or setting priorities which affect graduate student life; to initiate and administer programs and services for the graduate student body and the university as appropriate; to monitor the development of all mandatory fees and the services which they support; and to provide the graduate student body regular, open meetings for participation in graduate student governance.

The board of the GSO has representation from each department with an approved graduate program and provides representatives to most of the major university committees.

Facilities and Services

Graduate Student Residences

Babcock House Babcock House provides on-campus housing and a sense of community for full-time graduate students. Babcock lies within easy walking distance of all major classroom buildings as well as the university library, computer clusters, and the Memorial Union Building. Babcock itself is a center for both academic and nonacademic graduate student activities. Events in the past have included job opportunity seminars, art exhibits, film series, and evening gatherings; whale watches and hiking trips have also been organized.

Six-story Babcock can accommodate 180 persons on coed or single-sex wings. The general atmosphere is quiet but sociable. A common TV and social lounge with tables and comfortable seating is located on each floor. On the ground floor, students can relax in front of the fireplace in the main lounge, unwind with a game of Ping-Pong in the recreation room, or check out sports equipment for use outside. Other facilities in the hall include a piano, locked bicycle storeroom, coin-operated laundry, vending machines, luggage storage areas, and individual mailboxes. All student rooms are single occupancy. Each room is furnished with a bed, easy chair, desk and chair, wardrobe, clothing drawers, medicine cabinet, mirror, and lights.

A full-time hall director lives in a ground-floor apartment. Five resident assistants, one on each floor, assist in administration and programming and can provide information on university policies and personal services available to graduate students. Babcock also has a house council with elected representatives. The council acts as an advocate for residents and, traditionally, supplies papers, magazines, television, recreational equipment, and other services and programs for residents.

Following acceptance to the Graduate School, each student will be contacted about housing by the university's Department of Housing, Pettee House, University of New Hampshire, 14 Garrison Avenue, Durham, NH 03824-3558.

Forest Park Apartments The university owns and operates Forest Park, a complex of 154 studio (efficiency), one-bedroom, and two-bedroom apartments for married students, students with families, and faculty. The community is composed of two- and three-story buildings located on the southern edge of campus, within walking distance of all UNH facilities and Durham's shopping area and schools.

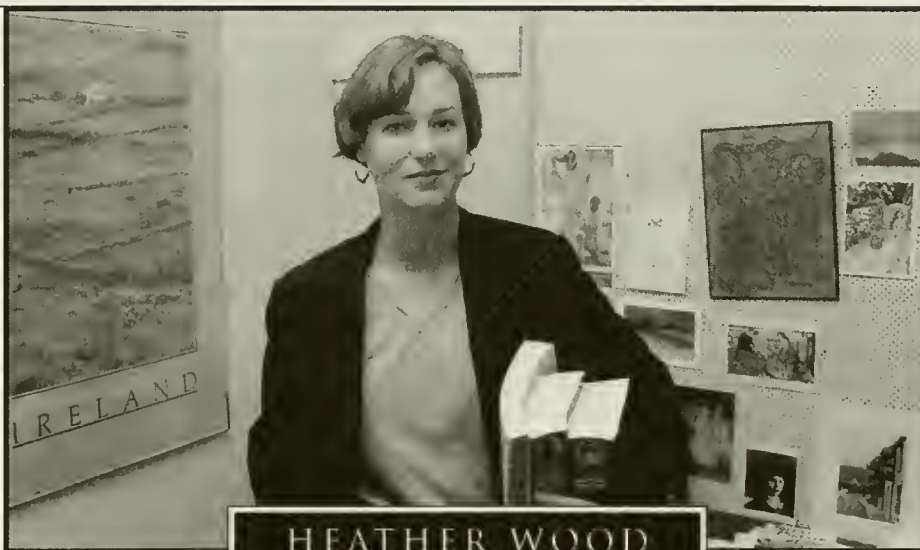
To be eligible for housing, all graduate students must be admitted to the university and be considered full time as defined in this catalog. Students may apply for Forest Park before fulfilling the above requirements, as long as the requirements are met at the time of assignment. All interested individuals must fill out an application form available at the Forest Park Office. A brochure and application can be requested by writing to Forest Park Manager, 160 Forest Park, University of New Hampshire, Durham, NH 03824.

Summer Housing Rooms in Babcock House are available to graduate students taking courses during the summer. Students interested in summer accommodations should contact the Department of Housing (Petee House, University of New Hampshire, 14 Garrison Avenue, Durham, NH 03824-3558) or complete and return the Summer Housing Application Form in the *Summer Session Bulletin*.

Off-Campus Housing The Office of Student Activities operates the Commuter and Information Center, which assists students in obtaining off-campus housing and provides services and support to UNH's commuter population. Students are encouraged to visit or contact the Commuter and Information Center in the Memorial Union Building at (603) 862-2136 or to access the housing list on UNHinfo, the campuswide information system.

Dining Facilities

All graduate students are eligible to purchase meal plans for dining hall meals. Babcock House has limited communal cooking facilities, none in individual rooms. Students may choose among dining plans providing for 19, 14, 10, or 7 meals or 5 lunches weekly or "any 35 meals" plan. Any of the above may be owned separately or in conjunction with



HEATHER WOOD
M.A. student, English

HEATHER WOOD spent the summer between her first and second years in the M.A. program writing a paper on the prototype of the Yankee mill girl and the Irish domestic servant in the work of nineteenth-century New England author Elizabeth Stuart Phelps, thanks to a university fellowship.

The subject is typical of Wood's work, which takes a cultural studies and postcolonial approach that brings together history, culture, and literary theory, and draws on her passion for Ireland.

"The majority of my professors are interested in looking at literature from an interdisciplinary viewpoint that seeks to contextualize the work," Wood notes. "In an English course at UNH, you are apt to work with history, art history, women's studies, and cultural studies. The 'new historicism,' as this approach is called, is fascinating."

Wood's interest in Ireland was sparked when she attended an exchange program in England as a UNH undergraduate. After receiving her B.A. in English literature, she lived in Belfast, where she completed an M.F.A. in creative writing with a concentration in poetry from the University of Lancaster. She returned to her native New Hampshire and UNH to enroll in the M.A. program but plans to make Irish literature the focus of her thesis.

"I came back to UNH because the English department is incredibly supportive," says Wood. "It's a student-based program where the emphasis is on teaching. The professors are very approachable. As an undergraduate and now as a graduate student, I have always felt nurtured and encouraged."

Wood received a teaching fellowship when she entered the program and describes her experience teaching English 401, a required course for undergraduates, as invaluable. After completing her M.A., Wood plans to apply to Ph.D. programs. "I feel much stronger going into the Ph.D. application process now. The experience teaching at UNH has shown me that I like to teach, and the program has made me both a competent and confident student."

a declining balance debit account known as Cat's Cache, which may be used to purchase meals, supplies, and services in the Memorial Union Building as well as dining hall meals and snacks at the MUB Food Court. Dining plans and debit accounts are administered electronically through a magnetic stripe in the student's university ID card.

For further information about UNH Dining Services or Cat's Cache, please contact UNH Dining, 20 Stillings Hall, 20 Ballard Street, Durham, NH 03824-3555, (603) 862-1821.

Recreation Programs and Facilities

The Department of Campus Recreation offers a comprehensive selection of activities including intramurals, sport clubs, noncredit fitness classes, and informal recreation. Graduate students are encouraged to put to full use the facilities, equipment, and imagination of the recreation staff. They can gain access to all activities by using their student ID and will receive reduced rates for noncredit fitness classes.

Informal Recreation The informal recreation program offers graduate students the opportunity to participate in self-directed recreational activities—a chance to relax, get some exercise, or do whatever they like to get away from it all. Activities include basketball, volleyball, swimming, skating, racquetball, squash, tennis, jogging, weight lifting, indoor soccer, floor hockey, and the Fitness Center. Schedules for open recreational use of the Field House and the Hamel Recreation Center are published at the beginning of each month and are available in the recreation facilities.

Intramurals The intramural program consists of competitive individual and team sports. The program includes men's and women's intramural sports, co-rec intramural sports, and special events. To learn more about the program, contact the Babcock House sports managers (for on-campus students), the Commuter and Information Center, or the recreation staff in the Hamel Recreation Center. Graduate students have the option of participating in the student or faculty/staff leagues.

Sport Clubs Sport clubs provide an opportunity to stay in shape and develop athletic skills for competition and demonstrations. Some clubs are intensely competitive and require daily commitments to workouts and conditioning. Others meet on a casual, come-when-you-can basis. See the Campus Recreation calendar for the times of organizational meetings.

Noncredit Fitness and American Red Cross Programs The campus recreation department offers a variety of individual and group activities designed to assist students in reaching their personal fitness goals. These programs will teach new skills and build upon those one already has. Certification is available in CPR, in first aid, in lifeguard training, and as a water safety instructor. Aerobics are free!

Employment The recreational sports department hires approximately 350 students to officiate intramurals, teach fitness classes, and assist with the supervision of facilities for open recreation. For more information, call (603) 862-2031.

Memorial Union

The Memorial Union and Student Activities department provides numerous programs for students and the larger university community. The union, a gift of UNH alumni/ae and the only official state war memorial, is the university's community center. It provides opportunities for student involvement in a casual atmosphere and offers space for programs, meetings, and study.

The Memorial Union Building (MUB) hosts many major events, film presentations, and other entertainment. It houses the Information Center, University Bookstore, UNH Copy Center, Wildcards (a card shop), Granite Square Station (postal center), Computing Help Desk, Tech Underground (computer store), MUB ticket office, games room, and several meeting rooms and lounges. Food establishments include the Food Court, Lumpy's, the Notch, and the Coffee Office. These numerous activities and facilities offer students employment opportunities in a friendly atmosphere from early morning to late at night. Many student organizations operate in the MUB including WUNH FM 91.3; *The New Hampshire*, the student newspaper; and the Memorial Union Board of Governors.

Information Center The Information Center in the Memorial Union Building provides information services for students, faculty, staff, and the university community and helps commuter students cope with the challenges of off-campus living. Lists of available rental houses, apartments, rooms, and names of people looking for roommates are published weekly. The off-campus housing list is on the Internet at: <http://www.unh.edu/mub/housing.htm#housing>. Other services include a Ride Board, Coast Bus schedules, information on leases, tenant rights, security deposits, subleasing, and sports activities information. Jumper cables and dictionaries are available as well as access to a refrigerator and microwave. The Memorial Union Information Center can be reached at (603) 862-2600.

University Health Services

Health Services provides comprehensive primary health care, including laboratory examination, x-rays, and pharmacy services. The staff maintains close relationships with outside specialists in the area to whom they may refer patients. Three well-staffed and -equipped community hospitals are nearby, and emergency ambulance service is available in Durham at all times. For after-hours urgent care, Health Services has an agreement with Wentworth-Douglass Hospital in nearby Dover to provide care for students.

During the regular academic year, Health Services is staffed by full-time board-certified physicians, as well as part-time consultant physicians in orthopedics, pathology, and radiology. Additional clinical staff include nurse practitioners and nurses. All full-time registered nurses are certified in college health. Visits with physicians or nurse practitioners are by appointment. Medical problems requiring immediate attention are evaluated and treated on a walk-in basis.

Office of Health Education and Promotion (Health Services)

The Office of Health Education and Promotion presents educational workshops on a variety of physical and emotional health issues. Confidential assessment

and referral are also available. The resource room (Room 249) contains information on physical and emotional health issues, including HIV/AIDS, alcohol/other drugs, men's and women's health issues, wellness, stress management, sexuality, and eating concerns. These services and programs reflect Health Services' commitment to promoting awareness and encouraging self-care and informed decision making.

Appointments are made at the Office of Health Education and Promotion, or by calling (603) 862-3823.

Counseling Center

The Counseling Center offers confidential professional consultation, individual and group therapy, and educational workshops for a broad range of emotional, psychological, and interpersonal concerns. Services are provided for all students who have paid their health services and counseling fee and who may be facing a major crisis, confusion, depression, family difficulties, or other personal problems.

The center provides a scheduled intake system. Intake appointments can be made over the phone or in person. In addition, emergency services are offered by the Counseling Center during regular business hours, 8:00 A.M.–5:00 P.M., Monday through Friday, and after hours through Health Services at (603) 862-2844. When necessary, the center's staff assists with outside mental health referrals.

The staff, which includes certified psychologists, counselors, and consulting psychiatrists, is committed to the welfare and development of UNH students. The staff is available for consultation with faculty, administrative staff, and parents on matters relating to the welfare of students.

All information about a student's visits to the Counseling Center is confidential and cannot be released without the written permission of the student. For information or to schedule an appointment, call (603) 862-2090 or check out our home page at <<http://www.unh.edu/counseling-center/index.html>>.

Other Services

Career Services

The Office of Career Services assists students at every stage of their career development, from help with career goal clarification to job placement. Career identification testing, career counseling, placement workshops, a career advisers network, internships, part-time jobs, Career Fairs, and an on-campus interviewing program are all available. A library of information on employers and career information is also available to help with the student's career goals. A credential service that sends letters of recommendation and transcripts to prospective employers in education and not-for-profit organizations may be useful. Their web page carries complete information on Career Services' offerings. Their address is: <<http://www.unh.edu/career-services/index.html>>.

Office of International Students and Scholars

The Office of International Students and Scholars (OISS) promotes international education at UNH by facilitating the enrollment and employment of foreign nationals and by providing them with essential support services. The OISS coordinates programs which encourage interaction between the international, campus, and local communities, thereby fostering awareness and appreciation of other cultures. It is the responsibility of the OISS to ensure university compliance with U.S. immigration and employment regulations and to assist international students, exchange scholars, faculty, and staff in the achievement of their academic and professional goals.

The OISS staff provides counseling, information on university policies, administrative support, and referral services. A variety of social and educational programming activities are offered, including orientation for incoming students, faculty and staff, and the Host Family Program, designed to enhance student interaction with the broader community and provide opportunities for sharing in family events. For more information on programs and services, or to schedule an appointment, call (603) 862-1508 or send e-mail to <OISS@lists.unh.edu>.

All international students are encouraged to maintain contact with the OISS and are required by law to report changes of address, academic program, or source of educational funds.

Center for International Education

The Center for International Education fosters the growth of international awareness and programming at UNH and throughout the state by facilitating multidisciplinary education on global issues and international affairs, contributing to the overall international character of the state. The center runs the New Hampshire International Seminar Series, which is open to the public. The center also houses study abroad programs and academic programs in International Affairs. For information, call the center at (603) 862-2398.

Multicultural Student Affairs

The mission of the Office of Multicultural Student Affairs (OMSA) at UNH is twofold:

1. To provide services to African American, Latino, Asian American and Pacific Islanders, Native American, and gay, lesbian, bisexual, and transgendered students in order to increase their retention and graduation rates;
2. To support, promote, and assist students and student groups that contribute to making the university a diverse, multicultural community.

In pursuit of this vision and mission, the Office of Multicultural Student Affairs is dedicated to fostering the full participation of these student groups in all facets of the UNH community, and assuring that they have equal and fair access to all academic, social, and recreational groups and activities.

In addition, OMSA serves as an umbrella organization and assists in planning efforts to promote diversity and pluralism in all facets of campus life. It acts as an advocate for students and as a university liaison to various student organizations and offices, such as the Diversity Support Coalition, Asociación de Estudiantes Latinoamericanos, (ADELA), the Black Student Union

(BSU), United Asian Coalition (UAC), Native American Cultural Association (NACA), the Alliance (gay, lesbian, bisexual, and transgendered student group), and Hillel (Jewish Student Organization), among others.

The Office of Multicultural Student Affairs is open to all students at the University of New Hampshire. The office also assists the university in facilitating understanding, acceptance, and promotion of ethnic and racial diversity, integration, and intentional social interaction through both structured programs and various opportunities for productive dialogue.

Services for Students with Disabilities

Students with physical, mental, or learning disabilities who need accommodations must register with the ACCESS Office (Accessing Career Challenges in Education through Specialized Services) Memorial Union Building, Room 118, (603) 862-2607, Voice/TDD.

The university encourages members of the community with disabilities to use existing services and to become involved in the mainstream of campus life. Inquire through the ACCESS Office for information about priority scheduling, accessible classrooms, special parking arrangements, assistance in securing academic aides, accessible on-campus transportation, reading services, interpreters, academic modifications, and other special arrangements.

The Sexual Harassment and Rape Prevention Program (SHARPP)

This program offers intervention and prevention services around the issue of sexual violence. Three staff members and fifty volunteer victim advocates provide crisis intervention services to students, faculty, and staff on a twenty-four-hour basis. Advocates provide survivors with support and options surrounding legal, medical, administrative, and therapeutic issues. Support groups and one-to-one



support are available for male and female survivors, as well as their significant others. In addition, advocates provide peer education to the UNH community. Educational programs are conducted for fraternities, sororities, athletic teams, residence halls, student organizations, and academic classes. For more information, call (603) 862-3494, Monday through Friday, 8:00 A.M.–4:30 P.M., and (603) 862-1743, 24 hours a day.

University Police

The University Police Department, which is committed to the enforcement of laws and university policies supportive of the rights and dignity of all persons, seeks to maintain a campus environment in which learning may thrive. Officers, professionally trained in their respective areas, staff both the department and its Security Services unit.

Programs, including a women's self-defense program, and literature regarding crime prevention are offered. On request, staff members will meet with groups to share precautions for increasing personal safety and protection of per-

sonal property. A walking patrol provides an escort service for students, faculty, and staff. Engraving pencils to inscribe identification numbers on property in case of theft are loaned free of charge to members of the campus community. To take advantage of any of these services, contact the University Police Department at (603) 862-1427.

Veterans Information

The UNH veterans coordinator, located in the Registrar's Office (603) 862-1595, provides counseling on all aspects of veterans benefits as well as assistance in procuring and completing the required forms and certifications for veterans benefits. The veterans coordinator maintains a comprehensive directory to assist veterans in contacting state, local, and university resources for housing, daycare, career planning, employment, financial aid, tutorial assistance, remedial training, handicapped services, and Vietnam Veterans Outreach. The coordinator also provides a framework for networking among campus veterans.

Women's Commission

The Women's Commission consults with other university offices and organizations, faculty, staff, and students to help promote the status of women and to encourage the full participation of women throughout the university. It provides education and programs aimed at helping women develop new skills and continue their education, increasing networking among women, and informing the university community of issues relating to the status of women. The commission collects information on current UNH salary, hiring, enrollment, and retention of women. All women graduate students are encouraged to become part of the commission. The commission is located in Batcheller House on Rosemary Lane. The office is open from 8 A.M. to 4:30 P.M., Monday through Friday, (603) 862-1058.

DEPARTMENTAL REQUIREMENTS AND DESCRIPTION OF COURSES

The following pages describe the graduate programs offered at the university. Program descriptions include faculty, degrees offered, special admission requirements, degree requirements, and course descriptions.

Course Description 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: e.g., Prereq: EDUC 807; PSYC 841. If permission (of the instructor, department, adviser, or committee) is a prerequisite for all students, it is listed among the prerequisites: e.g., Prereq: EDUC 807; PSYC 841; 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: e.g., Prereq: EDUC 807; PSYC 841;/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: e.g., Prereq: EDUC 807 or permission; PSYC 841.

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 courses for the semester.

Permission of the instructor may be required for enrollment in a particular course. Courses are offered subject to adequate student demand. Consult departments for detailed descriptions of current course offerings.

All courses flagged with a # have not been offered in the last three years.

Animal and Nutritional Sciences (ANSC)

Chairperson: William E. Berndtson

Professors: William E. Berndtson, William A. Condon, Thomas P. Fairchild, Charles G. Schwab, Samuel C. Smith, Robert L. Taylor, Jr.

Associate Professors: Patricia D. Bedker, Elizabeth P. Boulton, Gale B. Carey, Joanne Curran-Celentano, Thomas L. Foxall, Colette H. Janson-Sand, Anthony R. Tagliaferro, Paul C. Tsang

Assistant Professors: Dennis J. Bobilya, David H. Townson, Allen J. Young

Graduate Program Coordinator: Robert L. Taylor, Jr.

Degrees Offered

The Department of Animal and Nutritional Sciences offers the master of science and doctor of philosophy degrees. Doctoral and master's students may specialize in animal nutrition, human nutrition, reproductive physiology, mammalian physiology, cell biology, and immunology. Master's students may also specialize in genetics or dairy management.

Admission Requirements

An applicant is expected to have had sufficient undergraduate training in the basic biological sciences to qualify for special work in this field. All applicants must submit general test scores from the Graduate Record Examination.

M.S. Degree Requirements

A student will meet the Graduate School's requirements for the master's degree and must defend a thesis based on a research problem. The program requires a minimum of 30 credit hours and may include no more than 6 credits of thesis research and no more than 4 credits of investigations. Each candidate must present at least two seminars (exclusive of the thesis defense) and must serve as a teaching assistant for one semester.

Ph.D. Degree Requirements

A minimum of 20 graduate credits (exclusive of dissertation research) beyond those required for an M.S. degree, or a minimum of 48 course credits without an M.S.

degree, is required. However, it is expected that most students will accumulate additional course credits beyond these minimal requirements. A guidance committee will assist the candidate in designing the program of study. Upon completion of graduate courses and demonstration of computer literacy, a doctoral student will be required to pass an oral qualifying examination conducted by the guidance committee. This examination may include a written component at the discretion of the committee. After the student's advancement to candidacy for the Ph.D. degree, a doctoral committee will be appointed to supervise and approve the dissertation and to administer the final examination, which will be primarily an oral defense of the dissertation. During the tenure of the Ph.D. program, the candidate will be required to serve as a teaching assistant for two semesters or to teach a course for one semester.

801. Physiology of Reproduction

Comparative aspects of embryology, anatomy, endocrinology, and physiology of reproduction. Special fee. Lab. 4 cr.

802. Endocrinology

Structure and function of vertebrate endocrine systems. Influence of endocrine system on the molecular and biochemical mechanisms and physiology of vertebrates, with special reference to mammals. Current investigations of the endocrine system as a regulator and integrator of body functions including such systems as growth, reproduction, metabolism, differentiation, and behavior. Prereq: general biochemistry; principles of biochemistry;/or permission. (Also offered as BCHM 802.) 4 cr.

804. Principles of Pathobiology

Principles of disease processes; reactivity of the diseased cell, tissue, and organ. Prereq: animal anatomy, health, and disease courses;/or permission. 3 cr.

808. Ruminology

Anatomy of the ruminant gastrointestinal tract, physiological factors related to rumen function, and microbial metabolism of carbohydrates, protein, and lipids. Prereq: general microbiology or equivalent. 2 cr.

814. Research Methods in Endocrinology

Application of modern laboratory techniques to the study of hormonal and molecular mechanisms in the endocrine system. Prereq: physiology of reproduction; general biochemistry; endocrinology; permission. Special fee. Lab. 4 cr.

815. Physiology of Lactation

Examines the biological and biochemical influences of the lactation process. Emphasis on the physiological effects of environments, hormones, and nutrition on milk synthesis and secretion, mammary physiology, and maternal response. Prereq: general biochemistry and physiology of reproduction. 4 cr.

818. Mammalian Physiology

Advanced study of the systems that control mammalian functions with emphasis on cellular and molecular mechanisms. Includes the nervous, muscular, cardiovascular, renal, gastrointestinal, and endocrine systems. Prereq: human anatomy and physiology, principles of animal physiology, one semester of biochemistry, or permission. 4 cr.

820. Public Health Nutrition

Focus on managerial processes of planning, leading, and evaluating nutrition programs and the skills and tools needed to develop and present such programs. 4 cr. (Not offered every year.)

822. Immunogenetics

Cellular interactions leading to immune regulatory mechanisms. Emphasis is placed on the major histocompatibility complex, immune responses, and antibody diversity. 4 cr. (Offered in alternate years.)

824. Reproductive Management and Artificial Insemination

Focus on goals and fundamentals of reproductive management of horses, dairy and livestock animals, and, through experience, development of competency in performing modern breeding techniques for equine or bovine reproduction. Prereq: physiology of reproduction and permission. Special fee. Lab. 4 cr.

846. Animal Cell Culture

Theory and principles fundamental to the culture of animal cells *in vitro*. Introduction to techniques and maintenance of animal cell cultures. Application of cell culture to contemporary research in the biological sciences. No credit for students who have completed ANSC 851. Special fee. Lab. 4 cr.

850. Nutritional Biochemistry

Study of the digestion, absorption, transport, and utilization of food nutrients from a biochemical perspective. Emphasis on the role of macro- and micronutrients as substrates and catalysts for metabolic pathways, and the role of these pathways in maintaining human health at the cellular, organ, and whole body levels. Prereq: general biochemistry. 4 cr.

851. Cell Culture

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

852. Mammalian Cell Culture

Basic concepts and techniques associated with the cultivation of mammalian cells *in vitro*, including media preparation, cell viability, transfer, cloning, cryopreservation; use of transformed cells harboring cloning vectors for production of bioproducts. No credit for students who have completed ANSC 851. Prereq: general microbiology. (Also offered as MICR 852.) Special fee. 5 cr.

855. Disorders in Energy Balance

Etiology, pathophysiology, and treatments of obesity, anorexia nervosa, and bulimia are reviewed. Role of hereditary, neurological, metabolic, and environmental mechanisms are discussed. Particular emphasis on obesity. Prereq: permission. 4 cr.

860. Geriatric Nutrition

Emphasis on the nutritional requirements and status of the elderly in view of psychological and physiological changes in aging. Approaches for nutrition intervention and support are addressed. Prereq: principles of human nutrition or permission of instructor. 3 cr. Cr/F.

873. Clinical Nutrition

Principles of normal nutrition and physiology applied to clinical problems; altered nutrient requirements in human disease. Prereq: basic nutrition and biochemistry or permission. Coreq: ANSC 875. 4 cr. (Spring semester only.)

875. Practical Applications in Therapeutic Nutrition

Supervised practical experience in therapeutic dietetics in one of several cooperating New Hampshire hospitals. Emphasis on nutritional counseling, assessment, and instruction of patients with nutrition-related disorders. Coreq: ANSC 873. 3 cr. (Fall semester only.)

880. Critical Issues in Nutrition

Critical reviews and analysis of controversial topics in nutrition; emphasis on developing analytical reasoning skills. Prereq: permission. 4 cr. (Fall semester only.)

898. Contemporary Topics in Biomedical Science and Nutrition

Lecture-discussion series on topics in animal biology, nutrition, and medicine including production and applications of monoclonal antibodies; oncogenesis; sports nutrition; nutrition and cancer; toxicology; arterogenesis. May be repeated. 2 cr.

900. Topics in Animal and Nutritional Sciences

An informal forum for graduate students to gain experience in organizing and presenting a research seminar. Each student presents one or two seminars during the semester on a research paper(s) of their choice, and the instructor provides feedback. Prereq: ANSC graduate students only. May be repeated to 2 cr. 1 cr. Cr/F.

901. Introduction to Research

This 2-credit graduate course is designed to acquaint first-year master's and doctoral degree students with facilities and tools for designing, conducting, and communicating research. Topics include: acquiring proper background information, the art of the oral presentation, effective writing, data analysis and graphics using computers, ethics in science, and issues in animal and human research. Class size limited to eight students. 2 cr.

#903. Energy Metabolism and Nutrition

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

904. Amino Acid Metabolism

Intermediary metabolism and interorgan transport of amino acids and nitrogenous compounds in the mammalian system. Prereq: ANSC 905. 2 cr. (Offered first half of the semester.)

905. Intermediary Metabolism and Exercise

A. Regulation of mammalian cellular metabolism by enzymes, effectors, hormones, and diet in response to exercise. Focus on mechanisms for controlling pathway flux; identification of rate-limit-

ing steps; techniques for studying metabolism, and glucose, glycogen, and lipid metabolism in muscle response to exercise. 2 cr.

B. Regulation of mammalian cellular metabolism with focus on the influence of exercise on amino acid metabolism in liver and muscle, lipid mobilization and adipose tissue metabolism, hepatic gluconeogenesis, and mechanisms of exercise-induced fatigue. Prereq: general biochemistry and human anatomy and physiology or equivalent. 2 cr.

906. Methods in Protein Nutrition and Metabolism

Survey and evaluation of common techniques in the study of protein nutrition and metabolism. Prereq: ANSC 904. 2 cr. (Offered second half of the semester.)

909. Contemporary Trends in Reproductive Physiology

Comprehensive survey of recent developments in the areas of comparative mammalian reproduction and animal biotechnology. Prereq: ANSC 801 or permission. May be repeated. 4 cr.

910. Mineral Nutrition

Detailed analysis of the digestion, absorption, transport, and intermediary metabolism of minerals as essential nutrients. The chemical and biochemical characters of minerals are examined to account for their physiological functions. Graduate students at the 900 level. Prereq: ANSC 850 or permission. 2 cr. Cr/F. (Spring semester only.)

911. Lipids

Structure, metabolism, and function of lipids of importance to animals. 2 cr. (Offered in alternate years.)

912. Vitamin Nutrition

Detailed analysis of the digestion, absorption, transport, and intermediary metabolism of vitamins as essential nutrients. The chemical and biochemical characteristics of vitamins are examined to account for the physiological functions. Prereq: ANSC 850 or permission. 2 cr. Cr/F. (Spring semester only.)

913. Contemporary Topics in Immunobiology

Topical lectures, seminars, and assigned reading emphasizing recent advances in immunology. May be repeated for a maximum of 4 credits. 2 cr. (Offered in alternate years.)

#953. Advanced Cell Biology

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. 4 cr. (Not offered every year.)

995, 996. Research in Animal Sciences

Advanced investigations in a research project, exclusive of thesis project. Elective only after consultation with the instructor. May be repeated. 1-4 cr.

997, 998. Animal Science Seminar

Survey of recent literature and research in the animal sciences. May be repeated. 1 cr. Cr/F.

999. Master's Thesis

6 cr. Cr/F.

999. Doctoral Research

Biochemistry and Molecular Biology (BCHM)

Chairperson: Clyde L. Denis

Professors: Clyde L. Denis, Thomas M. Laue, Samuel C. Smith, Stacia A. Sower, James A. Stewart

Associate Professors: John J. Collins, Rick H. Cote, Anita S. Klein, Andrew P. Laudano

Research Associate Professor: William A. Gilbert

Assistant Professor: George Eric Schaller

Graduate Program Coordinator: John J. Collins

Degrees Offered

The Department of Biochemistry and Molecular Biology offers the master of science and the doctor of philosophy degrees in biochemistry. The department offers research opportunities in biochemistry of AIDS, developmental genetics, eukaryotic gene regulation, metabolism, molecular evolution, molecular genetics, plant biochemistry, physical biochemistry, oncogene function, regulatory molecules, signal transduction, structure and function of macromolecules, transposable elements, biochemical endocrinology and neuroendocrinology, and molecular population genetics. Opportunities also exist for interdisciplinary research in marine biochemistry, biochemical nutrition, and cell biology in adjunct facilities on campus.

Admission Requirements

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 during the first year. All applicants must submit general test scores from the Graduate Record Examination.

M.S. Degree Requirements

A student will meet the Graduate School's requirements for the master's degree (minimum 30 credits) and 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. Demonstration of proficiency in organic chemistry, physical chemistry, and biochemistry will be assessed in the first year. 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.

Ph.D. Degree Requirements

Doctoral students will be required to complete a dissertation on original research in biochemistry or molecular biology. Demonstration of proficiency in organic chemistry, physical chemistry, and biochemistry will be assessed in the first year. In the second year, students will be required to write and defend a research proposal in an area unrelated to their thesis project. Upon completion of graduate courses recommended by a guidance committee, 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.

Teaching Requirement

Teaching assignments—in the laboratory, in lectures, or in an individual instruction format—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.

802. Endocrinology

Structure and function of vertebrate endocrine systems. Influence of endocrine system on the physiology of vertebrates, with special reference to mammals. Current investigations of the endocrine system as a regulator and integrator of body functions including such systems as growth, reproduction, metabolism, differentiation, and behavior. Prereq: general biochemistry or principles of biochemistry; or permission. (Also offered as ANSC 802.) 4 cr.

806. Human Genetics

Genetic basis of human traits and diseases. New understanding added by molecular genetic approaches. Human genome project, gene therapy. Discussion of genetic components of quantitative and behavioral traits, and human evolution. Prereq: principles of genetics or permission. (Also offered as GEN 806.) 3 cr. (Not offered every year.)

811. Genetics of Eukaryotic Microbes

Expression and transfer of genetic material in eukaryotic microbes including fungi, algae, protozoa, and *Caenorhabditis elegans*. Laboratory experience in DNA sequence entry retrieval and analysis. Macintosh workstations are used for accessing and retrieving data from the National Laboratory of Medicine and other sources via the Internet. Prereq: general microbiology; principles of genetics. Special fee. Lab. (Also offered as GEN 811 and MICR 811.) 4 cr.

850. Physical Biochemistry

Structure, interactions, and physical-chemical properties of biomolecules. Thermodynamic, kinetic, and spectroscopic methods for the study of proteins and nucleic acids. Prereq: BCHM 851 or permission. 3 cr.

851-852. Principles of Biochemistry

In-depth survey of biochemistry; macromolecule structure; metabolism of proteins, nucleic acids, carbohydrates, and lipids; molecular biology of DNA, RNA, and protein synthesis and regulation. Prereq: organic chemistry or permission. 4 cr.

854. Laboratory in Biochemistry and Molecular Biology of Nucleic Acids

Application of modern techniques to the analysis of biomolecules, with an emphasis on nucleic acids; includes DNA isolation and analysis, cloning and sequencing and analysis of gene products. No credit for students who have completed microbial genetics. Prereq: general biochemistry, principles of biochemistry or permission. (Also offered as GEN 854 and PBIO 854.) Special fee. Lab. 5 cr.

855. Laboratory in Biochemistry and Molecular Biology

Application of modern techniques to the characterization of biomolecules, with an emphasis on proteins and nucleic acids; analysis of enzyme kinetics; and basic techniques used in molecular biology. Special fee. Prereq: BCHM 851 or permission. 5 cr.

860. Cellular Signaling Processes

Metabolic basis of cellular communication and signal transduction. Activation of membrane receptors by external stimuli; signal transducer proteins; classes of intracellular messengers; biochemical basis of regulation of enzymes resulting in cellular metabolism. Prereq: general biochemistry or BCHM 851 or permission. 3 cr.

863. Biochemistry of Cancer

Molecular mechanisms of viral and chemical carcinogenesis; role of oncogenes in normal cell growth, development, and differentiation. Biochemical basis of cancer chemotherapy. Critical reviews of research papers and an advanced research paper required. Prereq: general biochemistry or BCHM 851 or permission. 3 cr. Cr/F.

864. Membrane Biochemistry

Structure and biogenesis of membranes and membrane proteins, transport across the membrane and bioenergetic membranes, mechanisms of protein targeting, processing, and trafficking. Prereq: general biochemistry; principles of biochemistry; or permission. 3 cr.

865. Molecular Biology and Biochemistry of Plants

Molecular mechanisms and regulation of plant metabolic functions. Structure and function of

cellular constituents of plants; roles of secondary metabolites. Emphasis is on developments in current literature. Complements PBIO 874/875. Prereq: general biochemistry or BCHM 851; principles of genetics or permission. (Also offered as PBIO 865.) 3 cr.

871. Molecular Genetics

Structure, organization, replication, dynamics, and expression of genetic information in eukaryotes. Focus on molecular genetic *mechanisms* of gene expression and its control; molecular genetics *methods*; molecular genetic control of cell division and differentiation during development. Prereq: general biochemistry or BCHM 851; principles of genetics;/or permission. (Also offered as GEN 871.) 3 cr.

882. Developmental Genetics

The molecular genetic basis of metazoan development. Course focuses on how genes direct the process of development and how this problem is analyzed in model organisms using molecular genetic approaches. Topics include: control of cell division, maternal factors, cell-cell interactions, differential gene expression. Prereq: principles of genetics; BCHM 851. (Also offered as GEN 882.) 3 cr.

894. Protein Structure and Function

Analysis of how the three-dimensional architecture of proteins and enzymes contributes to their biochemical function. Topics include methods for determining the structure of proteins, protein folding, intermolecular interactions of proteins, mechanisms of enzyme catalysis, enzyme kinetics, protein evolution and biosynthesis. Prereq: general biochemistry or principles of biochemistry. 3 cr.

895. Investigations in Biochemistry and Molecular Biology

Independent research experience in the following areas: genetics, signal transduction, gene regulation, molecular evolution, biochemistry of cancer, biophysics of macromolecules, endocrinology, plant signal transduction, and teaching experience. Prereq: permission. Not more than 4 total credit hours can be applied to BCHM or major electives. 1-4 cr.

942. Biochemical Regulatory Mechanisms

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: BCHM 852 or permission. (Also offered as GEN 942.) 3 cr.

950. Macromolecular Interactions

Interactions between macromolecules are central to all biological processes. Focuses on the structures and energetics that underlie these processes. Topics include self-associations, hetero assembly, cooperativity, ligand linkage and methods for their analysis. Prereq: physical chemistry I, II or BCHM 850. May be repeated. 3 cr.

960. Advanced Topics in Signal Transduction

Examination of current topics in signal transduction mechanisms, with emphasis on sensory transduction. Pathways involving receptor activation, G-protein activation, regulation of effector enzymes, and changes in second messengers covered, along with mechanisms for short- and long-term

desensitization of cellular responses. Prereq: BCHM 860 or permission. 3 cr.

991. Advanced Topics in Molecular Genetics

Selected topics of current research in molecular genetics including gene structure and function, chromosome structure, and gene expression. Emphasis on eukaryotic model organisms such as worms, flies, zebra, fish, and mice. Prereq: permission. (Also offered as GEN 991.) May be repeated to a maximum of 6 credits. 3 cr.

992. Advanced Topics in Molecular Biology

Selected topics of current research on the molecular biology of gene regulation, protein interactions, and the AIDS virus. Emphasis on eukaryotic systems such as yeast and mammals. Prereq: permission. (Also offered as GEN 992.) May be repeated to a maximum of 6 credits. 3 cr.

993-994. Advanced Topics in Enzyme Regulatory Mechanisms

Selected topics of current research in the molecular basis of enzyme regulation. Emphasis on biochemical and molecular biological approaches to determining the mechanisms by which key regulatory enzymes are controlled. Prereq: permission. May be repeated to a maximum of 6 credits. 3 cr.

997, 998. Biochemistry Seminar

Prereq: permission. 1 cr. Cr/F.

899. Master's Thesis

6-10 cr. Cr/F.

999. Doctoral Research

Biology (BIOL)

Associate Professors: Wayne R.

Fagerberg, James E. Pollard

Graduate Admissions Coordinator:

Wayne R. Fagerberg

Graduate Program Coordinator:

James E. Pollard

Degree Offered

The master of science degree in biology is a nonthesis program in general biology. It is designed primarily for secondary school science teachers and others who wish to enhance their academic credentials in biology, and who do not require experimental research experience. **This program is not intended as a preparation for doctoral degree programs in the biological sciences and, therefore, may not satisfy admission requirements for some of these programs.** Those students interested in experimental research M.S. programs should refer to other biological science department programs listed in this catalog.

Students admitted to the program will be referred by the graduate admissions coordinator to an appropriate adviser for program planning. The adviser may serve as chairperson of the student's M.S. program guidance committee. Faculty members who currently serve as advisers are from the following discipline areas within biology: molecular, cellular, and developmental biology; ecology; evolutionary biology; physiology; anatomy; nutrition; genetics; and pathology. Specific program requirements and guidelines are available from the graduate admissions coordinator.

Admission Requirements

Applicants must have a bachelor's degree with a major in one of the biological sciences or a strong background in the biological and physical sciences. In addition to requirements listed under the application procedures section in the *Graduate Catalog*, applicants must also submit general and subject biology scores from the Graduate Record Examination.

Degree Requirements

Students must meet the Graduate School's requirements for the master's degree, complete a final comprehensive examination on program coursework, and present a seminar and written report on a 5-credit biology master's project. The project and coursework will focus on a biological topic of specific interest to the student which has been approved by the guidance committee. To ensure a reasonable breadth in preparation, the student is expected to select courses from several biological sciences departments. Persons interested in this degree should contact the graduate admissions coordinator for further information.

802. Genetics Lab

An experimental approach to understanding the fundamental principles of heredity. Theoretical aspects of genetics hypothesis testing, data analysis, and techniques of isozyme and DNA electrophoresis and polymerase chain reaction (PCR). In lab, students conduct mating and mutagenesis experiments with plants, animals, and yeast; do human DNA fingerprinting; employ techniques of DNA isolation, electrophoresis, PCR, cytogenetics, and statistical analysis to generate and interpret genetic data. Prereq: principles of genetics or equivalent. Special fee. Lab. (Also offered as GEN 802.) 4 cr.

811. Applied Biostatistics II

Design and analysis of biological and ecological research experiments. "Real world" studies used to

discuss the identification of hypotheses, appropriate experimental design, and the application of statistical analyses including ANOVA, ANCOVA, correlation and regression, cluster analysis, classification and ordination techniques. Theoretical statistical concepts tailored to consider student's own thesis and dissertation research, allowing statistical problems to be addressed at various stages of the research process. Common computer packages used for analyses. Prereq: applied statistics or equivalent; permission. 4 cr.

895, 896. Biology Independent Investigations
Topics may include teaching practicum in a biological science supervised by a biology faculty member; research—research practicum in a biological science supervised by a biology faculty member (permission required); special topics of current interest in biology (lecture/discussion format). Prereq: 12 cr. of biology or permission. May be repeated to a maximum of 4 credits. 1–4 cr.

897. Biology Masters Project

An independent project approved by student's master's program advisory committee. Requires written report and seminar presentation. Students should register for a total of 5 credits in 4 plus 1 sequence. 1–4 cr. Variable. IA.

898. Contemporary Topics in Biomedical Science and Nutrition

Lecture-discussion series on topics in animal biology, nutrition, and medicine including production and applications of monoclonal antibodies; oncogenesis; sports nutrition; nutrition and cancer; toxicology; atherogenesis. 2 cr.

902. Design of Experiments

Practical application of common experimental designs to the planning of research. Focus on the appropriate blocking structure to compensate for extraneous variability and the treatment structure to optimize use of available experimental material. The method of Least Squares introduced to adjust for unequal numbers of replicates and to obtain unbiased estimates of parameters from unbalanced designs. Common computer packages used for analyses. Prereq: BIOL 811 or equivalent and basic computer skills. 4 cr. (Not offered every year.)

Business Administration (ADMN)

Professors: Ahmad Etebari, Stephen L. Fink, John Freear, Lyndon E. Goodridge, Charles W. Gross, Jonathan Gutman, Francine S. Hall, Fred R. Kaen, Marvin J. Karson, Allen M. Kaufman, Michael J. Merenda, Barry Shore, Jeffrey E. Sohl, Linda G. Sprague

Associate Professors: Gene Boccialetti, Catherine A. Craycraft, Ross J. Gittell, Lucy L. Henke, Richard L. Mills, William Naumes, R. Daniel Reid, Allen R. Thompson, A. R. Venkatachalam, Rita Weathersby, Craig H. Wood

Assistant Professors: Carole K. Barnett, L. Franklin Fant, Jr., Roger B. Grinde, Flora G. Guidry, Edward S. O'Neal, Steven K. Rock, Christine M. Shea, Douglas E. Stevens, James E. Stoddard

Academic Director, Graduate Business Programs: Craig H. Wood

Degree Offered

The Whittemore School offers a program leading to the M.B.A. in formats designed for day students, part-time evening students, and practicing managers. The M.B.A. program is directed toward a broad preparation in general administration. In the day and evening programs, functional concentrations are available at the student's option. The Whittemore School seeks constantly to improve the quality and to enhance the relevance of its programs by making curricular revisions from time to time. Consult with the program office for an up-to-date list of program requirements.

The mission of the Whittemore School of Business and Economics is to be a distinguished professional school in which the liberal arts are the basic foundation and the management of change in a global economic community is the major emphasis.

In order to achieve this mission, the school is committed to the following goals:

1. The preservation of the unique disciplinary traditions in each of its departments and programs and the simultaneous commitment to broad educational excellence in critical thought, verbal and written communications, quantitative skills, computer literacy, and ethical reasoning.
2. The transmission, through excellent teaching, of basic and advanced education that prepares students for future careers in management, public service, research, and education, in which an understanding of business, economic, political, and social environments on both a national and global level are crucial requirements.
3. The production of prominent scholarship and research by its faculty.
4. The promotion of international awareness and cross-cultural understanding as an essential component of the educational experience of its students.
5. The integration of practice and theory in its educational process, the testing of its ideas in applied settings, and the guid-

ance of its research by the acknowledged basic paradigms in its various disciplines.

6. The fostering of an environment that values collegiality, fairness, interdisciplinary activities, and continuous faculty development.

7. The encouragement of interaction with business and other external entities through such activities as research, consulting, executive development opportunities, midcareer learning programs, and other scholarly activities that contribute to lifelong learning.

Admission Requirements

The Whittemore School welcomes applicants with an above-average academic record in any undergraduate specialty. The crucial requirement for admission into the M.B.A. program is a history that demonstrates that the applicant has the potential and desire for graduate study in business. The focus of the student's earlier education is of less importance than evidence of academic ability and potential for becoming a responsible manager and leader. Consequently a "portfolio" approach to admissions is adopted, in which an applicant's work and military experience along with other indications of maturity, motivation, and self-discipline are considered as well as the applicant's test scores and academic record. All applicants are required to take the Graduate Management Admission Test (GMAT). Applicants are expected to have successfully completed one semester of calculus or have demonstrated proficiency in quantitative reasoning. Interested applicants are encouraged to contact George T. Abraham, Director of Graduate and Executive Programs, Whittemore School, 15 College Road, UNH, Durham, NH 03824-3593.

Day M.B.A. Degree Requirements

The Whittemore School curriculum for day students consists of an integrated sequence of twenty courses normally requiring two years of full-time study. During the first year, ten required courses in the basic disciplines and the functional areas of management are integrated into an overall study of the process of administration. In the second year, a student may continue the emphasis on general management or pursue a functional concentration. In addition to electives offered by the departments in

the Whittemore School, students are encouraged to undertake internships and a maximum of two appropriate graduate-level courses offered by other departments within the university.

Curriculum

First Year

Semester I

Financial Accounting
Management Information Systems
Managerial Statistics
Economics
Organizational Behavior

Semester II

Managerial Accounting
Financial Management
Operations Management
Quantitative Methods
Marketing

Second Year

Semester I

Advanced Organizational Theory
Business, Government, and Society
3 open electives

Semester II

Strategic Management: Decision Making
4 open electives

Part-Time M.B.A. Degree Requirements

A sequence of thirteen required and seven elective courses may be started in September, January, or April. However, the principal admission period is in September. Courses are offered on a tri-semester basis with a fall, winter, and spring term each year. By taking two classes per term, students will complete the program in three and a third year.

The thirteen required courses are divided into skill, functional, and policy courses with the skill courses early in the program. The policy courses complete the Whittemore M.B.A. experience and are taken only after the skill and functional classes are completed. The seven elective courses are based on prerequisites.

Students may choose electives to develop and expand areas that fit individual career goals. In addition to electives offered in the M.B.A. program, students may take a maximum of two electives, provided they have program approval, from other departments of the university.

The curriculum is designed to build a base for understanding and analytical competence. Most classes meet four hours per week in the evening.

Curriculum

Suggested Sequence

First Year

Term 1

Organizational Behavior
Financial Accounting

Term 2

Managerial Statistics
Management Information Systems

Term 3

Economics
Business, Government, and Society

Second Year

Term 1

Managerial Accounting
Quantitative Methods

Term 2

Advanced Organizational Theory
Marketing

Term 3

Financial Management
Operations Management

Third Year

Term 1

2 electives

Term 2

2 electives

Term 3

2 electives

Fourth Year

Term 1

Strategic Management: Decision Making
Elective

Executive M.B.A. Degree Requirements

The curriculum for practicing managers contains the same thirteen core course requirements as the day M.B.A., as well as a required Integrative Management Seminar that runs throughout the program and five elective courses. The curriculum is tailored and scheduled to meet the needs of those individuals working full time at managerial-level jobs. The program emphasizes general management and provides for broad-based exposure to the functional areas of finance and accounting, human resource management, marketing, and operations and strategic management. The program is offered in Durham at the

New England Center. The twenty-two-month program begins in the fall with a full week of classes. Thereafter, classes are held twice each month in all-day Friday and Saturday sessions.

Curriculum

First Year

Term 1

Financial Accounting
Managerial Statistics
Organizational Behavior
Integrative Management Seminar

Term 2

Quantitative Methods
Management Information Systems
Marketing

Integrative Management Seminar

Term 3

Managerial Accounting
Economics

Operations Management

Integrative Management Seminar

Summer

Research Project (optional)

Second Year

Term 1

Financial Management
Organizational Theory
Elective

Integrative Management Seminar

Term 2

Business, Government, and Society
2 electives

Integrative Management Seminar
International Residence (optional)

Term 3

Strategic Management: Decision Making
2 electives

Integrative Management Seminar

International Residence During the second year of study, the curriculum will address the issues of global competition via case studies, guest presenters, and an optional ten-day international residence. While guest presenters and case studies will be scattered throughout the year, the international residence will take place in the spring.

All graduate-level courses require permission of the instructor and graduate program office.

#812. Managing Organizational Change

Conceptual and technical tools to manage the challenge of change, both unpredictable and predictable. Topics include the process of change; change strategies; change agent roles—internal and exter-

nal; bases of resistance to change; coping with resistance. Prereq: organizational behavior or equivalent desirable. 3 cr.

#813. Management Skills

Focuses on the role of the manager, particularly the interpersonal competencies required to work effectively with superiors and subordinates. Participants develop and critique their behavior in situations that involve interviewing, listening, delegation, conflict management, performance appraisal, and handling problem employees. May include writing, presentations, field study, and videotaping. 3 cr.

#814. Personal Values, Organizational Conflict, and Business Ethics

Analyzing the procedures and objectives of capitalism, the relationship between organizational goals of the business and the values of both the individual manager and society, and the assumptions and conceptual foundations of ethical theory and moral philosophy. 3 cr.

821. Auditing

The attest function and the responsibility and professional ethics of the independent auditor in our society. Audit concepts, procedures, objectives, and reports. Operational audits, social audits, and management services. Prereq: financial and managerial accounting;/or permission. 3 cr.

822. Advanced Cost Accounting

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 budgeting analysis. 3 cr.

823. Topics in Finance

Prereq: financial management. 3 cr.

824. Resource Management

Analysis and development of resource management planning and control systems. Topics include inventory management, material requirements planning, and capacity management. 3 cr.

825. Manufacturing Management

Analysis and development of manufacturing management planning and control systems. Topics include production planning, master scheduling, distribution, and production activity control. 3 cr.

826. Decision-Support Systems

Exploration of computer usage in support of the problem-solving and decision-making process. Topics include conceptual foundations of decision-support systems, design of decision-support systems, spreadsheets, databases, and expert systems. Use of mainframe and microcomputers, cases, projects; guest speakers. 3 cr.

#827. Topics in Accounting

Special topics. 3 cr.

830. Investments Analysis

Security analysis, efficient market hypothesis, portfolio theory, and alternative investments. 3 cr.

831. Derivative Securities and Markets

Derivative assets and markets, and their role in business decision-making and portfolio management. Emphasis on practical and theoretical aspects

of hedging and speculating using futures and options for both commodities and financial assets, including their market mechanics. 3 cr.

832. Exploration in Entrepreneurial Management

Examination of the management of change and innovation with particular attention to the role of the entrepreneur in the management of new ventures. Characteristic behavioral, organizational, financial, and marketing problems of entrepreneurs and new enterprises. 3 cr.

#836. Financial Statement Analysis

The empirical properties of financial statement data and evidence of its ability to predict such events as security returns, corporate restructuring, debt ratings, and financial distress. An empirical research project using computer data banks is required. 3 cr.

837. Financial Accounting Theory and Applications I

Theory and practice of income measurement and asset valuation; consolidations, partnerships, leases, pensions, price-level reporting, foreign currencies, and fund accounting. 3 cr.

839. Financial Accounting Theory and Applications II

Theory and practice of income measurement and asset valuation; consolidations, partnerships, leases, pensions, price-level reporting, foreign currencies, and fund accounting. 3 cr.

840. 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. 3 cr.

841. International Management

Develops an understanding of international business from the point of view of management and leadership, human resource management, and organizational structure and change. Emphasis on cultural impact on management thinking and business practice and on skills for managing effectively in international and multicultural environments. 3 cr.

842. Time Series Analysis

The role of time series analysis in operational forecasting is examined. Modern time series models are studied, with particular emphasis on Box-Jenkins methods. Computer programs are used and their output examined. Prereq: introduction to statistics. (Also offered as ECON 828.) 3 cr.

#843. Regression Analysis

Regression analysis is studied as an applied statistical methodology, with a blend of underlying theory. Emphasis is on inference, diagnostic checking of assumptions, and remedial measures. 3 cr.

846. International Financial Management

Financial management problems facing multinational firms. Focus on effects of currency denominations on financial decisions. 3 cr.

847. Business Taxation

Taxation factors relevant to business decisions. Emphasis on federal income taxation from the

viewpoint of the firm. Prereq: financial and managerial accounting. 3 cr.

848. Law: Use and Application in Business

Use and understanding of law as it applies to business judgment and policy decision making; basic legal rules and their application. Contracts, corporations, agencies, partnerships, administrative agencies, commissions, and other related business matters. Case-method teaching with outside research. 3 cr.

851. Advertising and Promotion

Advertising, personal selling, and other promotional tools to help solve marketing problems; advertising as a medium of communication and as a social-cultural force in the Western world. 3 cr.

852. Marketing Research

Identification, collection, and analysis of data for the marketing process. Strengths, limitations, environment, and evaluation of research in the marketing process. 3 cr.

#854. Seminar in Accounting and Finance

Seminar discussions of advanced readings in accounting and finance. For second-year M.B.A. students. 3 cr.

855. Marketing of Services

Managerial aspects of the design, development, positioning, and implementation of intangible offerings (services). Theory and application to private, public, nonprofit, and commercial enterprises with local, national, and international perspectives. Discusses service quality attainment and maintenance both internally and competitively. Roundtable discussions, student presentations, and service marketing project. Text, cases, speakers. 3 cr.

858. Strategic Management of Operations

Review and application of operations management techniques and methodologies for the development of operations strategies. Team projects with client firms including operations analyses leading to recommendation for developing the firm's strategic operations posture. Prereq: ADMN 940. 3 cr.

#861. Sales Management

Principles and methods of successful personal selling and management of the sales function. Exposure to selling experience in field of student interest; case studies; sales presentations; oral and written analyses of sales management issues. 3 cr.

#862. Marketing Workshop

Integrative study of a real marketing situation in a business, nonprofit institution, or government agency. Student teams identify problem, research or collect data, suggest alternative solutions, and submit a recommended course of action. 3 cr.

863. International Marketing

Environmental factors affecting international trade: culture and business customs, political and legal factors and constraints, economic and technological development, and the international monetary system. Integration of these with the marketing management functions of market research and segmentation; product, promotion, distribution, and pricing decisions. 3 cr.

867. Art and Science of Decision Making

Explores the way individuals make decisions in organizational environments. Topics include tradi-

tional models of decision making, traps into which decision making falls, role of creativity in the generation of alternative choices, and negotiation—decision making with difficult opponents. Emphasis on the way in which the individual can become a better decision maker. The influence of national culture is examined. Course format involves several texts, readings, and the requirement that students maintain a daily decision journal. 3 cr.

#885. Career Management

Develops individual career management skills. Topics include concepts of career development and issues pertaining to career management in organizations. Helpful for students interested in human resource management. 3 cr.

898. Topics in Administration

Special topics; may be repeated. Prereq: consent of adviser and instructor. 1–3 cr.

900. Integrative Management Seminar

Extends throughout the Executive M.B.A. Program. Material and topics not offered in regular courses are offered here, as are distinguished speakers from business and government, field trips, issues of immediate concern, etc. 0–2 cr. Cr/F. (Executive M.B.A. Program only.)

912. Organizational Behavior

Application of behavioral and social science concepts to contemporary organizational life. Covers theories and modes related to individual, interpersonal, and group behavior as well as to total organizational issues such as goals, structure, and design of management systems. In addition to reading material, the course methods include experiential learning and the use of case studies for application. 3 cr.

913. Consulting Practicum

Field consulting experience as a member of M.B.A. Associates. Development of client relationships, diagnoses and analyses of actual problems, written and oral reports to clients, and administrative participation in M.B.A. Associates. May be repeated. 3 cr. Cr/F.

920. Financial Accounting

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

921. Managerial Accounting

Introduction to various models employed by organizations in the financial planning and control processes. 3 cr.

925. Advanced Organization Theory

Examines organizations as complex social systems, focusing on organizational structures as they relate to various functions, including rewards, controls, and decision making. Emphasis placed on the design of organizations for the future with special attention to rapid changes in technology and environmental factors. 3 cr.

926. Management Information Systems

Provides students with the background to understand, develop, and use computer-based information systems in organizations. Five major topics are covered including: the information system framework; information technology; application software for managers; applications development; and

management of information systems resources. The application software component covers the use of spreadsheets and relational database systems. Students participate in groups and are required to make several presentations during the semester. Prereq: M.B.A. students. 3 cr.

930. Financial Management

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

935. Financial Policy

Analytical tools and practical skills for recognizing and solving complex problems of business finance. Working-capital management; capital budgeting; cost of capital; capital structure; dividend policy. 3 cr.

940. 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.

#942. Survey of Management Science

Survey of mathematical aspects of decision making and the use of the computer in the decision-making environment. Development and analysis of basic principles and methods of management science as applied to decision making in the public and private sector. Emphasis is on the methods and techniques that form the basis of management science, mathematical model formulation, real world applications, and computer solution of the model. 3 cr.

950. Managerial Statistics

Basic mathematical and statistical concepts applied to managerial decision making. Probability, statistics, decision trees, and mathematic models. 3 cr.

952. Multivariate Analysis

Applied multivariate analysis, with examples from business and economics research. Descriptive methods and classical inference methods are covered in the context of models and underlying assumptions. Computer programs are used and their output explained. 3 cr.

955. Quantitative Methods

Examines the role of quantitative models in the decision-making environment. Topics include forecasting, deterministic optimization, and stochastic models. Major emphasis on mathematical model formulation and the application to business decision making. 3 cr.

960. 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.

965. Strategic Marketing

Examines marketing management and decision making in practical settings. Students are expected to draw upon various marketing and other business concepts and apply them to actual situations. Students are assigned one or two cases per week which they must prepare for class discussion. Emphasis on various aspects of marketing in various cases, including making decisions in strategic marketing, evaluating market opportunity, developing integrated marketing programs, and developing components of the marketing mix. 3 cr.

970. Economics

An introduction to micro- and macroeconomic principles and their application to business. Topics include consumer theory, production and cost, market structures, gross national product, monetary and fiscal policy, and international trade and finance. 3 cr.

981. Business, Government, and Society

Analysis of contemporary organizational forms in relation to changing external environments. 3 cr.

982. Strategic Management: Decision Making

A "capstone" course, focused on industries, companies, and other organizations in operation, and studied through the role of the strategic manager and case examples, with emphasis on integration of materials covered in prior courses. 3 cr.

992. 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. Maximum of 6 cr., except by special permission. Variable credit. 1–6 cr.

Chemical Engineering (CHE)

Chairperson: Stephen S. T. Fan

Professors: Stephen S. T. Fan, Ihab H. Farag, Virendra K. Mathur, Gael D. Ulrich

Associate Professors: Dale P. Barkey, Russell T. Carr, Donald C. Sundberg, Palligarnai T. Vasudevan

Graduate Program Coordinator: Stephen S. T. Fan

Degree Offered

The Department of Chemical Engineering offers the master of science degree. Students interested in graduate studies beyond the master of science degree should refer to the section entitled Engineering Ph.D. Program.

Admission Requirements

An applicant is expected to have completed a baccalaureate degree in chemical engineering. 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.

M.S. Degree Requirements

A minimum of 30 credits—which must include CHE 913, 915, 916, 923, and 932—is required for the master of science in chemical engineering. The core

courses requirement can be waived only in special cases with permission from the department faculty. A thesis (6 credits) is required, unless the candidate is specifically exempted by the faculty because of previous research experience. These candidates must still fulfill the 30 credit minimum requirement.

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

801. Introduction to Polymer Engineering

Principles of polymer chemistry, polymerization kinetics, polymer rheology, and material characteristics. Design and analysis of polymer reactors, extruders, molding machines, and other forming operations. Lab. 4 cr.

#805. 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. Lab. 4 cr. (Not offered every year.)

809. Fundamentals of Air Pollution and Its Control

The origin and fate of air pollutants. Fundamentals of atmospheric meteorology, chemistry, and dispersion phenomena. Control of air pollutants and the related equipment. Current issues. Prereq: differential equations with linear algebra; general chemistry. Lab. 4 cr.

812. Introduction to Nuclear Engineering

Development of nuclear reactors; binding-energy; radioactivity; elements of nuclear reactor theory; engineering problems of heat transfer, fluid flow, materials selection, and shielding; environmental impacts. 4 cr. (Not offered every year.)

#844. Corrosion

Fundamentals of corrosion processes in industrial and environmental settings; thermodynamics, kinetics, and mass transport in local corrosion cells; protection by electrochemical, chemical, surface modification, or barrier methods; instrumental methods in corrosion science. Lab. 4 cr. (Not offered every year.)

851. Process Simulation and Optimization

Techniques for computer-aided analysis of chemical processing systems. Development of mathematical models to describe process behavior. Application of optimization techniques. Prereq: knowledge of FORTRAN programming. Lab. 4 cr. (Not offered every year.)

852. Process Dynamics and Control

Dynamic behavior of chemical engineering processes described by differential equations; feedback control concepts and techniques; stability and analysis. Lab. 4 cr.

#854. Graphical, Numerical, and Finite Element Applications in Chemical Engineering

Computational methods for solving differential equations resulting from the modeling of a process or physical phenomenon. Graphical display of results of data and of curve-fitted equations. Use of

interactive graphics and the solution of boundary-value problems. Applications of finite element analysis and discussion of other software available. Prereq: permission; knowledge of FORTRAN programming. 4 cr. (Not offered every year.)

861. Biochemical Engineering

Immobilized enzyme technology, microbial biomass production, transport phenomena in microbial systems, biological reactor design, process instrumentation and control, applications in separation and purification processes. Lab. 4 cr. (Not offered every year.)

872. Physicochemical Processes for Water and Air Quality Control

Origin and characterization of pollutants. Controls, including filtration, sedimentation, coagulation and flocculation, absorption and adsorption. Applied fluid mechanics, mass transfer, and kinetics. Thermal pollution, chemical treatment, oil spills on water, and aeration. Lab. 4 cr. (Not offered every year.)

#904. Radiative Heat Transfer

Heat transmission in high-temperature operations and interaction of radiative and other transport mechanisms; radiation geometry; application of matrix algebra to radiative transfer in enclosures; zoning methods of temperature measurements. Analytical and empirical approximations of engineering use. Quantitative design of several furnaces and high-temperature systems. 3 cr. (Not offered every year.)

913. 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.

914. Fluidization Engineering

Fluidization regimes, fluid mechanics of particle suspensions, motion of single and multi-bubbles in fluidized beds. Heat and mass transfer and gas-solid reactions in fluidized beds. Applications in design of noncatalytic reactors and heat transfer equipment. 3 cr. (Not offered every year.)

915. Heat Transfer

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

916. 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.

923. Advanced Chemical Engineering Thermodynamics

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

932. Advanced Chemical Engineering Kinetics

Specialized applied kinetics problems; catalysis; fast reaction and shock tubes; combustion and detona-

tion processes; nonisothermal kinetics; heat and mass transfer in nonequilibrium, chemically reacting systems. 3 cr.

990. 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.

996. Graduate Independent Study

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

899. Master's Thesis

6-10 cr. Cr/F.

999. Doctoral Research

Chemistry (CHEM)

Chairperson: W. Rudolf Seitz

Professors: Christopher F. Bauer, N. Dennis Chasteen, Richard P. Johnson, Howard R. Mayne, James D. Morrison, W. Rudolf Seitz, James H. Weber, Gary R. Weisman, Edward H. Wong

Associate Professors: Roy Paul Planalp, Sterling A. Tomellini, Charles K. Zercher

Assistant Professors: Carmela C. Amato-Wierda, Julius C. Fister, Glen P. Miller

Graduate Program Coordinator:

N. Dennis Chasteen

Degrees Offered

The Department of Chemistry offers programs leading to the doctor of philosophy and the master of science degrees in the areas of organic, inorganic, physical, and analytical chemistry. The department also offers the master of science for teachers.

Admission Requirements

Admission to the master of science and the doctor of philosophy degrees is based upon a strong undergraduate record 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.

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 each semester on dates announced in the departmental graduate calendar.

Applicants for the master of science for teachers should consult the General Regulations of the Graduate School for special admission requirements.

M.S. Degree Requirements

The master's degree requires completion of coursework appropriate to the student's field of study and the completion of a research problem presented in the form of a thesis. A minimum of 30 credit hours is required.

Master of Science for Teachers Degree Requirements

This degree requires 30 credit hours in graduate-level courses approved by the graduate coordinator. Persons interested in this degree should confer with the department's graduate program coordinator.

Ph.D. Degree Requirements

The doctoral degree requires completion of coursework appropriate to the student's field of study and the completion of a research problem presented in the form of a dissertation. The analytical, inorganic, organic, and physical divisions require expertise in the use of computers. Students will also demonstrate to the guidance committee that they have a broad basic knowledge of the field of chemistry: (1) by completing certain fundamental graduate courses; (2) by means of a series of examinations in the major field; and (3) by presenting and defending an original research proposal before the end of the third year (CHEM 907). The culmination of the program will result in a public defense and acceptance of the dissertation.

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 graduate coordinator for further information.

Teaching Requirement

All graduate students who are doctor of philosophy or master of science candidates will obtain some teaching experience during their tenure.

Analytical Chemistry

800. Chemistry Teaching Seminar

Introduction for graduate students to their role as chemistry teaching assistants: professional responsibilities, safety, and ethics; theory-based teaching, learning, and assessment; reflective practice. Presemester sessions and periodic seminars during semester. 1 cr. Cr/F.

862. Instrumental Methods of Chemical Analysis

Theory, instrumentation, and application of methods such as atomic absorption, coulometry, emission spectrography, gas and liquid chromatography, IR and UV-VIS absorption spectrophotometry, and mass spectrometry to chemical analysis. Prereq: quantitative analysis; physical chemistry as a pre- or corequisite;/or permission. 3 cr.

930. Advanced Optical Methods

Techniques of chemical identification and analysis utilizing optical instrumentation from the standpoint of theory and application. Topics include UV-visible absorption, luminescence, atomic spectroscopy, IR, NMR, x-ray methods, and mass spectrometry. Prereq: CHEM 935 or permission. 3 cr. (Not offered every year.)

931. Advanced Electrochemical Methods

Theory and application of important electrochemical techniques such as potentiometry, polarography, and voltammetry. Prereq: CHEM 935 or permission. 2 cr. (Not offered every year.)

932. Statistics and Experimental Design

Confidence intervals, analysis of variance, regression analysis, sampling statistics, optimization procedures. Examples drawn primarily from the analytical chemistry literature. 2 cr. (Not offered every year.)

933. Chemical Separations

The use of various separation techniques prior to analysis; separations as methods of analysis. Prereq: CHEM 934 or permission. 3 cr. (Not offered every year.)

934. Chemical Equilibria

Formulation and solution of chemical equilibrium problems of relevance to analytical chemistry. 2 cr. (Not offered every year.)

935. Analytical Instrumentation

Introductory electronics for chemists. Emphasis placed on how electronic components and circuits affect acquisition, manipulation, and quality of chemical information. Includes optical transducers and detectors and signal processing. 3 cr.

Inorganic Chemistry

874. Inorganic Chemistry

Intermediate level overviews of modern inorganic chemistry including structure, bonding, and reactivity. Prereq: organic chemistry; physical chemistry;/or permission. 3 cr.

903. Advanced Inorganic Chemistry I

Survey of important advanced topics in concepts of modern inorganic chemistry. 3 cr.

904. Advanced Inorganic Chemistry II

Advanced topics for students after CHEM 903: transition metal reaction mechanisms; organometallic chemistry. Overview of current trends in inorganic research. 3 cr.

#947. Advanced Inorganic Chemistry III

Special topics in metal complexes and chemistry of organometallic compounds. Prereq: CHEM 903 or permission. 3 cr.

Organic Chemistry

855. Intermediate Organic Chemistry

An overview of organic chemistry at the intermediate levels. Aspects of synthetic organic chemistry and physical organic chemistry, including stereochemistry, are covered. 3 cr.

901. Physical Organic Chemistry I

Advanced treatment of organic reaction mechanisms, theoretical organic chemistry, organic stereochemistry, and other topics. Fourth hour problem session. 4 cr.

902. Physical Organic Chemistry II

A continuation of CHEM 901. 3 cr.

911. Organic Synthesis

Fundamentals of synthetic organic methodology and applications in multiple syntheses. Fourth hour recitation session. 4 cr.

917, 918. Special Topics in Organic Chemistry

Advanced courses dealing with specialized subdisciplines of organic chemistry. 2-4 cr.

Physical Chemistry

876. Physical Chemistry III

Application of quantum theory to atomic electron structure, spectroscopy, and molecular structure. Lab. 3 cr.

905. Advanced Physical Chemistry I

Introduction to topics in quantum mechanics and group theory, which form the background of all areas of modern chemistry. 3 cr. (Not offered every year.)

906. Advanced Physical Chemistry II

Wave mechanics and quantum chemistry, spectroscopy, molecular structure, and statistical thermodynamics. Prereq: one year of physical chemistry. 3 cr. (Not offered every year.)

922. Physical Chemistry—Chemical Thermodynamics

The foundations and interrelationships of the laws of thermodynamics. The methods by which the theoretical principles may be applied to practical problems. 3 cr. (Not offered every year.)

926. Physical Chemistry of Solutions

Thermodynamics and kinetics of solution chemistry. 3 cr. (Not offered every year.)

#927, 928. 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. Scattering theory. Molecular reaction dynamics. May be offered as a tutorial. 3 cr. (Not offered every year.)

General Offerings

Courses in which all areas of specialization participate.

808. Research Techniques

Selected instrumental and chemical methods used in chemical research for the separation, identification, and structural analysis of chemical compounds. Typical topics include mass spectroscopy, NMR spectroscopy, IR and UV spectroscopy, and chromatographic methods. 1–4 cr.

907. Introduction to Research

Introduces the doctor of philosophy student to the planning, experimental methods, and interpretation of a research problem. Student presents and defends 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. Cr/F.

908. Applied Multinuclear Magnetic Resonance Spectroscopy

Survey of basic theory, instrumentation, and practical techniques of NMR spectroscopy; interpretation of 1D and 2D hydrogen-1 and carbon-13, and multinuclear NMR spectra of organic, inorganic, and organometallic compounds in the solution of problems of structure and dynamics. Prereq: a knowledge of basic NMR at the undergraduate level. 3 cr.

971. Teaching and Learning in Chemistry

Issues, activities, and research in chemical education, including history of curricula, student and teacher knowledge and beliefs, epistemologic and cognitive bases of science learning, and related instructional approaches. Extensive reading, writing, discussion, and reflection. Not open to students who have completed GRAD 971. Prereq: permission. 3–4 cr. (Not offered every year.)

995, 996. Colloquium in Chemistry

A) Inorganic Chemistry; B) Organic Chemistry; C) Theoretical Organic Chemistry; D) Physical Chemistry; E) Analytical Chemistry; F) Chemical Education. 1–4 cr. Sections of the course may be taken to a total of 12 cr.

997, 998. Seminar

Presentation and discussion of recent investigations in chemistry. 1 cr. Cr/F.

899. Thesis—Problems in Chemistry

Conferences, library, and experimental work in some field of chemistry. 6–10 cr. Cr/F.

999. Doctoral Research**Civil Engineering (CIE)**

Chairperson: Thomas P. Ballestero

Professors: Jean Benoit, Michael R. Collins, Pedro A. de Alba, David L. Gress, Paul J. Ossenbruggen

Associate Professors: Thomas P. Ballestero, Charles H. Goodspeed, Robert M. Henry, Nancy E. Kinner, James P. Malley

Research Associate Professor:

T. Taylor Eighmy

Assistant Professor: Raymond A. Cook

Research Assistant Professor: Larry K. Brannaka

Graduate Program Coordinator:

Michael R. Collins

Degree Offered

The Department of Civil Engineering offers the master's degree in civil engineering with the following areas of specialization: structural/materials, geotechnical, water resources, systems analysis, and environmental engineering. Interested applicants are encouraged to write the graduate program coordinator for specific information on current research in the department.

An engineering Ph.D. program with specialization in civil engineering is also available. For general information, refer to the section entitled Engineering Ph.D. Program.

Admission Requirements

An applicant must have completed a baccalaureate degree in engineering, mathematics, or science at an accredited college or university. If coursework or laboratory experience is deficient, an admitted student will be required to fulfill, without graduate credit, all undergraduate prerequisites for graduate courses. In some cases the student's adviser may require additional undergraduate courses in order to achieve a well-integrated program of study.

M.S. Degree Requirements

A student in the master's program may elect either a thesis (minimum of 25 course credits and 6 thesis credits) or nonthesis (minimum of 31 course credits and a 0-credit project) option. For the thesis option, a formal oral presentation/thesis defense is required. A student electing the nonthesis option is required

to prepare a noncredit project paper and give a final oral presentation/project defense. In addition to the paper, the nonthesis candidate must pass a departmental comprehensive examination on fundamental engineering concepts prepared and evaluated by the candidate's advisory committee.

For graduation, a B average must be achieved. All students are required to register for Civil Engineering Seminar (CIE 900) for one semester.

821. 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 or permission. 3 cr.

822. Properties and Production of Concrete

Basic properties of hydraulic cements and mineral aggregates and their interactions in the properties of plastic and hardened concrete; modifications through admixtures; production handling and placement problems; specifications; quality control and acceptance testing; lightweight, heavyweight, and other special concretes. Prereq: engineering materials or permission. 3 cr.

823. Bituminous Materials and Mixtures

Considerations of major types of bituminous materials, asphalt cements, cutback asphalts, asphalt emulsions, and tars; influence of chemical composition on physical properties; desirable aggregate characteristics for bituminous mixtures; construction techniques; current practices for determining optimum asphalt contents. Prereq: engineering materials or permission. 3 cr.

834. Project Analysis

Methods of analysis for decision making used in planning, design, and management of various engineering systems involving chance and uncertainty. Topics in applied probability and statistics are used for risk analysis and for investigating system performance and reliability. Prereq: systems analysis; probability and statistics for applications;/or permission. 3 cr.

839. 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: systems analysis; fundamental aspects of environmental engineering;/or permission. 3 cr.

840. Public Health Engineering

The proper application of environmental engineering and sanitation principles in disease prevention and control discussed. Special emphasis given to areas of the world where communicable and related diseases have not yet been brought under control and to what can happen in the more advanced countries when basic sanitary safeguards are relaxed. The following topics covered: principles of communicable disease control, vector-borne diseases and control, sanitary landfills, safe water supply development and treatment, and on-site wastewater disposal systems. Prereq: fundamental aspects of environmental engineering or permission. 3 cr.

841. Open Channel Flow

Energy and momentum principles in open channel flow; flow resistance; channel controls and transitions; unsteady open channel flow; and basic modeling techniques. Prereq: fluid mechanics or permission. 3 cr.

842. Hazardous Waste Management

A thorough examination of the hazardous waste management problem in terms of the magnitude of the problem, the regulation of hazardous wastes, hazardous waste treatment and disposal technology, siting requirements, and remedial actions required at uncontrolled dump sites. Prereq: fundamental aspects of environmental engineering or permission. 3 cr.

845. Engineering Hydrology

Hydrologic cycle, probability theory related to hydrology and the design of water resources structures, flood discharge prediction, hydrograph development, hydraulic and hydrologic river routing, reservoir routing, theory of storage, reservoir operations, hydropower development, multipurpose projects; and computer simulation of watershed hydrology. Prereq: permission. 3 cr.

847. Introduction to Marine Pollution and Control

Introduction to the sources, effects, and control of pollutants in the marine environment. Dynamic and kinetic modeling; ocean disposal of on-shore wastes, shipboard wastes, solid wastes, dredge spoils, and radioactive wastes; and oil spills. Prereq: fundamental aspects of environmental engineering or permission. 3 cr.

848. Solid Waste and Residuals Management

Focuses on collection, characterization, treatment, and disposal of solid waste and residuals (sludges) from environmental treatment processes. Topics include waste minimization, sludge stabilization, thickening, dewatering, composting, codisposal, landfill design, and incineration. Prereq: fundamental aspects of environmental engineering or permission. 3 cr.

849. Water Chemistry

Emphasizes the use of chemical equilibrium principles. Theory, calculations, and applications of ionic equilibrium stresses. Topics include thermodynamics, kinetics, acid/base, complexation, precipitation/dissolution, and redox equilibria. Computer equilibrium modeling is presented. Prereq: general chemistry or equivalent. 4 cr.

854. Transportation Engineering and Planning

Fundamental relationships of traffic speed, density, and flow applied to public and private modes of transport. Principles of demand forecasting and urban systems planning. Prereq: permission. 3 cr.

855. Design of Water Transmission Systems

Pressure, sewer, and open channel system design. Theory developed for individual components to large complex systems. Topics include closed conduit flow, open channel flow, pressure surge, design of storage, valves and meters, pump selection, system planning and layout, system operation and maintenance, and computer simulation of pressure systems and storm water runoff. Prereq: fluid mechanics or permission. 3 cr.

856. Environmental Engineering Microbiology

Concepts of wastewater treatment microbiology. Topics include taxonomy of wastewater species; cellular chemical composition and ultrastructure of sewage microorganisms; microbial metabolism, interaction, and growth kinetics in wastewater treatment; biogeochemical cycling in polluted water; and effects of environmental parameters on wastewater microbial processes. Laboratory projects examine these concepts. Prereq: fundamental aspects of environmental engineering or permission. Special fee. Lab. 4 cr.

857. Coastal Engineering and Processes

Introduction to small amplitude and finite amplitude wave theories. Wave forecasting by significant wave method and wave spectrum method. Coastal processes and shoreline protection. Wave forces and wave-structure interaction. Introduction to mathematical and physical modeling. Prereq: fluid dynamics or permission. (Also offered as ME 857 and OE 857.) 3 cr.

860. Foundation Design I

Foundation design based on subsurface investigation and characterization using current methods of laboratory and in situ testing. Use of consolidation theory and bearing capacity theory for the design of shallow foundations, including footings and rafts. Basic design of pile foundations. Earth pressure theory applied to design of retaining walls. Slope stability theory and applications. Prereq: soil mechanics or permission. 4 cr.

861. Foundation Design II

Advanced pile and pier design under vertical and lateral loads. Slope stability by circular and noncircular arc methods. Design of flexible bulkhead walls and mechanically stabilized walls. Excavation and dewatering. Soil and site improvement. Prereq: CIE 860 or permission. 3 cr.

862. Introduction to Geotechnical Earthquake Engineering

Overview of earthquake source mechanisms; magnitude and intensity; seismicity of the U.S.A. Dynamics of simple structures; response spectra. Selection of design parameters; source, magnitude, input records. Measurement of dynamic characteristics of soils; site response, liquefaction, and ground deformation. Prereq: CIE 860 or permission. 3 cr.

863. Geological Engineering

Functional classification of rocks and rock masses. Stereographic projection. Engineering properties of rocks. Rock mechanics. The influence of geology in the design of underground excavations, tunneling, foundations, and rock slope engineering. Prereq: principles of geology or permission. 3 cr.

866. Introduction to Geo-Environmental Engineering

Geo-environmental site characterization and investigation using in situ geotechnical and geophysical methods; groundwater, soil and gas monitoring and sampling; containment design including landfills, geosynthetics for liners and covers, leachate collection systems, vertical cutoff walls and stability analyses; remediation techniques such as stabilization, bioremediation, and electrical methods. Prereq: CIE 860;/or permission. 3 cr.

874. Reinforced Concrete Design I

Introduction to the design of reinforced concrete structural members by the CA strength design method. Includes beams, columns, foundations, and construction details of reinforcing. Prereq: structural analysis. 4 cr.

882. 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 or permission. 3 cr.

883. Matrix Structural Analysis

Analysis of determinate and indeterminate structures; nonprismatic members subject to static and moving loads. Solution by matrix and computer-applied methods. Prereq: structural analysis or permission. 3 cr.

884. Civil Engineering Analysis with Numerical Techniques

Unifying concepts of civil engineering analysis, theory, and numerical techniques. Discussion includes the assumptions required by numerical techniques and their relationship to the theory and the analytical results. Prereq: permission. 3 cr.

885. Introduction to Structural Vibrations

Dynamic analysis of single- and multi-degree-of-freedom systems. Applications include simple beam and frame structures. Earthquake analysis and design. Pre- or coreq: indeterminate structures. 3 cr.

886. Introduction to Finite Element Analysis

Topics include basic matrix theory, Galerkin method, direct stiffness method, development of finite element theory, and modeling techniques. Applications in solid mechanics, heat transfer, fluids, and dynamics using commercially available codes. Prereq: classical structural analysis; matrix algebra;/or permission. 3 cr.

887. Dynamics of Structures

Dynamics of single- and multi-story buildings. Response due to earthquakes, blasting, traffic, and mechanical equipment. Analysis in the time domain and through the Fourier Transform. Fundamentals of structural vibration measurement. Prereq: CIE 885 or permission. 3 cr.

889. Project Management

Project management concepts including labor, material, and equipment usage; cost estimation; financing and economic evaluation of projects; scheduling; and quality control and safety during construction. Existing projects are integrated in class discussions and homework. An understanding of systems analysis is assumed. 3 cr.

891. Prestressed Concrete

Design of prestressed and post-tensioned concrete sections in flexure and shear. Introduction to prestressing systems and ultimate strength methods. Prereq: CIE 893 or permission. 3 cr.

892. Introduction to Bridge Design

Introduction to the AASHTO LRFD Bridge Design Specifications using SI units. Design objectives, loads, load case analysis and selection, load distributions, static analysis, and design for axial loads,

flexure, and shear. Design of slender columns, composite beams, and plate girders. Prereq: CIE 874 or permission. Coreq: CIE 893. 3 cr.

893. Structural Design in Steel

The design of members and connections: tension, members, columns, beams, plate girders, bolted joints, and welded joints. Introduction to plastic design of beams and frames. Prereq: structural analysis or permission. 4 cr.

895, 896. Independent Study

A limited number of qualified graduate students will be permitted to pursue independent studies under faculty guidance. May be repeated. 1–4 cr.

900. Civil Engineering Seminar

Topics of interest to graduate students and staff; reports of research ideas, progress, and results; lectures by outside speakers. Continuing course: instructor may assign IA grade at the end of one semester. 1 cr.

#922. 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 821 or permission. 2–4 cr.

940. Hydrologic Monitoring

Field course designed to familiarize the student with measurement of hydrologic variables in surface and ground water situations. Topics covered include weirs, stream gaging, dilution gaging, sampling of bed and suspended sediments, groundwater/surface water interactions, well monitoring, borehole dilution measurements, groundwater velocity and dispersion, unsaturated zone, well construction, and water quality measurements. Prereq: permission only. Special fee. 3 cr. (Summer session only, in even numbered years. Interested students should contact the department prior to May 1.)

942. River Mechanics

Geomorphic principles, erosion and sediment transport problems, sediment transport mechanics in pipes and open channels, sediment measurement techniques, sediment sources and yields, control methods, effects of structures on riverine systems, design of hydraulic structures. Prereq: fluid mechanics or permission. 3 cr.

943. Advanced Hazardous Waste and Environmental Sampling and Analysis

Laboratory and field techniques for the sampling and analysis of hazardous waste. Lecture covers theory behind techniques. Prereq: general chemistry; systems analysis; and fundamental aspects of environmental engineering. Lab. Special fee. 4 cr.

944. Advanced Physicochemical Treatment Design

Theoretical and experimental examination of physicochemical treatment processes. Discusses design, application, and operational principles associated with gas transfer, coagulation, particle-liquid separation, absorption, water stabilization, chemical precipitation, and disinfection unit processes. Stresses the knowledge of laboratory applications. Prereq: fundamental aspects of environmental engineering; CIE 849;/or permission. Special fee. Lab. 4 cr.

945. Advanced Groundwater Topics

Review of Darcy's Law for confined and unconfined aquifers, linearization techniques, drawdown computations under varying boundary conditions, solutions to the inverse problem, drainage theory, recharge theory, two-phase flow, succession of steady states modeling, and borehole geophysics. Prereq: groundwater hydrology. 3 cr.

946. Advanced Biological Treatment Design

Theoretical and experimental examination of the fundamental parameters used in selection, design, and operation of biological treatment processes for waters, wastewaters, and hazardous wastes. Topics include design and evaluation of aerobic and anaerobic processes, suspended and fixed-film processes, and advanced biological water and wastewater treatment processes. Prereq: CIE 856; 943;/or permission. 4 cr.

#949. Aquatic Chemistry

Emphasizes the use of chemical equilibrium principles to provide an understanding of the chemistry of surface waters, groundwaters, and unit operations and processes in environmental engineering. Topics include surface and colloid chemistry, acid-base reactions, oxidation-reduction, dissolution-precipitation, and coordination chemistry. Prereq: CIE 849 or permission. 4 cr.

#958. Topics in Environmental Engineering

Selected topics in specialty areas of environmental engineering not ordinarily included in other courses. May involve formal classes, seminars, discussions, laboratory work, or independent investigations. Prereq: permission. May be repeated up to 4 cr. 2–4 cr.

960. Advanced Soil Mechanics

Stresses and stress spaces. Introduction to constitutive models for sands and clays. Recent developments in strength and compressibility analysis of soils. Prereq: CIE 860 or permission. 3 cr.

961. In Situ Geotechnical Testing

In situ geotechnical testing methods for site characterization; theory and practice. Geotechnical testing methods include the piezocone, the pressuremeter, the flat plate dilatometer, the field vane, and the standard penetration test. Includes sampling techniques, geophysical exploration, and recent innovations in site and soil characterization. Prereq: CIE 960 or equivalent. 3 cr.

962. Soil Testing for Engineering Purposes

Modern techniques for measuring mechanical properties of soils in the laboratory. Instrumentation. Static shear strength and consolidation. Dynamic properties. Prereq: CIE 960 or permission. 3 cr.

#968. Offshore Geotechnical Problems

Techniques for sampling and testing of marine soils; design of offshore foundations. Stability problems under wave and earthquake loading. Prereq: CIE 863; 865;/or permission. 3 cr.

969. Advanced Topics in Geotechnical Engineering

Seminar for advanced graduate students: presentations by students, faculty, and outside speakers on topics of current research interest. Prereq: CIE 960; 961; 962;/or permission. 3 cr.

981. Advanced Structural Analysis I

Advanced structural theory and analysis with computer applications, including multistory structures, beam columns, frames with variable moment of inertia, arches, rings, continuous curved beams, and curved frames. 4 cr.

982. Advanced Structural Analysis II

Methods of calculating stresses and deformations in plates and shells used in engineering structures. Bending of circular and rectangular plates. Membrane and flexural analysis of shells of revolution with application in the design of domes, pressure vessel tanks, and shell roofs. 4 cr.

#983. Structural Stability

Study of the elastic and inelastic buckling behavior of structures. Topics include stability of columns, mathematical treatment of buckling problems and buckling criteria. lateral stability of beams, buckling of trusses and framed structures, and stability of rings and curved beams. 4 cr.

#985. 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.

990. Topics in Structures

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

995, 996. Civil Engineering Problems

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

899. Master's Thesis

6 cr. Cr/F.

999. Doctoral Research

Communication Disorders (COMM)

Chairperson: Stephen N. Calculator

Professor: Stephen N. Calculator

Associate Professors: Steven P. Bornstein, Frederick C. Lewis, Penelope E. Webster

Assistant Professor: Christine G. Guarino

Graduate Program Coordinator: Frederick C. Lewis

Degree Offered

The Department of Communication Disorders offers the master of science degree. Students are prepared to practice in a variety of job settings within the field of speech-language pathology, and to meet the academic and practicum requirements of the American Speech-Lan-

guage-Hearing Association (ASHA) for the Certificate of Clinical Competence in speech-language pathology. The program is accredited by the Council on Academic Accreditation of ASHA.

Admission Requirements

Applicants for admission should possess a bachelor's degree in communication disorders or its equivalent. The following courses, or their equivalents, are undergraduate prerequisites for the master's program: COMM 521, Anatomy and Physiology of the Speech and Hearing Mechanism; COMM 522, Language Acquisition; COMM 523, Clinical Observation; COMM 524, Phonetics; COMM 630, Organic Pathologies; COMM 631, Articulation and Language Disorders in Children; COMM 704, Basic Audiology; COMM 705, Aural Rehabilitation; COMM 777, Speech and Hearing Science. In addition, a course in statistics is required. Students are also encouraged, but not required, to have completed introductory coursework in linguistics and normal human development in preparation for fulfillment of ASHA requirements.

Applicants with degrees in related fields may be admitted to the Graduate School as provisional students, with the expectation that they complete the above prerequisites prior to beginning graduate courses. A specially designed curriculum is available to provisionally admitted students. They may also choose to complete undergraduate prerequisites through the Division of Continuing Education.

Acceptance to the communication disorders program is based primarily on grade-point average, and GRE (Graduate Exam Record Examination general test) or MAT (Miller Analogies Test) scores. Generally, students must have earned a minimum grade-point average of 3.00 to be considered for admission. The average GRE scores of admitted students over the past three years have been 530v, 584q, 594a. A score in the 50th percentile or higher on the MAT, is required. Letters of recommendation are considered, particularly for the awarding of scholarships, assistantships, and other sources of support.

M.S. Degree Requirements

Required Courses The following courses are required of all students: KIN 806, Neurology; COMM 900, Articula-

tory and Phonological Disorders in Children; 901, Closed Head Injury/Dysphagia; 902, Stuttering; 904, Aphasia in Adults; 905, Motor Speech Disorders; 906, Voice Disorders; 907, Advanced Seminar in Aural Rehabilitation; 908, Language and Learning Disabilities in School-Age Children; 910, Clinical Practicum; 911, Off-Campus Clinical Practicum; 912, Language Disorders in Early Childhood; EDUC 981, Methods and Techniques of Educational Research; 920, Seminar (at least 2 credits). Students may elect a thesis or nonthesis option, with the latter requiring successful completion of Comprehensive Exams at the conclusion of their program.

Students who have not completed COMM 880, Diagnosis of Speech and Language Disorders, or its equivalent prior to enrolling in the master's program must complete this course as part of their program requirements.

Electives Electives supplement required courses to meet academic and clinical requirements for certification by the American Speech-Language Hearing Association.

Clinical Practicum The number of credits needed by students may vary depending on previous undergraduate experiences. Students must meet the practicum requirements for certification by the American Speech-Language-Hearing Association, including practicum in at least three different practicum sites.

Written Examination All students except those selecting the thesis option must pass a written comprehensive examination designed to assess their mastery of the professional concepts of communication disorders in the areas of normative processes, pathologies, and remediation.

Thesis Option Students may elect the option of writing a thesis. Upon completion of the research project, a student must defend the thesis in an oral examination and must gain approval of the thesis committee. Six credits will be awarded for satisfactory completion of a thesis.

880. Diagnosis of Speech and Language Disorders

Principles and practice for diagnosis of speech and language disorders; examination procedures and measurement techniques. 4 cr.

895. Special Topics in Communication Disorders

Advanced study in specific areas; involves an independent project. Prereq: permission. May be repeated. 1-3 cr.

900. Articulatory and Phonological Disorders in Children

Phonological theories as they relate to analysis and remediation of articulation disorders. 3 cr.

901. Closed Head Injury/Dysphagia

The types of brain injuries, their behavioral, psychological, and cognitive sequelae discussed. Clinical assessment and treatment a major emphasis. Normal and disordered swallowing processes covered. Videofluoroscopic and behavioral assessment and treatment emphasized. Prereq: COMM graduate students only. 3 cr.

902. Stuttering

Theoretical and therapeutic considerations of the stuttering syndrome; emphasis on clinical management. Prereq: speech pathology II or permission. 3 cr.

904. Aphasia in Adults

Principles concerning etiologies, evaluation, classification, and methods of clinical management including the team approach to rehabilitation of aphasia in adults. Prereq: KIN 806. 3 cr.

905. Motor Speech Disorders

Neurological bases, diagnosis, and treatment of motor speech disorders including cerebral palsy, acquired dysarthria, and apraxia of speech. Prereq: KIN 806 or permission. 3 cr.

906. Voice Disorders

Types, causes, and characteristics of functional and organic voice disorders. Specific evaluation of deviant vocal characteristics; treatment techniques for children and adults. 3 cr.

907. Advanced Seminar in Aural Rehabilitation

Current issues in therapeutic techniques and management considerations for the hard-of-hearing child. Speech perception by the hearing impaired, use of amplification systems, counseling approaches, and modification of the listening environment and language considerations, and the development of IEPs. Prereq: basic audiology, introduction to auditory perception and aural rehabilitation, speech and hearing science;/or equivalent. 3 cr.

908. Language and Learning Disabilities in School-Age Children

Examination of language-based learning disabilities; relation between language and learning; current assessment and treatment strategies. Prereq: permission. 3 cr.

910. Clinical Practicum

Practicum provides graduate students with the opportunity to apply advanced theoretical knowledge in clinical setting with speech-, language-, and hearing-impaired individuals. Diagnostic and therapy experience is supervised. Prereq: permission. May be repeated up to 6 credits—a minimum of 3 credits is required for the M.S. degree. Variable. Special fee. 1-3 cr.

911. Off-Campus Clinical Practicum

Application of advanced theoretical knowledge in an off-campus clinical setting. Prereq: permission. Two practicum experiences are required for 3 credits each.

912. Language Disorders in Early Childhood

Transdisciplinary examination of interrelationships between early language, social, and cognitive development, with emphasis on collaborative models of assessment and intervention. Reviews implications for special populations (e.g., mentally retarded, autistic, sensory impaired, and limited English proficiency). 3 cr.

920. Graduate Seminar

Current topics, recent investigations, and library research. May be repeated up to 9 credits barring duplication of subject matter. A minimum of 2 credits is required for the M.S. degree. 1-6 cr.

899. Master's Thesis

Prereq: permission. 6 cr. Cr/F.

Computer Science (CS)

Chairperson: Philip John Hatcher

Professors: R. Daniel Bergeron, Eugene C. Freuder, Philip John Hatcher, T. M. Sparr

Associate Professors: Pilar de la Torre, Raymond Greenlaw, Robert D. Russell, James L. Weiner

Adjunct Associate Professor: Sylvia Weber Russell

Assistant Professors: Radwin Bartos, Elizabeth Varki

Adjunct Assistant Professors: Elise H. Turner, Roy M. Turner

Graduate Program Coordinator: Pilar de la Torre

Degrees Offered

The Department of Computer Science offers programs leading to the master of science and the doctor of philosophy degrees. A major emphasis in these programs is the blending of theoretical and applied aspects of computer science. Students pursuing a specialization in computer science theory are required to develop a strong background in systems and are encouraged whenever possible to identify applications for theory. Similarly, students specializing in applied areas of computer science are required to base their work on strong theoretical foundations.

Admission Requirements

Applicants for the master's program are expected to have studied high-level language programming, data structures, analysis of algorithms, operating system fundamentals, programming language concepts, and discrete mathematics. Further experience in computer science, mathematics, and/or electrical engineering will also be expected. All applicants must submit general and computer science subject test scores from the Graduate Record Examination.

Applicants for the Ph.D. program must have a strong academic record and a bachelor's or master's degree in computer science (or a closely related area with a strong concentration in computer science). All applicants must submit general and computer science subject test scores from the Graduate Record Examination.

M.S. Degree Requirements

The student may choose to follow a depth-oriented program with a thesis or a breadth-oriented program without a thesis. Both options require the completion of CS 900 (a 1-credit graduate seminar). The thesis option requires eight additional courses numbered 800 or above (two must be above 900), plus 6 credits of thesis work. The nonthesis option requires ten additional courses numbered 800 or above (three must be above 900) distributed among five subject categories, and a comprehensive written examination.

Ph.D. Degree Requirements

Following the student's entrance into the program, a guidance committee will be appointed by the dean of the Graduate School to review the student's preparation for pursuing a particular program and to assist in outlining a program of study. The program of study will include courses in both the theoretical and applied aspects of computer science as determined by the guidance committee. Normally a student will be expected to complete at least the equivalent of sixteen semester courses (of at least 3 credits each) beyond the bachelor's degree, or eight courses beyond the master's degree.

In addition, each doctoral student is required to acquire competence in the use of a research tool determined by the

guidance committee. The research tool should contribute to the student's dissertation research and is expected to consist of courses from disciplines outside computer science, such as mathematics, engineering, psychology, or linguistics, as determined by the guidance committee.

Every doctoral student must pass a written qualifying exam consisting of two major components: a breadth requirement and a depth requirement. The breadth requirement consists of a written examination covering four major areas of computer science. The depth requirement has three parts: a written survey of relevant literature, a written research report focused on an area of research, and an oral examination.

A student is admitted to candidacy for the Ph.D. after successfully completing the qualifying examination and the research tool requirement. A doctoral committee will be appointed by the dean of the Graduate School for the purpose of approving and monitoring the candidate's dissertation work and administering the final dissertation defense. The doctoral candidate must make a formal presentation of the proposed research work, including both written and oral components, prior to undertaking the major research effort. Upon completion of the research, the candidate must present a written dissertation and a formal oral defense.

812. Compiler Design

Formal languages and formal techniques for syntax analysis and parsing; organization of the compiler and its data structures; problems presented by error recovery and code generation. Classical top-down and bottom-up techniques currently in widespread use, general discussion of LL (k) and LR (k) parsers; automatic methods of compiler generation and compiler compilers. Students required to define a simple, nontrivial programming language and to design and implement its compiler. Prereq: programming language concepts and features. 3 cr.

#818. Software Engineering

Design approaches, implementation methodologies, and management techniques required to develop large, reliable software systems including applications-oriented systems. Team programming projects. Prereq: data structures. 3 cr.

819. Object-Oriented Methodology

Object-oriented system design. Object-oriented programming. Languages for object-oriented programming. Prereq: strong programming skills; experience with C programming is highly desirable. 3 cr.

820. Operating System Concepts

Theory and practice of building operating systems. In-depth investigation of operating system concepts and design. Developments from current op-

erating systems. Prereq: operating system fundamentals or equivalent. 3 cr.

822. Advanced Systems Programming

Topics in systems programming. Organization and implementation of typical POSIX 1003.2 utilities and tools. Emphasis on file handling, text processing, pattern matching, and portability. Prereq: operating system fundamentals. 3 cr.

825. Introduction to Computer Networks

Introduction to local, metropolitan, and wide-area networks using the standard OSI reference model as a framework. Introduction to the Internet protocol suite and to network tools and programming. Discussion of various networking technologies such as Ethernet, FDDI, and ATM. Prereq: operating system fundamentals. 3 cr.

827. Computer Communications Software Design

Telecommunications software. Error detection algorithms. Asynchronous and synchronous communications software. Network architectures. Protocol definition and implementation. Links through a local area network. Timing considerations. Implementation of selected communications software. Prereq: operating system fundamentals. 3 cr.

829. Collaborative Computing

The goal of collaborative computing is to assist groups in communicating, in collaborating and in coordinating their activities. Study of computer-based systems that support groups of people engaged in a common task (or goal) and that provide an interface to a shared environment. Investigation of several sample collaborative applications, like World Wide Web, virtual reality, video conferencing and work flow systems, along with related protocols and languages. Prereq: operating system fundamentals or permission. 3 cr.

830. Introduction to Artificial Intelligence

Machine intelligence, representation and control issues, search methods, problem solving, learning, natural language understanding, knowledge engineering, game playing. Heuristic programming using the LISP language. Prereq: data structures. 3 cr.

835. Introduction to Parallel Programming

Data-parallel programming, message-passing parallel programming, parallel programming with threads, performance evaluation of parallel programs, debugging of parallel programs, and parallel computing hardware. Course requirements consist primarily of programming assignments. Parallel programming tools based upon the C/C++ programming languages are used. Prereq: operating systems fundamentals; assembly language programming and machine organization; computer organization or permission. 3 cr.

846. Introduction to Programming Semantics

Informal, nonmathematical introduction to descriptive techniques of denotational semantics. Provides framework needed to describe formally programming languages such as PASCAL. No previous knowledge of the theory of computation or of any particular programming language is assumed. Prereq: programming language concepts and features or permission. 3 cr.

853. Introduction to Numerical Methods

Introduction to mathematical algorithms and methods of approximation. A wide survey of approximation methods are examined including, but not limited to, polynomial interpolation, root finding, numerical integration, approximation of differential equations, and techniques used in conjunction with linear systems. Included in each case is a study of the accuracy and stability of a given technique, as well as its efficiency and complexity. It is assumed that the student is familiar and comfortable with programming a high-level computer language. (Also offered as MATH 853.) 3 cr.

854. Introduction to Scientific Computing

Introduction to the tools and methodology of scientific computing via the examination of interdisciplinary case studies from science and engineering. Emphasis on numerical approaches to solving linear systems, eigenvalue-eigenvector problems, and differential equations. Problems are solved on various hardware platforms using a combination of software and data visualization packages. Prereq: linear algebra; differential equations; introduction to scientific programming; or permission. (Also offered as MATH 854, PHYS 854) 3 cr.

865. Introduction to Computational Linguistics

Introduction to computational analysis of natural language, with a focus on semantic representations and the resolution of ambiguity. Provides an elementary working knowledge of linguistic and artificial intelligence analysis methods as motivated by examples of potential input text. Topics include parsing, formal grammars, representation of knowledge and memory, inference, and interpretation of nonliteral language. Prereq: elementary knowledge of LISP or permission. 3 cr.

870. Computer Graphics

Input-output and representation of pictures from hardware and software points of view; interactive techniques and their applications; three-dimensional image synthesis techniques. Prereq: data structures. 3 cr.

875. Database System Principles

Introduction to database system concepts and design; data models, especially the relational model; data description and manipulation languages; normalization and schema design; implementation issues and mechanisms. Prereq: data structures; mathematical proof. 3 cr.

880. Topics in Computer Science

Material not normally covered in regular course offerings. May be repeated. 3 cr.

900. Graduate Seminar

Regularly scheduled seminars presented by outside speakers, UNH faculty, and graduate students. Topics include reports of research ideas, progress, and results. 1 cr. Cr/E.

912. Advanced Compiler Design

In-depth study of automatically generated syntactic error recovery, intermediate representation, machine independent and machine dependent optimization, code generation, register allocation. Tools for generating code generators and Graham-Glanville style instruction selectors. Example of production code generators. Prereq: CS 812 or equivalent. 3 cr.

920. Operating Systems Techniques

Theoretical aspects of operating systems. Scheduling and resource allocation; deadlock; paging and segmentation; thrashing; synchronization; inter-process communication; cooperating sequential processes; protection and security; in-depth study of a complex system such as MULTICS. Prereq: CS 820 or equivalent. 3 cr.

925. Computer Networks

Distributed computer systems; techniques for connecting and controlling them. Tightly coupled systems to loosely coupled systems. Design, capabilities, and problems associated with different types of connections. Organizational possibilities for networks. Queuing theory applied to computer networks. Modeling and performance evaluation in distributed systems. Case studies of existing networks such as ARPANET. Prereq: operating system fundamentals. 3 cr.

930. Artificial Intelligence

Current approaches to machine intelligence and the simulation of human cognitive processes, including an introduction to recursive functions and programming with the LISP language. Heuristic programming, programs for game playing and natural language understanding, elementary theory of computability. Individual computer project required. Prereq: programming experience. 3 cr.

934. Logic Programming

Introduction to the foundation, implementations, and application of logic programming. Emphasis on the study of example applications. Application areas include compilers, databases, and expert systems. 3 cr.

941. Design and Analysis of Algorithms

Principles of design of efficient algorithms. Methods studied include recursion, divide and conquer, dynamic programming, greedy techniques, and data structure selection. Correctness and analysis of algorithms. Examples are drawn from problems in the areas of graphs, sorting, searching, pattern matching, and polynomials. Prereq: undergraduate algorithms course recommended. 3 cr.

959. Theory of Computation

Models of computation, Church's thesis, completeness, undecidability. Time and space complexity of Turing machines. Savitch's theorem and hierarchy theorems. NP-completeness and Cook's theorem. Prereq: introduction to the theory of computation or equivalent. 3 cr.

970. Advanced Computer Graphics

Advanced image synthesis techniques and photorealism. Ray tracing. Complex shading and lighting models. Antialiasing. Texture mapping. Surface generation and display. 3 cr.

975. Object-Oriented Database Systems

Introduction to object-oriented database systems concepts and design; object-oriented data models and languages; implementation issues and mechanisms. Prereq: CS 875. 3 cr.

The following special topics courses are offered on an irregular basis with varying content. Students may repeat these courses with the instructor's permission.

- 980. Advanced Topics in Computer Science**
3 cr.
- #981. Advanced Topics in Database Systems**
3 cr.
- 983. Advanced Topics in Artificial Intelligence**
3 cr.
- #984. Advanced Topics in Computer Science Theory**
3 cr.
- #985. Advanced Topics in Operating Systems**
3 cr.
- #987. Advanced Topics in Computational Linguistics**
3 cr.
- 988. Advanced Topics in Computer Graphics**
3 cr.
- 989. Advanced Topics in Algorithms**
3 cr.
- 998. Reading Course**
1–6 cr.
- 999. Master's Thesis**
6 cr. Cr/F.
- 999. Doctoral Research**

Earth, Oceans, and Space, Institute for the Study of (EOS)

The Institute for the Study of Earth, Oceans, and Space offers students the opportunity for interdisciplinary study and research. Certain graduate degree programs in earth sciences, natural resources, and physics may be accessed through the institute: at both the master's and Ph.D. levels, the option in oceanography and the specialization in geochemical systems in earth sciences (either of two tracks: biogeochemistry or climate change), the specialization in space physics in physics; and through the departmental (M.S.) or intercollege (Ph.D.) program in natural resources. Admission and degree requirements are set by the respective departments. In addition, EOS students are required to participate in an EOS interdisciplinary seminar and are encouraged to elect specialized courses on the various components of the earth and space system. See the graduate program descriptions in earth sciences, natural resources, and physics for admission and degree requirements.

801. Systems Approach to Biological Ocean Science

Broad survey of one topic area in biological ocean science; topic areas change each time the course is taught and have included: biophysical interactions from micro- to megascales; and the coastal ocean. All topics are treated using an interdisciplinary "systems" approach that is intended to focus attention on the major opportunities and challenges facing ocean science now and in the future. The course comprises a structured series of presentations by guest speakers, with integration by the instructors. Prereq: ZOOL 850 and permission. May be repeated. 3 cr. (Offered every other year.)

807. Global Ecosystem Policy

Scientific and institutional issues pertinent to global change; scientific basis for the global Earth and biogeochemical cycles that maintain Earth's thermostasis; long-term effects of major human perturbations (greenhouse warming of the atmosphere, ozone depletion, deforestation, desertification, and biotic and soil impoverishment) and human-environment feedback mechanisms on the viability of the Earth versus the survival of the human species; effectiveness of existing and alternative national, regional, and international institutions in responding to global change. Prereq: permission. 3 cr.

810. Introduction to Astrophysics

Review of the sun, stars, Milky Way, external galaxies, and expansion of the universe. Recent discoveries of radio galaxies, quasi-stellar objects, cosmic black-body radiation, x rays, and gamma rays precede a discussion of Newtonian and general relativistic cosmological models, steady-state big-bang theories, and matter-antimatter models. (Also offered as PHYS 810) 4 cr.

812. Physics of the Ionosphere

Introduces basic plasma physics using a case study of the Earth's ionosphere and its connection both to the upper atmosphere and to the Earth's magnetosphere. Topics include single particle motion, fluid and kinetic descriptions of ionospheric plasma, wave propagation, and instabilities. Prereq: electrical and magnetic I or equivalent; calculus II. (Also offered as PHYS 812.) 4 cr.

813. Biogeochemical Dynamics

Examines the influence of biological processes on geochemical transformations and elemental cycles from the molecular to the global scale involving both microorganisms and higher plants and animals; factors that regulate cycles; interactions among biosphere, hydrosphere, lithosphere, and atmosphere; transformations of C, N, S, and trace elements. Prereq: one semester each biology and chemistry. 3 cr.

815. Global Atmospheric Chemistry

Introduction to the principles of atmospheric chemistry and their relationship to biogeochemical cycles, climate, and global change. Focus is on understanding the basic physical and chemical processes that determine the trace gas distribution in the global troposphere. An introduction to atmospheric vertical structure and global circulation dynamics provides the foundation. Chemical cycles of important C, S, and N molecules examined, including their possible perturbation by human activities. Basic photochemical processes outlined, particularly with respect to reactive nitrogen, hy-

drocarbons, and the production/destruction of ozone. Prereq: one year college chemistry. (Also offered as ESCI 815.) 3 cr.

816. Atmospheric Aerosol and Precipitation Chemistry

Description and examination of the processes determining the chemical and physical characteristics of atmospheric aerosol particles and precipitation. Important foci include the role of aerosol particles in the long-range transport and deposition of geochemical materials, optical properties of these particles and their impact on the global radiative balance, cloud microphysical processes relevant to both radiative effects and precipitation scavenging, and heterogeneous reactions at the solid-liquid solid-gas and liquid-gas interfaces in the atmosphere. Major segments of the course are devoted to the removal of gases and particles from the atmosphere by wet and dry deposition processes. Most attention will be paid to processes active in the troposphere, but important differences between the troposphere and stratosphere, radiative effects of stratospheric aerosol particles, and exchange between the troposphere and stratosphere addressed. Prereq: one year college chemistry or permission. 3 cr.

817. Macro-scale Hydrology I

Focus on the numerous roles of water in the Earth System. Topics include the global water cycle, impacts of the greenhouse effect and other anthropogenic disturbances, hydrologic modeling, soil-vegetation-atmosphere transfer schemes, water quality, GIS and water-related remote sensing tools. Based on extensive reading of current scientific literature, the students and instructor jointly select a research topic in macro-scale hydrology which will result in the preparation of a manuscript for publication in a refereed scientific journal. Course designed to be taken two consecutive semesters (fall and spring.) Prereq: principles of hydrology or permission. (Also offered as ESCI 817.) 4 cr.

818. Macro-scale Hydrology II

Students and instructors jointly select a research topic in macro-scale hydrology to be analyzed in depth during the course of the semester. A primary goal is the preparation of a manuscript for publication in a refereed scientific journal. Extensive library research, reading of recent and relevant scientific literature, technical analysis, writing. Course designed to be taken two consecutive semesters (fall and spring.) Prereq: macro-scale hydrology I. (Also offered as ESCI 818.) 4 cr. (Alternate years only.)

824. Introduction to Ocean Remote Sensing

Introduction to a wide range of remote sensing techniques and applications in oceanography. Surveys a variety of different sensors including satellite imaging systems that operate in the visible and infrared spectral range, both passive and active microwave systems, and airborne remote sensors. The goal is to provide students with an understanding of the physical basis for remote sensing measurements, exposure to image and data analysis techniques, and the variety of remote sensing applications that exist in oceanography. Research on future remote sensing techniques and applications discussed. 3 cr. (Offered every other year.)

854. Ocean Waves and Tides

Introduction to waves: small-amplitude, linear wave theory, standing and propagating waves, transformation in shallow water, energy and forces on structures, generation by wind and specification of a random sea, long waves with rotation, and internal waves. Introduction to tides: description of tides in ocean tidal generation forces, equilibrium tide, and tidal analysis. Lab/project: field and lab measurements with computer analysis. Prereq: general physics; differential equations;/or permission. (Also offered as OE 854.) Lab. 4 cr.

860. Introductory Dynamic Oceanography

Basic physical laws governing ocean and atmospheric circulation under the influence of Earth rotation, density stratification, and friction. Topics include surface waves, wind-driven and thermohaline ocean circulation, ocean/atmosphere interaction, instabilities, fronts, and climate. Simplified mathematical models demonstrate the important principles. Prereq: college physics and differential equations or permission. 3 cr.

864. Introductory Paleoclimate Analysis

An overview of paleoclimate indicators for the last one million years in the context of global teleconnections (atmosphere-lithosphere-hydrosphere-cryosphere) and mathematical tools developed to interpret and link the different records of climate change. Prereq: one year calculus; one year chemistry; basic statistics;/ or permission. (Also offered as ESCI 864.) 4 cr.

865. Natural Climate Variability

Review of paleoclimate over the last several billion years of Earth history with particular emphasis on paleoclimate indicators and major events. (Also offered as ESCI 865.) Lab. 4 cr.

895. Topics in Earth, Oceans, and Space

Study on an individual or group basis of topics not covered by the other listed courses. Topics may include any area relevant to interest in Earth, ocean, atmospheric, and space studies. (May be repeated.) Lab. 1-4 cr.

901. EOS Seminar

Introduction to the fundamental components of the Earth system, such as the biosphere, cryosphere, hydrosphere, and its environment in space. Basic concepts are presented in a lecture format by selected EOS faculty according to their research specialization. To familiarize the student with the literature in earth, oceans, and space science and engineering, students are expected to contribute to a discussion of current topics of interest in the literature. 1 cr. Cr/F.

955. Geophysical and Astrophysical Fluid Dynamics

The principles of fluid dynamics and magnetohydrodynamics, applied to the Earth's atmosphere and oceans and to space plasmas. Emphasis on common problems and techniques. Topics include mass, momentum, and energy conservation; static equilibria; quasigeostrophic flow; waves (acoustic-gravity, planetary, magnetoacoustic); surface waves in the ocean and in space; instabilities (convective, baroclinic Rayleigh-Taylor, Kelvin Helmholtz); boundary layer problems (Ekman layers, Stewartson layers, tearing modes; resonance absorption); supersonic flows (the solar wind,

shock waves). Prereq: MATH 845 and 846, or PHYS 931. (Also offered as PHYS 955.) 3 cr. (Not offered every year.)

964. Advanced Paleoclimate Analysis

Extensive readings and problem solving concerned with the interpretation of climate change focused on new developments in the interpretation of ice core records. Ice core records viewed as a framework for other proxy records of climatic change and as analogs for future change. Prereq: EOS 864 or ESCI 864;/or permission. (Also offered as ESCI 964.) May be repeated. 4 cr.

987. Magnetospheres

Introduces plasma physics of the interaction of solar and stellar winds with planets having internal magnetic fields, most predominantly, the Earth. Both MHD and kinetic descriptions of internal and boundary processes of magnetospheres as well as treatment of the interaction with collisional ionospheres. Flow of mass, momentum, and energy through such systems. Prereq: PHYS 951; 952; /or permission. (Also offered as PHYS 987.) 3 cr. (Normally offered every other year.)

988. High Energy Astrophysics

One-semester course on the physical principles underpinning the field of high energy astrophysics. Subjects covered include production, detection, and transport processes of neutral and charged high energy particles and photons. Emphasizes the applications of these processes to the detection and measurement problem and theory of telescope design. Uses astrophysical examples to illustrate the subject matter. First part serves as a basis for discussing the astrophysics of the heliosphere, including solar flares, galactic and solar cosmic rays, and the influence of the Earth's magnetic field on the cosmic rays. Prereq: PHYS 941; 942; 944. (Also offered as PHYS 988.) 3 cr. (Normally not offered every year.)

995. Special Topics in Earth, Oceans, and Space Science

1-4 cr.

Earth Sciences (ESCI)

Chairperson: Wallace A. Bothner

Professors: Franz E. Anderson, Francis S. Birch, Wallace A. Bothner, Wendell S. Brown, S. Lawrence Dingman, Henri E. Gaudette, Theodore C. Loder III, Paul A. Mayewski

Adjunct Professors: Eugene L.

Boudette, Anthony Jack Gow

Associate Professors: Jo Laird, Karen L. Von Damm

Research Associate Professors: Janet

W. Campbell, Patrick M. Crill, Jack E.

Dibb, Michael L. Prentice, Dork L.

Sahagian, Robert W. Talbot, Larry G.

Ward, Gregory A. Zielinski

Adjunct Associate Professors: Mark

E. Hines, Neal R. Pettigrew

Assistant Professor: John Matthew Davis

Research Assistant Professors:

Charles J. Vorosmarty, Cameron P. Wake

Graduate Program Coordinator:

Francis S. Birch

Degrees Offered

The Department of Earth Sciences offers the master of science and doctor of philosophy degrees in earth sciences with options in geology and oceanography and a specialization in geochemical systems. The department also offers the master of science degree in hydrology and specialization at the Ph.D. level.

Emphasis in the geology option may be placed upon petrology, mineralogy, structural geology, tectonics, geophysics, sedimentation, glacial geology, paleoclimates, glaciology, hydrogeology, stratigraphy, paleontology, low- or high-temperature geochemistry, and isotope geochemistry.

Concentration in the oceanography option may be placed upon chemical, geological, or physical oceanography. Although the broad scope of oceanography will be presented, the program emphasizes estuarine, coastal, continental margin processes and environments, and mid-ocean ridges.

The hydrology specialization is intended for students with an interest in fluvial processes, global-scale hydrology, groundwater hydrology, hydroclimatology, surface-water hydrology, water quality, and quantitative hydrology.

The geochemical systems specialization is intended for students with an interest in all aspects of geochemistry: bedrock, sediment, water, ice, and air with particular emphasis on interpreting and modeling the interaction of these media; biogeochemistry; and climate change. Students may also access this specialization through the Institute for the Study of Earth, Oceans, and Space.

Admission Requirements

An applicant is expected to have completed one year each of college chemistry, physics, and calculus; to have an undergraduate major or equivalent in geology, chemistry, physics, mathematics, engineering, or the biological sciences; and to present scores from the general test of the Graduate Record Examination. Students lacking some background in a particular area may be admitted provided they are prepared to complete courses,

without graduate credit, in which they may be deficient. The program of study (geology, hydrology, oceanography, or geochemistry) a student wishes to follow as well as the student's undergraduate major determines the level of necessary preparation. The preparation of each student is determined before the beginning of the first semester in residence in order to plan the course of study. Each entering student is assigned an academic adviser who assists the student in planning a program of study. Normally, students are required to have completed a master's degree before entering the Ph.D. program.

M.S. Degree Requirements

Students in the M.S. programs are required to complete the core curriculum for their respective areas. A minimum of 30 credits, which may include the credits accumulated in the core curriculum, must be completed satisfactorily. Students must complete a master's thesis and give an oral presentation of the results. All students are required to participate in the instructional activities of the department.

Geology The core curriculum for the option in geology normally includes 832, Regional Geology and Advanced Structure; 834, Applied Geophysics; 841, Geochemistry; and 997, 998 (Seminar in Earth Sciences, 1 cr. each semester of the first year).

Hydrology The core curriculum for the major in hydrology usually includes 805, Principles of Hydrology; 810, Groundwater Hydrology; and 997, 998 (Seminar in Earth Sciences, 1 cr. each semester of the first year).

Oceanography The core curriculum for the option in oceanography normally includes 852, Chemical Oceanography, 3 or 4 cr.; 858, Introductory Physical Oceanography; 859, Geological Oceanography; and 997, 998 (Seminar in Earth Sciences, 1 cr. each semester of the first year).

Geochemical Systems The core curriculum for the specialization in geochemical systems usually includes three courses from 841, Geochemistry; 846, Analytical Geochemistry; 847, Aqueous Geochemistry; 852, Chemical Oceanography; 864, Paleoclimate Analy-

sis; EOS 813, Biogeochemical Dynamics; EOS 815, Atmospheric and Precipitation Chemistry; and 997, 998 (Seminar in Earth Sciences, 1 cr. each semester of the first year).

In each of the above, additional electives are to be selected from 800- and 900-level courses in the department and/or from courses numbered 700 and above in related disciplines outside of the department. More detailed information is available from the department.

Ph.D. Degree Requirements

Course requirements for the Ph.D. program are flexible and are determined by the student's individual guidance committee. In addition, students are required to (1) have a reading knowledge of an appropriate foreign language; (2) pass a preliminary examination, given generally after one year of study; (3) pass a qualifying examination, given generally after two years of study; (4) complete significant original research presented in a dissertation; and (5) pass an oral defense of that work. Ph.D. students are also encouraged to obtain some appropriate teaching experience.

Emphasis in the Ph.D. program may be placed on geology, oceanography, geochemical systems, or hydrology.

803. Fluvial Hydrology

Mechanics of natural open channel flows: forces, the continuity and energy principles, velocity distributions, flow resistance, fluvial erosion and sediment transport, channel form, computation of flow profiles, weirs, hydraulic jumps, and streamflow routing. Lab and field exercises. Prereq: one year each of calculus and physics. Special fee. 4 cr.

805. Principles of Hydrology

Physical principles important in the land phase of the hydrologic cycle, including precipitation, snowmelt, infiltration and soil physics, and surface and subsurface flow to streams. Problems of measurement and aspects of statistical treatment of hydrologic data. Field trips. Transportation fee. Prereq: one year each of calculus and physics. Special fee. Lab. 4 cr.

808. Hydrology and Water Resources

Interrelations of hydrologic data and analysis with the environmental, economic, and legal aspects of water resources management. Examines local, national, and global water-resource problems. Prereq: ESCI 805; basic statistics;/or permission. 3 cr.

810. Groundwater Hydrology

Principles for fluid flow in porous media with emphasis on occurrence, location, and development of groundwater, but with consideration of groundwater as a transporting medium. Major topics include well hydraulics, regional groundwater flow, explo-

ration techniques, and chemical quality. Laboratory exercises involve use of fluid, electrical, and digital computer models to illustrate key concepts. Prereq: ESCI 805 or permission. Special fee. Lab. 4 cr.

815. Global Atmospheric Chemistry

Introduction to the principles of atmospheric chemistry and their relationship to biogeochemical cycles, climate, and global change. Focus is on understanding the basic physical and chemical processes that determine the trace gas distribution in the global troposphere. An introduction to atmospheric vertical structure and global circulation dynamics provides the foundation. Chemical cycles of important C, S, and N molecules examined, including their possible perturbation by human activities. Basic photochemical processes outlined, particularly with respect to reactive nitrogen hydrocarbons, and the production/destruction of ozone. Prereq: one year college chemistry. (Also offered as EOS 815.) 3 cr.

817. Macro-scale Hydrology I

Focus on the numerous roles of water in the Earth System. Topics include the global water cycle, impacts of the greenhouse effect and other anthropogenic disturbances, hydrologic modeling, soil-vegetation-atmosphere transfer schemes, water quality, GIS and water-related remote sensing tools. Based on extensive reading of current scientific literature, the students and instructor jointly select a research topic in macro-scale hydrology which will result in the preparation of a manuscript for publication in a refereed scientific journal. Course designed to be taken two consecutive semesters (fall and spring.) Prereq: principles of hydrology or permission. (Also offered as EOS 817.) 4 cr.

818. Macro-scale Hydrology II

Students and instructors jointly select a research topic in macro-scale hydrology to be analyzed in depth during the course of the semester. A primary goal is the preparation of a manuscript for publication in a refereed scientific journal. Extensive library research, reading of recent and relevant scientific literature, technical analysis, writing. Course designed to be taken two consecutive semesters (fall and spring.) Prereq: macro-scale hydrology I. (Also offered as EOS 818.) 4 cr. (Alternate years only.)

#825. Igneous Petrology

The evolution of igneous rocks as determined from field, petrographic, chemical, experimental, and theoretical studies. Application of thermodynamics to igneous petrogenesis. Physical properties of magmas. Prereq: mineralogy; petrography; adequate background in calculus, chemistry, and physics. Field trips. Special fee. Lab. 4 cr. (Offered alternate years with ESCI 826.)

826. Metamorphic Petrology

The metamorphism of pelitic, mafic, and calc silicate rocks as determined from field, petrographic, mineral chemistry, experimental, and theoretical studies. Closed- and open-system reactions, multisystems, reaction space. Calculation of pressure, temperature, time paths. Prereq: mineralogy; petrography; adequate background in calculus, chemistry, and physics. Field trips. Special fee. Lab. 4 cr. (Offered alternate years with ESCI 825.)

832. Regional Geology and Advanced Structure

Readings, discussion, and field/lab exercises in the

tectonic analysis of mountain systems. Emphasis on the northern Appalachian Orogen. Application of modern structural analysis. Prereq: structural geology or permission. Field excursion; lab fee. 4 cr.

834. Applied Geophysics

Gravity, magnetic, seismic, and electrical methods of investigating subsurface geology. Fieldwork and use of computers in data analysis. Prereq: one year of calculus; introductory geology; one year of college physics;/or permission. Special fee. Lab. 4 cr.

841. Geochemistry

Thermodynamics applied to geologic processes; geochemical differentiation of the earth; the principles and processes that control the distribution and migration of elements in geological environments; stable and radiogenic isotopes in geologic processes. Prereq: one year of mineralogy or permission. 4 cr.

845. Isotope Geochemistry

Discussion of element abundance and isotope formation; radioactive decay as applied to geologic systems, detailed investigation of K-Ar, Rb-Sr, U-Pb, and Sm-Nd systems, and geologic-oceanographic applications of stable isotopes. Lab involves mass spectrometric and chemical techniques of isotopic analysis. Course includes the completion of a laboratory project. Prereq: ESCI 841 or permission. Special fee. Lab. 4 cr.

846. Analytical Geochemistry

Introduction to the theory, instrumentation, and applications of analytical methods in geochemistry. Prereq: one year of chemistry or geochemistry;/or permission. Special fee. Lab. 4 cr.

847. Aqueous Geochemistry

Processes that determine the geochemical characteristics of water bodies. Emphasis on the geochemical continuum of terrestrial water and its geochemical evolution. Topics include the influence of cyclic salts, the nature of weathering reactions, the CO_2 - CaCO_3 system, the formation and dissolution of salts and authigenic mineral formation. Prereq: one year of chemistry or geochemistry;/or permission. Lab. 4 cr.

#850. Biological Oceanography

Biological processes of the oceans including primary and secondary production, trophodynamics, plankton diversity, zooplankton feeding ecology, microbial ecology, and global ocean dynamics. Emphasis on experimental approaches. Term project involves either development of an ecosystem model or performance of a field experiment. Field trips on R/V *Gulf Challenger* and to the Jackson Estuarine Laboratory. Prereq: one year of biology or permission of instructor. (Also offered as ZOOL 850.) 4 cr.

852. 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 *Gulf Challenger*. Prereq: permission. Lab (optional, special fee). 3 or 4 cr.

854. Modern Sediments

Examines recent sediments from their source area to the depositional environment. Emphasis on the shallow water clastic sediments and their charac-

teristic properties. The weekly laboratory is primarily concerned with aspects of textural and compositional analysis. New analytical techniques are compared with classical sediment analysis. Lab. 4 cr.

855. Analytical Techniques for Sediments

A laboratory course focusing on applied analytical techniques geoscientists use in sediment sampling; coarse- and fine-grained textural analysis, and some aspects of mineralogical composition. Special fee. Lab. 2 to 4 cr.

#856. Estuarine Sedimentation

Examines all aspects of estuarine sedimentation from erosion and transportation to deposition. Emphasis on fine-grained estuarine sediments and factors affecting particulate matter transport. Animal/sediment and plant/sediment interactions are considered in detail, including the salt marsh environment. Includes an in-depth field research project in the student's area of interest. Subject matter is relevant to students in related disciplines where animal/plant/sediment relationships are important. Lab. 4 cr.

858. Introductory Physical Oceanography

A descriptive treatment of atmosphere-ocean interaction; general wind-driven and thermohaline ocean circulation; waves and tides; continental shelf and near-shore processes; instrumentation and methods used in ocean research. Simplified conceptual models demonstrate the important principles. Prereq: college physics; introduction to oceanography;/or permission. 3 cr.

859. Geological Oceanography

Major geological features and processes of the ocean floor; geological and geophysical methods; plate tectonics. Prereq: permission. Lab. 4 cr.

860. Introductory Dynamic Oceanography

Basic physical laws governing ocean and atmospheric circulation under the influence of Earth rotation, density stratification, and friction. Topics include surface waves, wind-driven and thermohaline ocean circulation, ocean/atmosphere interaction, instabilities, fronts, and climate. Simplified mathematical models demonstrate the important principles. Prereq: college physics and differential equations or permission. (Also offered as EOS 860.) 3 cr.

862. Glacial Geology

The glacial environment: glacier dynamics and glacial erosion and deposition. Review of world glacial stratigraphy in light of causes of glaciation and climatic change. Field trips. Prereq: introduction to geology; geomorphology;/or permission. Special fee. Lab. 4 cr.

#863. Glacier Research

Glaciers as proxy indicators of climatic change with specific emphasis on the interpretation of physical and chemical time series collected from glaciers. Field and laboratory work is used as a tool in the course. Prereq: geomorphology; glacial geology; one year of college calculus; one semester each of college physics and chemistry;/or permission. 4 cr.

864. Introductory Paleoclimate Analysis

An overview of paleoclimate indicators for the last one million years in the context of global teleconnections (atmosphere-lithosphere-hydrosphere-cryosphere) and mathematical tools devel-

oped to interpret and link the different records of climate change. Prereq: one year calculus; one year chemistry; basic statistics;/or permission. (Also offered as EOS 864.) 4 cr.

865. Natural Climate Variability

Review of paleoclimate over the last billion years of Earth history with particular emphasis on paleoclimate indications and major events. Prereq: permission. (Also listed as EOS 865.) Lab. 4 cr. (Alternate years only.)

895, 896. Topics in Earth Sciences

Study on an individual or group basis in geologic, hydrologic, or oceanographic problems, under members of the graduate staff. Topics include: geochemistry, geomorphology, geophysics; glaciology; groundwater, structural, and regional geology; crystallography, mineralogy; petrology; thermodynamics; ore deposits; earth resource policy; paleontology; sedimentation; stratigraphy; water resources management; chemical, physical, and geological oceanography; earth systems; earth science teaching methods. Prereq: permission of staff concerned. May be repeated. 1-4 cr.

903. 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: ESCI 805; computer methods; basic statistics. 3 cr.

904. Contaminant Hydrology

Physical mechanisms of the migration and dispersion of miscible and immiscible contaminants through the saturated and unsaturated zone. Deterministic and stochastic models of transport phenomena including both analytical and numerical solutions. Term project. Prereq: groundwater hydrology; college chemistry; and computer methods. 3 cr. (Offered alternate years.)

906. Statistical Hydrology

Application of statistical principles to hydrologic problems. Covers laws of probability; parameter estimation; discrete and continuous distributions of importance in hydrology, inference, regression and multivariate analysis, and elementary time series analysis. Prereq: ESCI 805; basic statistics;/or permission. 4 cr. (Offered alternate years with ESCI 803.)

907. Geostatistics

Introduction to statistical methods of quantifying spatial variability with emphasis on the application of these methods to the earth and environmental sciences. Topics include sampling strategy; variography; kriging; simulation; and Monte Carlo techniques. Prereq: basic statistics or permission. 3 cr. (Offered alternate years.)

934. Advanced Applied Geophysics

Exploration methods including gravity, magnetics, electromagnetics, and seismics at an advanced level. Modern methods of interpretation as well as basic physics and geological applications. Prereq: ESCI 834; elementary computer programming; differential equations recommended. Lab. 4 cr. (Not offered every year.)

#942. Sedimentary Geochemistry

Chemistry of recent and ancient estuarine, marine, and lacustrine sediments, emphasizing both kinetic and thermodynamic principles in the understanding of biogeochemical processes, authigenic mineral formation, and pore water chemistry in these environments. 3 cr. (Offered alternate years.)

952. Advanced Chemical Oceanography

Readings on physical, chemical, and biological processes that affect the distribution of chemical components in estuaries and the open ocean. Lab includes projects investigating selected processes. Prereq: ESCI 852 or permission. 3 or 4 cr.

#954. Advanced Sedimentation

Extensive readings and discussions of original sources and relevant literature dealing with sedimentation concepts. Field project directed toward prethesis research. Prereq: ESCI 854; 856;/or permission. 2–4 cr. (Not offered every year.)

958. Dynamical Oceanography

The hydrodynamics of such ocean phenomena as waves, tides, and ocean turbulence; wind-driven circulation on the continental shelf and deep ocean is treated in detail. Prereq: ESCI 858; ME 807;/or permission. 3 cr. (Not offered every year.)

959. Data Analysis Methods in Ocean and Earth Sciences

Methods of analysis of oceanographic, geophysical, geological, and environmental data. Introductory tutorial on important mathematical concepts precedes the development of the bases for a number of data analysis techniques; digital filtering, regression analysis, cross-spectral analysis, objective analysis, and elementary inverse theory, etc. Students use these techniques on real data. Prereq: differential equations or equivalent. 4 cr.

#962. Glaciology

Physical principles controlling glacier activity and the implications of glacier activity in the context of current scientific problems. Prereq: geomorphology; glacial geology; one year of college calculus; one semester each of college physics and chemistry;/or permission. Lab and/or field project optional. 3 or 4 cr. (Offered alternate years.)

964. Advanced Paleoclimate Analysis

Extensive readings and problem solving concerned with the interpretation of climate change focused on new developments in the interpretation of ice core records. Ice core records viewed as a framework for other proxy records of climatic change and as analogs for future change. Prereq: ESCI 864 or EOS 864;/or permission. (Also offered as EOS 964.) May be repeated. 4 cr.

996. Advanced Topics in Earth Sciences

Advanced work on an individual or group basis. Sections of this course are the same as those listed under ESCI 895, 896. Prereq: permission of staff concerned. May be repeated. 1–4 cr.

997, 998. Seminar in Earth Sciences

Introduction to research in the earth sciences and development of thesis proposals. Required of all M.S. students in Earth Sciences. 1 cr.

899. Master's Thesis

6 cr. Cr/F.

999. Doctoral Research**Economics (ECON)**

Chairperson: Richard W. England

Professors: Richard W. England, Evangelos O. Simos

Associate Professors: William D. Bradford III, Karen Smith Conway, Bruce T. Elmslie, Michael D. Goldberg, Marc W. Herold, Richard L. Mills, Neil B. Niman, Torsten Schmidt, Allen R. Thompson, James R. Wible

Graduate Program Coordinator: Torsten Schmidt

Degrees Offered

The economics program offers the master of arts and the doctor of philosophy degrees.

The master of arts degree in economics may be a final degree for certain occupations and professions. Most students complete the program as a general rather than a specialized degree. The same fields of concentration in the Ph.D. program are available to the master's student as long as appropriate prerequisites are met.

The doctoral program in economics is intended for those students who are interested in research and teaching. The program has the following key features: a series of core courses, two fields of concentration, several significant research requirements, comprehensive exams in economic theory and two fields of concentration, and proficiency in one foreign language. Fields of concentration are environmental and energy economics, growth and development, industrial organization, and international economics.

In addition to these requirements, Ph.D. students may opt to seek the cognate in college teaching. This program, pursued simultaneously with the Ph.D., systematically trains students in pedagogical methods to prepare them for the challenging transition to teaching economics at the college level. The culmination of the cognate is the preparation and defense of a teaching portfolio. A notation appears on the student's transcript when the Cognate in College Teaching is awarded.

The economics program is offered through the Whittemore School of Business and Economics. The school's mission statement can be found under the M.B.A. program description.

Admission Requirements

In addition to requirements established by the Graduate School, the results from the Graduate Record Examination general test must be presented.

The master's program seeks students whose undergraduate experience provides evidence of superior ability and indicates the promise of serious scholarship. Undergraduate preparation will usually include exposure to economic reasoning and methodology, including mathematics and statistics. For those whose backgrounds are deficient, remedial work is available.

The doctoral program expects a master's degree in economics. Previous graduate study of economics is required.

M.A. Degree Requirements

Every student must meet the general requirements of the Graduate School and the following requirements of the major:

1. At least 30 total semester hours, which may include 6 hours of thesis;
2. Of the total hours:
 - a. a minimum of 12 hours *must* be in 900-level courses. These courses must be ECON 972 (Macroeconomics I), ECON 976 (Microeconomics I), and ECON 926 (Econometrics I);
 - b. in addition, 2 hours *must* be in the Graduate Economics Seminar;
 - c. a maximum of 4 credit hours *may* be taken in related disciplines in approved 700-level and above courses;
 - d. the remaining credit hours are to be taken in 800-level and above courses.
3. Written evidence of proficiency in economic theory (either by passing the qualifying examination in economic theory or by completing a thesis).

Additional requirements may be associated with the concentrations in environmental and energy economics, growth and development, industrial organization, and international economics. Further information about fields of concentration can be obtained from the department chair. A concentration is not required.

Ph.D. Degree Requirements

Ph.D. candidacy requires the following:

1. Completion of core courses:
 - Microeconomics I and II
 - Macroeconomics I and II
 - Econometrics I and II
 - History of Economic Thought

Topics in Economic Thought and Methodology;

2. Comprehensive exams in microeconomics and macroeconomics;
3. Completion of two fields of concentration (including an exam in each field);
4. Participation in the General Economics Seminar for four semesters;
5. Participation in a research workshop for two semesters;
6. Demonstrated knowledge of one foreign language; and
7. An accepted dissertation proposal.

There are eight core courses in the program. The two theory exams may be taken separately. Each of the two fields of concentration consists of two sequentially related courses. A continuously integrated approach to research is a highlight of the program. Ph.D. students are required to enroll in the Research Workshop where student and faculty research in progress as well as finished projects are presented. While this usually occurs in the third year, students are encouraged to participate informally in the workshop as early as the first year. This activity brings together students and faculty members and encourages the transition from course-related activities to proposing a dissertation topic. The student's formal presentation of a dissertation proposal takes place in the Research Workshop.

To complete the Cognate in College Teaching program, a student must submit, and have accepted, a letter of application with a curriculum vitae to the graduate dean after at least one year of full-time graduate studies in economics. Admission to the cognate will be decided by the graduate dean, based upon recommendations of the economics graduate program coordinator and Teaching Excellence Program director. The student must complete specific coursework: GRAD 950, Issues in College Teaching (3 credits total, 1-credit seminar offered every semester and summer); ECON 898, Teaching of Economics (4-credit seminar, offered every other year); and GRAD 990, College Teaching Praxis (3-credit course, to be completed at least twice during two or more semesters). Finally, the student must submit an approved teaching portfolio. Upon completion of all of these requirements, the Cognate in College Teaching is awarded and noted on the graduate transcript. The cognate cannot be awarded except in conjunction with the Ph.D., and none of the course

requirements for the cognate can substitute for requirements for the Ph.D.

Information about fields available for the dissertation as well as other details about the doctoral program can be obtained from the department chair.

807. Economic Growth and Environmental Quality

Analysis of the interrelationships among economic growth, technological change, population increase, natural resource use, and environmental quality. Application of alternative theoretical approaches drawn from the social and natural sciences. Focus on specific environmental problems, e.g., health effects of air pollution and environmental impact of technology transfer to less-developed nations. 4 cr.

811. Economic Fluctuations

Recurrent movements of prosperity and depression; emphasis on causes and public-policy implications. 4 cr.

#815. Marxian Economic Analysis

Analyses of capitalism by Marx and contemporary Marxists. Discussion of social class, values and prices, technical change, capital accumulation, and socioeconomic crises. 4 cr.

820. 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; noneconomic factors. 4 cr.

825. Mathematical Economics

Principal mathematical techniques and their application in economics. Topics covered: matrix algebra, derivatives, unconstrained and constrained optimization, linear and nonlinear programming, game theory, elements of integral calculus. 4 cr.

828. Time Series Analysis

Examines the role of time series in forecasting. Studies modern time series models, with particular emphasis on Box-Jenkins methods. Prereq: introductory statistics. (Also offered as ADMN 842.) 3 cr.

#835. 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. 4 cr.

836. Seminar in Monetary Theory and Policy

Contemporary developments in monetary theory and the evaluation of policy measures. 4 cr.

#841. Introduction to Public Policy

Explores the basic issues of public sector economics and emphasizes the use of economic theory in predicting the effects of public policy on individual behavior and the overall economy. Specific topics include market failures, collective decision making, cost/benefit analysis, and an evaluation of tax and transfer programs. 4 cr.

845. International Trade

Contemporary issues in international economic theory and policy. Analysis of trade theory, dynamics of world trade and exchange, and international commercial policy. 4 cr.

846. International Finance

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

847. Multinational Enterprises

The internationalization of economies. Growth and implications of the multinational corporation at the level of systems. Theories of imperialism, international unity/rivalry; theories of direct investment; the exercise of influence and conflict, technology transfer, bargaining with host country; effects on U.S. economy. 4 cr.

#856. Labor Economics

Recent developments in labor market analysis and public policies related to contemporary labor issues. Labor supply, the structure and stratification of labor markets, economic discrimination, unemployment and poverty, inflation, and wage-price controls. 4 cr.

868. Seminar in Economic Development

An advanced reading seminar. Topics include methodologies underlying economic development theory, industrialization and post-import substitution, state capitalist development, stabilization policies, appropriate technologies, the capital goods sector, agricultural modernization schemes, and attempts at transition to socialism. 4 cr.

#869. Case Studies in Economic Development

A) Southeast Asia; B) Cost-Benefit and Project Analysis; C) Africa; D) Latin America; E) Middle East. Problems and policies in selected countries; evaluations of national plans, programs, and projects; comparative analysis. 4 cr.

#874. Economic Dynamics

Use of difference and differential equations for analysis of dynamic properties of single-equation and system wide models in micro- and macroeconomics. Economic and business applications of optimization over time using advanced mathematical techniques such as calculus of variations and control theory. Prereq: mathematical economics; macroeconomics I; microeconomics I. 4 cr.

#878. Economics of Centralized and Mixed Systems

Origins of planning; planning agriculture and industry; growth models; input-output and material balances; optimal planning; value and prices in socialist economics; economic reforms and mixed systems; and theories about the nature of socialist societies. Mechanisms of centralized planning in their sociohistorical context. Prereq: macroeconomics I; microeconomics I; or permission. 4 cr.

898. Economic Problems

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

926. Econometrics I

Application of statistical and econometric methods to problems in economics. Topics: basic statistical theory, simple and multiple regression, violations of the basic assumptions, generalized least squares,

and introduction to simultaneous equation models. Prereq: undergraduate statistics course. 4 cr.

927. Econometrics II

Simultaneous equation models, nonlinear estimation, qualitative and limited-dependent variables, distributed lag models, introduction to time series (ARIMA) models, pooling of cross-section and time series models. Prereq: econometrics I or its equivalent. 4 cr.

957. History of Economic Thought

Traces the development of economic thought, with careful examination and critical appraisal of the contributions made by important figures and schools of thought. 4 cr.

958. Topics in Economic Thought and Methodology

Advanced seminar in a selected topic in economic thought or methodology. 4 cr.

972. Macroeconomics I

Development of the major macro models and approaches to macroeconomics: classical, Keynes' *General Theory*, Keynesian, Monetarist, New Classical, and New Keynesian models and views. An introduction to open economy macro models. 4 cr.

973. Macroeconomics II

Theory, empirical specification, and tests of macroeconomic functions. National econometric models. Theories and empirical models of the business cycle and economic growth. Use of models for policy analysis and forecasting. Prereq: macroeconomics I; econometrics I. 4 cr.

976. Microeconomics I

Survey and applications of modern microeconomic theory. Analysis of households, firms, product and resource markets, public goods, and behavior under uncertainty. 4 cr.

977. Microeconomics II

Analysis of stability, cooperative and noncooperative game theory, information economics, exhaustible resources, disequilibrium, public choice, and input-output analysis. Prereq: microeconomics I. 4 cr.

988. Graduate Economics Seminar

Required of all first-year graduate students. 1 cr.

995. Independent Study

Prereq: permission of adviser and instructor. 1-6 cr.

996. Research Workshop

A) Finance; B) Political Economy; C) Labor Economics; D) Econometrics; E) Resource Economics; F) International Development; G) Macroeconomics. 2 cr. Cr/F.

899. Master's Thesis

8 cr. Cr/F.

999. Doctoral Research

Education (EDUC)

Chairperson: Susan D. Franzosa

Professors: Michael D. Andrew, Angelo V. Boy, Ann L. Diller, Susan D. Franzosa, Jane A. Hansen, David J. Hebert, Barbara E. Houston, Bruce L. Mallory, Sharon N. Oja

Associate Professors: Charles H. Ashley, John J. Carney, Grant L. Cioffi, Ellen P. Corcoran, Todd A. DeMitchell, Janet Elizabeth Falvey, Virginia E. Garland, Georgia M. Kerns, Barbara H. Krysiak, Judith A. Kull, Rebecca S. New, Jane A. Nisbet, Joseph J. Onosko, Thomas H. Schram, M. Daniel Smith, William L. Wansart, Dwight Webb

Adjunct Associate Professor: Harry J. Richards

Assistant Professors: Eleanor D. Abrams, Richard M. Barton, Ann L. Loranger, Paula M. Salvio, Ruth M. Wharton-McDonald

Graduate Program Coordinator: Todd A. DeMitchell

The Department of Education is part of the UNH Unit for Professionals in Education. The unit's mission is to prepare professional educators who are excellent practitioners and leaders. All professional programs offered by the Department of Education are accredited by the National Council for the Accreditation of Teacher Education and are approved by the New Hampshire State Department of Education.

Degrees Offered

The Department of Education offers a variety of programs leading to the master's degree, the doctor of philosophy degree, and the certificate of advanced graduate study.

The master of arts is offered in counseling. The master of arts in teaching is offered in elementary and secondary education. The master of education is offered in administration and supervision, counseling, early childhood education (including an option in special needs), elementary education, reading, secondary education, and special education. Special education certification is also available to those who complete the M.A.T. or M.Ed. programs in either elementary or secondary education.

The certificate of advanced graduate study is offered in educational administration and supervision. The doctor of philosophy is offered in education and in reading and writing instruction.

The master of science for teachers is offered through the Departments of Chemistry, English, and Mathematics; the master of science in music education is offered through the Department of Music. (See those departments for information.)

Most programs are available to part-time admitted graduate students. Since not all courses are offered each semester, students should consult the current *Time and Room Schedule* for course offerings.

Admission Requirements

In addition to the materials required by the Graduate School, each application must include recent Graduate Record Examination general test scores and a thoughtful, well-written statement of purpose for undertaking graduate study in a particular program.

Individual programs within the department may have additional admissions requirements. Applicants should refer to specific program descriptions. Consultation with a program faculty member is recommended. In all cases, the applicant's relevant experience, references, and professional goals will be considered in the admission process.

Action on applications to Department of Education programs varies by individual program. Admission to programs in early childhood education, educational administration and supervision, and reading is on a rolling basis. Applications for teacher education, counseling (part-time) and special education are acted on during the fall and spring semesters, following deadlines noted in the Graduate School application. Applications for full-time study in the counseling M.Ed. and M.A. programs, as well as the Ph.D. programs in education and reading and writing instruction are acted on only in the spring, following deadlines noted in the Graduate School application. [The middle 50 percent of students admitted to all graduate programs in education during the years 1995 to 1997 scored between 430 and 550 on the verbal section of the GRE, 450 to 600 on the quantitative section, and 460 to 650 on the analytical section. They also had an average undergraduate grade-point average between 2.93 and 3.41.]

Doctor of Philosophy in Education

Program information: Ann Diller

The Department of Education offers the degree of doctor of philosophy in education with specialization in fields related to curriculum and instruction, educational administration, or teacher development. We seek to prepare educational leaders by assisting them in the construction of knowledge and skills necessary for clear, appropriate educational decisions based on systematically and theoretically derived information. The program engenders a broad understanding of the field of education as well as focused and scholarly inquiry. The Ph.D. in education provides students with the experiences for distinguished educational leadership in the profession via research on teaching and learning. The course of study prepares students to serve as coordinators and administrators in schools, faculty members at colleges and universities, and specialists in other private or public educational settings.

Programs for the doctoral degree in education are planned individually by the students and their guidance committee. Students must also meet specific university, department, and program requirements. Applicants should contact the department for further information on opportunities and requirements.

Admission Students admitted to the program will normally have completed a master's degree in education or a related field and will have worked full time as an educator at the elementary, secondary, or college level. Entering students are expected to have completed graduate-level coursework in educational psychology, curriculum and instruction, educational structure and change, and the philosophical and social foundations of education. Exceptional candidates who do not meet all these prerequisites will be considered.

To apply, candidates must submit a graduate school application, transcripts of all undergraduate and graduate coursework, and Graduate Record Examination (GRE) general test scores. Candidates must also submit an extended personal essay in addition to the statement required on the graduate school application. On-campus interviews are recommended.

Degree Requirements Candidates for the degree must (1) meet admission re-

quirements, (2) develop and complete an approved program of study in consultation with their guidance committee, (3) complete required core coursework, (4) pass a qualifying examination to advance to candidacy, (5) establish a dissertation committee, (6) develop an approved dissertation proposal, (7) write and present the dissertation, and (8) pass the final oral examination.

Program of Studies During the first year of study, students will identify, in consultation with their advisers, faculty members to serve as a guidance committee. These members will be appointed by the dean of the Graduate School. A program of study developed by the student and the guidance committee will include common core courses: Proseminar in Doctoral Studies, Normative Inquiry in Education, Methods and Techniques of Educational Research, and Issues and Methods of Ethnographic Research; focused and specialized coursework; integrative coursework across areas of inquiry; and appropriate electives. Typically, students complete 60 hours of graduate credit following their matriculation. Specific course requirements will be established by the guidance committee.

Qualifying Examination Written qualifying examinations are developed by the student's guidance committee in consultation with the coordinator of the Ph.D. in education and other faculty members. Qualifying examinations are administered after a student has completed at least two-thirds of his or her coursework. Following successful completion of the qualifying examination, the student proposes a topic for dissertation research. He or she is then advanced to candidacy, and a dissertation committee is appointed by the dean of the Graduate School.

Dissertation To complete the degree, the student must present and defend a dissertation of original research and publishable quality.

Doctor of Philosophy in Reading and Writing Instruction

Program information: Jane Hansen

The primary purpose of the Ph.D. program in reading and writing instruction

is to prepare students who will conduct research and successfully publish accounts of their work. Our students become leaders who advocate changes in literacy instruction. We want to create classrooms in which the voices of students, as well as those of the teachers, are honored. Within the program and beyond, students study the theory and practice of teaching reading and writing as related processes. Research is usually conducted in natural environments, and study within this program is on a full-time basis. Students' backgrounds vary: some are educators interested in adult education, others concentrate on preschool education. Program graduates work in universities, colleges, and various public or private educational settings.

Admission Requirements Applicants must have at least three years of teaching experience. Although most of our students have a master's degree, it is not required for admission. Applicants must submit a Graduate School application (except for the personal statement); a supplement to the Graduate School application (available from the Writing Lab in the education department); transcripts of all previous coursework; and Graduate Record Examination (GRE) general test scores. We also encourage applicants to come to the university and meet the faculty and students in the department.

Degree Requirements As part of the interdisciplinary program, students will take courses outside of education in the Department of English and at least one other university department. The program has two required courses, an 8-credit seminar in literacy, language, and culture, and a 4-credit seminar in reading. With faculty assistance, students design a course of study that will ensure they gain expertise in reading and writing instruction, language development and learning, and processes of conducting research. Once they have completed nearly all of their coursework, students will take a qualifying examination. Passing this exam advances students to degree candidacy. They then meet with a committee to discuss the proposal for their dissertation. Once the dissertation is complete, they will then defend their work in an oral session. Students can complete the degree in three years, with two years of concentrated coursework and a third for their dissertation.

Administration and Supervision

Program information: Charles Ashley, Richard Barton, Todd DeMitchell, Virginia Garland

The Department of Education, in general, and the program in administration and supervision, in particular, are responsible for training educational leaders. Many research studies on effective schools have underscored the pivotal role that strong leadership plays in building and sustaining the health of a good school. The program in administration and supervision fulfills the important mission of training leaders for New Hampshire's schools as well as the nation's schools.

The Department of Education offers the degree of master of education and the certificate of advanced graduate study in educational administration and supervision.

Master of Education The program is designed for the experienced teacher who wishes to become qualified in the broad area of supervision and administration, grades K–12. Emphasis is on the elementary and secondary school principalship and instructional supervision.

The requirements for the degree include the following:

Core requirements (28 credits): 953, Seminar in Curriculum Study; 961, Public School Administration; 962, Educational Finance and Business Management; 965, Educational Supervision; 967, Legal Aspects of School Administration; 969, Practicum in Educational Administration; and 972, Educational Program Evaluation.

Electives (8 credits): Selected in consultation with the program adviser.

Concluding experience: A degree candidate must successfully complete one of the following: a comprehensive oral examination based on a set of theses statements prepared by the candidate or a major research study related to school administration, curricula, or educational supervision.

Certificate of Advanced Graduate Study This program is designed for those who possess a master's degree in school administration or graduate study supplemented by work experience that is equivalent to that outlined in the Univer-

sity 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. This program requires 40 credits.

The certificate program requires the following:

Core requirements (20 credits): C.A.G.S. students may select any five of the following six core courses: 964, Personnel and Communication in Educational Organizations; 968, Collective Bargaining in Public Education; 970, The Change Process in Education; 971, School Facilities Management; 973, Analysis of Educational Policy; and 977, Leadership: The District Level Administrator.

Electives (8 credits): Electives are selected in consultation with the program adviser.

Concluding experience (12 credits): A student must complete a significant field project and field internship in an appropriate administrative setting.

Counseling

Program information: Angelo Boy, J. Elizabeth Falvey, David Hebert, Dwight Webb

The graduate program in counseling prepares graduates to function as professional counselors in a variety of institutions and agencies dedicated to psychological and educational development. The program is designed to produce professional counselors who are able to integrate theory and practice and provide professional leadership.

The Department of Education offers the degrees of master of arts and master of education. The master of arts and the master of education programs prepare counselors to function in a variety of professional settings.

Master of Arts The master of arts in counseling program has the following requirements:

Core requirements (48 credits): 920, Counseling Theory and Practice; 921, Psychology of Career and Personal De-

velopment; 922, Assessment in Counseling; 923, Group Counseling; 924, Psychological Disorders and Adaptation; 925, Counseling Internship I; 926, Counseling Internship II; 927, Theories of Personality; 928, Family Counseling; 929, Advanced Counseling Internship; 930, Research in Counseling; 931, Clinical Diagnosis and Treatment Planning in Counseling.

Electives (8 credits): Selected in consultation with the student's adviser. Additional coursework in statistics and research methodology is frequently required in order to complete the thesis.

Concluding experience (6 credits): A degree candidate must complete a research thesis.

Master of Education The master of education in counseling requires the following:

Core requirements (28 credits): 920, 921, 922, 923, 924, 925, and 926 (see course titles above under master of arts core requirements).

Electives (8 credits): Selected in consultation with the student's adviser.

Concluding experience: A degree candidate must successfully complete a comprehensive essay examination.

Early Childhood Education

Program information: Bruce L. Mallory, Rebecca S. New

The Department of Education offers the master of education degree in early childhood education and an option in special needs. Certification as an early childhood teacher (K–3) is available.

This program is an advanced course of study designed for teachers, administrators, and other early childhood practitioners who wish to improve their professional competence and broaden their career opportunities. The program emphasizes the acquisition of knowledge and competencies in child development (birth through eight years), learning environments, developmentally appropriate curriculum, developmental and cultural diversity, and professional leadership. The coursework culminates in extensive field-based experience.

Admission requirements: All admitted students are expected to have had at least one course in child development at the upper-division level and at least 200 hours of supervised classroom experience with children from birth through eight years of age, or the equivalent.

Core requirements (30 credits): 941, Child Development for the Early Childhood Professional I; 942, Child Development for the Early Childhood Professional II; 943, Environments for Early Childhood Education; 944, Curriculum for Early Childhood Education; 948, Leadership and Advocacy in Early Childhood Education; one course selected from the special needs option courses offering (EDUC 860, 947, 951, 952, 955, or 956); and two semesters (6 credits) of internship in EDUC 900B and 901B.

Electives (6 credits): Selected in consultation with the program adviser.

Concluding experience: A degree candidate must successfully complete one of the following: a comprehensive written and oral examination, or a research thesis.

Special Needs Option In addition to the early childhood core requirements described above, students choosing this option will concentrate on young children who are at risk for, or have, developmental difficulties and special needs. Coursework emphasizes an understanding of the role of the family, community, and social policy in early development and intervention. The program is noncategorical in its approach to assessment and educational planning.

Core requirements (38 credits): Identical to core requirements of early childhood program with addition of 860, Introduction to Young Children with Special Needs; 947, Curriculum for Young Children with Special Needs: Evaluation and Program Design; and 949, Supporting Parents of Students with Special Needs.

Electives (4 credits): Selected in consultation with the program adviser.

Concluding experience: A degree candidate must successfully complete one of the following: a comprehensive written and oral examination or a research thesis.

Reading

Program information: John Carney, Grant Cioffi, Jane Hansen, Paula Salvio

The graduate program in reading prepares reading specialists and teachers to provide instruction and leadership in literacy in a variety of educational contexts. The instructional sequence integrates theory, research, and instructional practice, and incorporates field-based and clinical components. Particular emphasis is placed on the interrelationship of reading and writing. Graduates of the program provide direct instruction in literacy and offer leadership in organizing, managing, and evaluating literacy programs.

The program's requirements are as follows:

Core requirements (28 credits): 907, Foundations of Reading Instruction; 908-909, Clinical Diagnosis and Remediation of Reading Difficulties and Disabilities; 910, Comprehensive Reading Methods in the Secondary School; 913, Field Practicum; 914, Seminar in Reading. Choose one of the following: 834, Children's Literature; 876, Reading for Children with Special Needs; 906, Language Arts through Reading and Writing; 980, Research in the Teaching of Writing.

Electives (8 credits): Selected in consultation with the program adviser. A student using the research thesis option as a concluding experience will use the 8 credits for EDUC 899, Master's Thesis.

Concluding experience: A degree candidate will successfully complete one of the following: a written examination or a research thesis.

Special Education

Program information: Georgia Kerns, Bruce L. Mallory, Jane A. Nisbet, William Wansart

The special education program prepares highly qualified educators who possess the knowledge, dispositions, and skills necessary to take the lead in establishing effective teaching and learning environments for a diverse population of learners, who are capable of collaborating with classroom teachers as team leaders or consultants, and who utilize these skills

within their school communities, and within the profession itself. The program meets current certification requirements in the State of New Hampshire.

Degree Requirements Prerequisites: All candidates are required to complete a course in mathematics teaching methods and a course in reading teaching methods. All candidates who have not already done so are required to complete an introductory course in exceptionality (e.g., 850, Introduction to Exceptionality) and an introductory course in special education methods (e.g., 851, Educating Exceptional Learners) with credits not to be counted toward the M.Ed. degree.

Core requirements (18-24 credits): 900C and 901C, Internship and Seminar/General Special Education; 939, Assessment of Children with Learning Difficulties; 940, Teaching Children with Learning Difficulties; and 949, Supporting Parents of Students with Special Needs.

Specialized courses (8 credits): Selected in consultation with the program adviser from courses in special education, or other related areas as appropriate.

Advanced courses (8 credits): 938, Advanced Seminar in Special Education; 981, Methods and Techniques of Educational Research.

Electives (4 credits): Selected in consultation with adviser. Students with no previous teaching certificate must complete at least 8 credits in elementary or secondary education courses in addition to reading and mathematics prerequisites.

Concluding experience: All degree candidates must complete, with a defense, a major curriculum project, action research project, or a research thesis. The thesis typically involves an additional 6 to 10 credits.

Teacher Education

Program information: Michael Andrew, Gerry Crocker

The teacher education program prepares teachers who possess the knowledge, disposition, and skills necessary to take the lead in establishing effective teaching and learning environments within their own classrooms, their school communities, and within the profession itself.

The Department of Education offers the master of arts in teaching degree in elementary and secondary education for those seeking initial teacher licensure, and the master of education degree in elementary and secondary education both for those seeking teacher licensure and for experienced teachers.

Applicants to teacher education programs are evaluated on the following criteria: undergraduate academic record, Graduate Record Examination (GRE) general test scores, and letters of recommendation regarding academic ability, motivation, interpersonal skills, and potential for success as a teacher. Those seeking admission to programs leading to teacher licensure should also have a positive recommendation from EDUC 500, Exploring Teaching, or equivalent experience.

In our admissions process, we seek evidence that our students have the following knowledge, abilities, and dispositions: (1) motives to teach that include a strong social commitment to contribute to society through education; (2) a disposition to care for their students—each and every one; (3) an ability to interact positively with children and adults; (4) a capacity to win the respect of their peers and be effective in group interaction, showing openness to the needs and views of others; (5) well-developed communication skills, including speaking, writing, and listening skills as well as an ability to engage others in both the giving and receiving of information and feelings; (6) perceptiveness—the ability to identify and process the relevant details in their environment, especially in the context of a classroom; (7) the ability to make reasonable judgments in a context of complex situations that change from moment to moment; (8) the capacity for clear thinking and an ability to translate their thoughts into simple and clear explanations; (9) superior academic skills, extensive knowledge of at least one major discipline, intellectual curiosity, the ability to be open to the unknown, and the willingness to tolerate uncertainty in the face of enormous pressure to deny it; (10) a disposition to take charge of their own learning, which includes the active pursuit of feedback and the willingness to take thoughtful risks.

Any course taken in the Department of Education that will be used to fulfill a teacher licensure requirement must be completed with a grade of B- or better.

Master of Arts in Teaching and Master of Education Programs for Those Seeking Teacher Licensure These programs are designed for two types of students: (1) those UNH undergraduates who anticipate completing the Five-Year Teacher Preparation Program at UNH and (2) those who completed an undergraduate degree either at UNH or elsewhere with little or no coursework in education. The programs lead to teaching licensure at the elementary and secondary levels. Admission to these programs is highly competitive.

Licensure requirements that must be met prior to or as part of the master's degree program include completion of 4 credits or an equivalent in each of the following: 500, Exploring Teaching; 800, Educational Structure and Change; 801, Human Development and Learning: Educational Psychology; 803, Alternative Teaching Models; 805, Alternative Perspectives on the Nature of Education; 900A, 901A, Internship and Seminar/Teaching (6 credits each).

Elementary teacher licensure requirements include two additional courses: 806, Introduction to Reading Instruction in the Elementary Schools, or 907, Foundations of Reading Instruction; and one mathematics course appropriate to preparation for teaching in an elementary school.

All students recommended for teacher licensure receive academic preparation in working with exceptional children, which is integrated throughout licensure coursework. Those pursuing teacher licensure in art, biology, chemistry, earth sciences, general science, home economics, physical education, physics, or social studies must also complete EDUC 807, Teaching Reading through the Content Areas (2 credits).

Credits earned in the seven-week Live, Learn, and Teach summer program may be applied toward the master's degree. Live, Learn, and Teach satisfies the EDUC 500, Exploring Teaching requirement; 4 credits of EDUC 935, Seminar and Practicum in Teaching; 4 credits of 800A, Educational Structure and Change; and 2 credits of 803H, Experiential Curriculum.

Preparation for licensure in general special education is available to those who complete the M.A.T. or M.Ed. programs in either elementary or secondary education. This licensure allows recipients to serve as general special education teachers. In order to qualify for licensure

in general special education, students must complete 22 credits (18 of which may be used toward the M.Ed. degree, or 6 toward the M.A.T. degree); a reading methods course; a mathematics methods course; 850, Introduction to Exceptionality; 851, Educating Exceptional Learners; 939–940, Assessment and Teaching of Children with Learning Difficulties; 900, 901, Internship and Seminar (6 credits).

Master of Arts in Teaching (Elementary and Secondary) The master of arts in teaching program is most appropriate for students who wish to do a portion of their graduate study outside the Department of Education in their major teaching field or associated fields.

The program has the following requirements:

Core requirements: 800, Educational Structure and Change; 801, Human Development and Learning: Educational Psychology; 803, Alternative Teaching Models (or required methods course); 805, Alternative Perspectives on the Nature of Education; 900A, 901A, Internship and Seminar/Teaching (in addition, for elementary licensure: 806, Introduction to Reading Instruction in the Elementary Schools, or 907, Foundations of Reading Instruction; and one appropriate mathematics course). An additional 12 credits outside the Department of Education related to the student's teaching field are selected to form a concentration. Secondary candidates may apply a methods course taken outside the Department of Education to the concentration.

Electives (up to 6 credits): Selected in consultation with the program adviser.

Concluding experience: A degree candidate must successfully complete one of the following: a project related to the internship, a comprehensive oral examination based on a set of theses statements prepared by the student, or a research thesis (6–10 credits).

Master of Education (Elementary and Secondary) This master of education degree is most appropriate for those students who wish to concentrate their graduate study in the Department of Education.

The program has the following requirements:

Core requirements: Core requirements are identical to those for the master of arts in teaching degree. Twelve credits within the Department of Education are selected to form a concentration. Elementary education candidates may apply 806 or 907 toward this concentration.

Electives (up to 6 credits): Selected in consultation with the program adviser.

Concluding experience: Concluding experiences are the same as those for the master of arts in teaching degree.

Master of Education for Experienced Teachers (Elementary and Secondary) This program is designed to extend the vision of the preservice program to experienced teachers who wish to remain in the classroom but expand their leadership role in improving schooling. Students must complete a minimum of eight 4-credit courses, of which three must be chosen from the curriculum and instruction core. Of the remaining courses, one must come from each of the four support areas. The final course can be chosen in consultation with the program adviser.

Core requirements: 953, Seminar in Curriculum Study; 965, Educational Supervision; 991, Curriculum Theory I; 995, Independent Study in a curriculum and instruction area.

Support areas (4 credits in each area): I. *The Moral and Philosophical Basis for School Improvement*—805B, Controversial and Ethical Issues in Education; 903, Normative Inquiry; 986, Philosophy of Education. II. *The Political Basis for School Improvement*—800A, Educational Structure and Change; 970, The Change Process in Education; 973, Analysis of Education Policy. III. *Personal Growth and Learning*—801C, Human Learning: Educational Psychology; 950, Culture, Diversity, and Development: Implications for Theory and Practice; 985, The Nature of the Learner; 990, Developmental Perspectives on Adulthood. IV. *Research for School Improvement*—885, Educational Assessment; 980, Research in the Teaching of Writing; 981, Methods and Techniques of Educational Research.

Electives (4 credits): Selected in consultation with the program adviser. Six credits (899) if thesis option is elected.

Concluding experience: A student must successfully complete one of the following: a comprehensive oral examination based on a set of these statements prepared by the student, or a research thesis.

800. Educational Structure and Change

Organization, structure, and function of American schools; historical, political, social, and cross-cultural perspectives; nature and processes of change in education. A) Educational Structure and Change; B) Education in America: Backgrounds, Structure, and Function; C) Governance of American Schools; D) School and Cultural Change; E) Teacher and Cultural Change; F) Social Perspectives of Conflict in the Schools; G) Nature and Processes of Change in Education; H) What Is an Elementary School?; I) Schooling for the Early Adolescent; J) Children with Special Needs: Historical and Institutional Aspects; K) Curriculum Structure and Change; L) Stress in Educational Organizations. 2- and 4-credit courses are offered each semester. Minimum of 4 credits required for teacher certification. (See *The Schoolhouse Book* for these requirements.) Prereq: permission. 2 or 4 cr.

801. Human Development and Learning: Educational Psychology

Child development through adolescence, learning theory, cognitive psychology, research in teaching and teacher effectiveness, cross-cultural variability, and evaluation—all applied to problems of classroom and individual teaching and learning. A) Human Development and Learning: Educational Psychology; B) Human Development: Educational Psychology; C) Human Learning: Educational Psychology; D) Developmental Bases of Learning and Emotional Problems; E) Learning Theory, Modification of Behavior, and Classroom Management; F) Cognitive and Moral Development; G) Evaluating Classroom Learning; H) Deliberate Psychological Education; I) Sex Role Learning and School Achievement; J) The Development of Thinking. 2- and 4-credit courses are offered each semester. 2-credit courses emphasize either development or learning. Candidates for teacher certification are required to have the full 4-credit EDUC 801A or 2 credits each of EDUC 801B and 801C. Prereq: permission. 2 or 4 cr.

803. Alternative Teaching Models

Basic teaching models, techniques of implementation, and relationships to curricula. A) Alternative Teaching Models; B) Curriculum Planning for Teachers; C) Alternative Strategies for Maintaining Classroom Control; D) Social Studies Methods for Middle and High School Teachers; F) Teaching Elementary School Science; G) Language Arts for Elementary Teachers; H) Experiential Curriculum; I) Children with Special Needs: Teaching Strategies for the Classroom Teacher; K) Writing Across the Curriculum; L) Learning and LOGO; M) Teaching Elementary School Social Studies. 2- and 4-credit courses are offered. Teacher education students should be aware of the specific course(s) required for their certification area. EDUC 803F and 803M are required for elementary education candidates. EDUC 803D is required for social studies candidates. EDUC 891 is required for science candidates. For all other secondary education candidates, the appropriate methods course in the department of the major is required. Prereq: permission. 2 or 4 cr.

805. 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. A) Contemporary Educational Perspectives; B) Controversial and Ethical Issues in Education; C) Ethical Issues in Education; D) Concepts of Teaching: Differing Views; E) Curriculum Theory and Development; F) Readings on Educational Perspectives; G) Philosophy of Education; I) Education as a Form of Social Control; K) Schooling and the Rights of Children; L) Education, Inequality, and the Meritocracy; M) Readings in Philosophies of Outdoor Education; N) Alternative Perspectives on the Nature of Education; O) Classrooms: The Social Context; P) Teaching: The Social Context; Q) School and Society. 2- and 4-credit courses are offered. Minimum of 4 credits required for teacher certification. (See *The Schoolhouse Book* for these requirements.) Prereq: permission. 2 or 4 cr.

806. Introduction to Reading Instruction in the Elementary Schools

Reading process; current procedures and materials; diagnostic techniques; practicum 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 before entrance into fifth year; in this case the course satisfies reading requirement but is not applicable toward the 12 required graduate credits. Prereq: exploring teaching. 4 cr.

807. Teaching Reading through the Content Areas

Approaches and methods for teaching reading through content materials; coursework includes practical applications through development of instructional strategies and materials. Required for candidates seeking licensure in art, biology, chemistry, earth science, general science, home economics, physical education, physics, or social studies. 2 cr.

820. Introduction to Computer Applications for Education

Major issues related to classroom computer applications: historical development; computer functioning; methods of instruction, problem solving, educational software development and evaluation, psychological and sociological impact of the computer on children and learning. Introduction to classroom applications of the programming language LOGO and the authoring language PILOT. A practical approach is stressed. Lab. 4 cr.

833. Introduction to the Teaching of Writing

Development of writers, child to adult; ways to respond to writing, and the organization of the classroom for the teaching of writing. Persons taking the course will need to have access to students to carry out course requirements. Prereq: permission. 4 cr.

834. 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.

#841. Exploring Mathematics with Young Children

Laboratory course for those who teach young children mathematics and who are interested in children's discovery, learning, and creative thinking; offers chance to experience exploratory activities with concrete materials, as well as mathematical investigations, on an adult level, that develop the ability to provide children a mathematically rich environment, to ask problem-posing questions, and to establish a rationale for doing so. 4 cr.

850. Introduction to Exceptionality

Social, psychological, and physical characteristics of exceptional individuals including intellectual, sensory, motor, health, and communication impairments. Implications for educational and human services delivery. 4 cr.

851A. Educating Exceptional Learners: Elementary

Foundations of special education and introduction to the techniques and innovations of special teaching. Primary application to learners with mild and moderate handicaps. 4 cr.

851B. Educating Exceptional Learners: Secondary

Foundations of special education and introduction to the techniques and innovations of special teaching. Primary application to learners with mild and moderate handicaps. 4 cr.

852. Contemporary Issues in Learning Disabilities

Critical analysis of current and historical conceptions of learning disability in the areas of definition, supporting theories, assessment practice, and teaching methodologies. Focus will be on contemporary issues in the field that relate to working with students labeled as learning disabled at both elementary and secondary levels. 4 cr.

853. Contemporary Issues in Behavior Disorders

Nature and scope of emotional disturbances and behavioral disorders in students, including causes, characteristics, treatment implications, and educational programming. 4 cr.

854. Contemporary Issues of Developmental Disabilities

The causal factors, physical and psychological characteristics, and educational and therapeutic implications of mental retardation, cerebral palsy, epilepsy, autism, and related conditions. Observations of programs and services for individuals with developmental disabilities required. 4 cr.

860. Introduction to Young Children with Special Needs

The needs of children (birth to eight years) with developmental problems or who are at risk for disabilities. Strengths and special needs of such children; causes, identification, and treatment; current legislation; parent and family concerns; program models. 4 cr.

876. Reading for Children with Special Needs

Techniques and procedures for teaching reading to children with special learning needs: the mentally retarded; learning disabled; gifted; culturally diverse. Emphasis is placed on the implications of providing reading instruction in the least restrictive alternative. 4 cr.

881. Probability and Statistics

Introductory-level coverage of applied probability and statistical methods. Problems are selected from many disciplines, with a focus on the behavioral and social sciences, to illustrate the logic and typical application of the techniques. Understanding concepts is emphasized through analyses of prepared data. 4 cr.

885. Educational Assessment

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

891. Methods of Teaching Secondary Science

Application of theory and research findings in science education to classroom teaching with emphasis on inquiry learning, developmental levels of children, societal issues, integration of technology, critical evaluation of texts and materials for science teaching, and planning for instruction. Lab. 4 cr.

897. Seminar in Contemporary Educational Problems

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

900, 901. Internship and Seminar

A) Internship and Seminar/Teaching: a two-semester, full-time, supervised internship consisting of less-than-full-time teaching responsibility in selected educational settings and programs. Weekly seminars and occasional workshops held concurrently with internship. B) Internship and Seminar/Early Childhood; C) Internship and Seminar/General Special Education; D) Internship and Seminar/Emotional Handicaps; E) Internship and Seminar/Mental Retardation; F) Internship and Seminar/Secondary Special Education. Admission by application. 3 or 6 cr.

902. Doctoral Proseminar in Education

Introduces students to the range of scholarly inquiry undertaken in doctoral programs. Students develop a broad understanding of educational studies and analyze various research paradigms in terms of assumptions, methods, and outcomes. Coursework includes developing a proposal. *Matriculated doctoral students only.* 4 cr.

903. Normative Inquiry in Education

A critical study of some of the central normative ideals, concepts, and assumptions that shape contemporary educational policy and practice. The course has two interrelated parts. Part I focuses on an understanding of, and skill in using, the critical perspective embodied in argument analysis and assessment. Part II broadens that perspective in application to normative issues and involves systematic and critical reflection on moral theories, moral experience, and their relevance to education. 4 cr.

906. Language Arts through Reading and Writing

Teaching practices in reading, writing, listening, and oral language. Language development and application to school learning environments. 4 cr.

907. Foundations of Reading Instruction

In-depth study of reading processes, theoretical bases, and principles applicable to the teaching of

reading (K-12). Emphasis on current methods, materials, and programs. 4 cr.

908-909. Clinical Diagnosis and Remediation of Reading Difficulties and Disabilities

Examination of theories and procedures for the diagnosis and remediation of moderate to severe disabilities in reading through case studies, discussions, demonstrations, and practice. Clinical experience each semester. Prereq: EDUC 907; 910;/or permission. 4 cr.

910. 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.

913. Field Practicum

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

914. Seminar in Reading

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

918-919. Seminar on Research in Reading/Writing Instruction

(1) Examines the teaching of reading and writing; (2) studies procedures for research in reading and writing; (3) provides students with an opportunity to conduct research projects; (4) encourages interdisciplinary exchanges between both faculty and students. The seminar is offered every other year and is a requirement for the Ph.D. students in reading and writing. Prereq: permission. 4 cr.

920. Counseling Theory and Practice

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

921. Psychology of Career and Personal Development

Career and personal development are emphasized and how each influences the other; literature and research examined to clarify application to individual and group career-counseling and to career education. 4 cr.

922. Assessment in Counseling

Evaluative instruments and methods that have particular use in counseling. Systematic procedures for measuring samples of an individual's behavior and statistical concepts that 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.

923. Group Counseling

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 920; permission. 4 cr.

924. Psychological Disorders and Adaptation

The development of effective and ineffective human functioning is examined. Behavior patterns that pose the most common problems encountered by contemporary counselors reviewed, with emphasis on the concepts and processes of adaptation. 4 cr.

925. Counseling Internship I: Professional Orientation and Ethics

Introductory supervised field experience focusing on the integration of counseling theory and practice, including laboratory microcounseling and seminars in contemporary professional issues. Interns select an approved field placement reflecting their professional interests. Prereq: permission. 4 cr.

926. Counseling Internship II

Supervised counseling at approved field site. Opportunities also provided for involvement in consultative, evaluative, and other organizational procedures. Focus is on critiques of audio/video samplings of intern's counseling. Prereq: permission. 4 cr.

927. Theories of Personality

Structure of personality and the dimensions along which individuals may vary; implications for the counseling process. 4 cr.

928. Family Counseling

Introduction to the theories, processes, goals, outcomes, and problems of family counseling. 4 cr.

929. Advanced Counseling Internship

Supervised application of advanced counseling theory and practice in counseling relationships. Samplings of the advanced counseling practices of students are analyzed and evaluated. Prereq: permission. 4 cr.

930. Research in Counseling

Research design and methodology in counseling. Students develop research projects that demonstrate knowledge of research procedures in evaluating the processes and outcomes of counseling. Prereq: permission. 4 cr.

931. Clinical Diagnosis and Treatment Planning in Counseling

A comparative review of major diagnostic classifications in the *Diagnostic and Statistical Manual of Mental Disorders*. Lectures, readings, and simulated cases illustrate differential diagnoses, with examination of the current status of treatment approaches for specific disorders. Prereq: EDUC 922 or permission. 4 cr.

932. Society and Culture: Contemporary Issues in Counseling

Examines the current social and cultural contexts of mental health counseling. Emphasis placed on preparing counselors to meet the mental health needs of an increasingly pluralistic population characterized by diverse racial/ethnic membership defined by gender, sexual orientation, and physical ability. Prereq: EDUC 925; 927 or 931. 4 cr.

933. Psychosocial Development in the Classroom

Focuses on increasing understanding of children's psychosocial development as a foundation for learning, motivation, and high-level functioning. Emphasis on presenting models of communication skills and interpersonal effectiveness. Participants expected to develop awareness of their own psy-

chosocial adaptations and to create a curricular plan of implementation and repertoire for teaching social skills and effective psychological interventions with, and for, their prospective student populations. 4 cr.

935. Seminar and Practicum in Secondary School Teaching

An exploratory practicum, which is an integrated part of the Live, Learn, & Teach (LLT) Summer Program. Designed to explore teaching as a career and to prepare, eventually, for a teaching internship. LLT includes preparation in curriculum and instruction; practical and theoretical approaches to experiential education; interpersonal and group skill development; approaches to classroom management; and exploration of the many aspects of teaching and learning. Students develop and coteach summer classes for children or adolescents with advisement from experienced educators. Prereq: admission to the Live, Learn, & Teach Summer Program. 4 cr. Cr/F.

938. Advanced Seminar in Special Education

Weekly seminars on current and/or controversial topics related to special education services. Possible topics include service delivery systems, classification and labeling, assessment, instructional techniques, classroom management, consultation, and the special educator as researcher. Prereq: matriculated student or permission. 4 cr.

939-940. Assessment and Teaching of Children with Learning Difficulties

A two-semester course to develop teacher competency to analyze learners and learning environments; specify learner characteristics; and design, implement, and evaluate appropriate educational interventions in the areas of language, mathematics, reading, behavior, and social skills. Focus on children with mild and moderate learning difficulties in regular classrooms. Prereq: EDUC 850; 851/ or permission. 4 cr.

941. Child Development for the Early Childhood Professional I

Focus on typical child development from birth to age eight. Considers theories of child development and assessment from historical and contemporary perspectives, with emphasis on observation during naturally occurring activities as a means of learning about child development. Includes child study. Prereq: permission. 4 cr.

942. Child Development for the Early Childhood Professional II

Considers the growing body of knowledge on the role of play in children's development; includes examination of contemporary constructivist theory. Organized around theme of teacher as researcher. Assignments include research review and student-designed study of child development issue. Prereq: EDUC 941 or permission. 4 cr.

943. Environments for Early Childhood Education

Forum for exchange of knowledge on developmentally appropriate environments for young children. Considers interface between characteristics of the environment (physical and social as well as organizational) and children being served. Includes field visits to settings appropriate for typically developing children as well as those with special needs. Prereq: EDUC 941 or permission. 4 cr.

944. Curriculum for Early Childhood Education

Classroom applications of constructivist theory. Curriculum planning and implementation; overview of research and theory related to teaching and learning of specific content areas, with emphasis on integrated approach to early childhood curriculum. Stresses the reciprocal nature of student-teacher relationship. Prereq: permission. 4 cr.

#945. Programming for Severely/Multiply Handicapped Young Children

Information and suggestions for working with the severely and/or multiply handicapped child, ages birth to eight. Emphasis will be on individualized program planning, particularly developmental and multidisciplinary approaches. Prereq: permission. 4 cr.

947. Curriculum for Young Children with Special Needs: Evaluation and Program Design

Overview of evaluation and intervention issues relevant to early childhood special education, focusing on ages three through eight. Norm-referenced and criterion-referenced assessment tools. Judgment-based evaluation and observation skills. Translation of evaluation information into goals and objectives for individual education programs. Developing appropriate programs in inclusive settings. 4 cr.

948. Leadership and Advocacy in Early Childhood Education

Examination of roles and responsibilities of early childhood professionals, with emphasis on action research skills, analysis of contemporary problems, strategies for advocacy, and program leadership skills. 4 cr.

949. Supporting Parents of Special Needs Children

Social, economic, and psychological consequences of raising a child with special needs. Issues include diagnosis and prognosis for the child, parent-child attachment, and interactions with other caregivers. 4 cr.

950. Culture, Diversity, and Child Development: Implications for Theory and Practice

Study of child development from comparative perspective, considering race, gender, and disabling conditions as dimensions of diversity. Cross-cultural research examined as challenge to contemporary theories of child development. Ethnopsychology of child development. Use of anthropological methods in study of child development. Implications for educational theory and practice. Prereq: permission. 4 cr.

951. Laws and Regulations Affecting the Education of Students with Disabilities

Analysis of current federal and state policies affecting students with disabilities. Focus on Section 504 and IDEA. The role of policy making and constitutional and ethical issues discussed. 4 cr.

953. Seminar in Curriculum Study

Analysis of recent trends in public school curriculum; structures, philosophy, development, change, and evaluation. Primarily for experienced teachers and administrators. Prereq: teaching experience. 4 cr.

957. Collaborative Models of Supervision for Cooperating Teachers

Becoming an outstanding supervisor and leader within school and professional communities is a complex process which includes learning to build productive relationships with supervisees, developing competence in observing supervisees, and providing constructive feedback to supervisees. Designed around a framework of six focus areas which guide the students in their practice and inquiry. Truly excellent supervisors must be familiar with and skilled at using multiple strategies. Provides the cooperating teacher with skills and knowledge about the supervision process and what is good teaching. Prereq: permission. 4 cr.

#958. 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.

959. Curriculum and Instruction in Secondary Special Education

Analysis of forces and factors affecting secondary special education. Analysis of forces and factors affecting secondary special education curriculum, the theoretical constructs of curriculum models, and the practical aspect of development and modification of curriculum for meeting the needs of learners with educational disabilities. Discussion of transition and school to work issues included. 4 cr.

961. Public School Administration

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

962. Educational Finance and Business Management

Principles of financing education, budgetary procedures, computer spreadsheets, and business management. Analysis of N.H. school funding system. Handling practical school finance problems is part of the project work. Prereq: EDUC 961. 4 cr.

964. 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.

965. Educational Supervision

Theoretical foundations and practical applications of supervisory and instructional practices and procedures; consideration of observation instruments and techniques. Teacher evaluation and supervision reviewed. Each student conducts a field supervision project. Prereq: teaching experience or permission. 4 cr.

#966. Practicum in Supervision and Curriculum

Supervision of teaching and curriculum development projects in the schools. Opportunity to apply skills in supervising and curriculum development. Prereq: EDUC 953; 965; permission. 4 cr.

967. Legal Aspects of School Administration

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, teacher employment, discrimination, negotiations, student rights, tort liability. Prereq: permission. 4 cr.

968. Collective Bargaining in Public Education

An examination of collective bargaining as practiced by school boards, administrators, and teacher organizations. Consideration is 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, fact finding, arbitration, and the administration of the negotiated contract. Prereq: EDUC 963. 4 cr.

969. Practicum in Educational Administration

Supervised practical experience in planning and implementing graduate student-initiated field projects in school administration. Prereq: all core requirements. 4 cr.

970. 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 are required to apply some of the theories in an institutional setting. 4 cr.

971. School Facilities Management

Techniques and procedures involved in the long-range planning of school facilities: for example, school population projections, characteristics of the present and future educational programs, 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, including educational effectiveness and tax impact. Prereq: EDUC 963 or permission. 4 cr.

972. Educational Program Evaluation

Selected models for educational program evaluation; rationale underlying these models examined and compared; practical applications developed. Program and student assessment techniques reviewed. Prereq: EDUC 953; 961;/or permission. 4 cr.

973. Analysis of Education Policy

Policy systems and fundamental values shaping the development and enactment of education policy at the federal, state, and local levels. Prereq: EDUC 969; EDUC 970 or permission. 4 cr.

974, 975. Administrative Internship and Field Project

Field-based internship. Administrative experience 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) is given upon suc-

cessful completion of the internship and field project. 6 cr.

976. The Principalship

Explores the theories and practical realities of the role and function of the public school principal. Reviews in depth leadership in the instructional setting, as a function of culture building, and as a moral craft; and the administration of a school. Students develop a knowledge base about the principalship and apply that knowledge through role playing, in-basket activities, and problem-solving activities. Prereq: two courses in educational administration. 4 cr.

977. Leadership: The District Level Administrator

Examines the school superintendency and other district level positions of leadership that comprise the administrative team, focusing on the complexity of the current role and relationships, the critical issues facing school leaders, and the skills necessary for success as an educational leader in today's climate. Students analyze contemporary issues of school governance and examine problems of practice to understand the role of school superintendent from a theoretical, political, and contemporary perspective. Prereq: M.Ed.; open to C.A.G.S. and Ph.D. students. 4 cr.

980. Research in the Teaching of Writing

Review of the last thirty years of research in writing, focusing on trends in design, research procedures, the contributions of linguistics, cognitive and developmental psychology, with a view to the conduct of research by participants. Prereq: permission. 4 cr.

981. Methods and Techniques of Educational Research

Conceptual aspects and practical realities of the research process applied to problems in education and human service disciplines. Develops skills necessary to use, as well as conduct, research. 4 cr.

982. Issues and Methods in Ethnographic Research in Education

Provides theoretical grounding and field experience in ethnography as a deliberate inquiry process. Examines the application of ethnographic fieldwork to educational research. 4 cr.

#983. 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 801 or equivalent. 4 cr.

#984. Advanced Human Development

Selected principles and skills humankind must consider in the attempt to maximize individual, social, and educational potential; emphasis on personal implementation. Prereq: EDUC 801; introduction to psychology;/or equivalent. 4 cr.

986. Philosophy of Education

Seminar in comparative analysis of educational theories and the philosophical foundations upon which they are based. Application of theoretical criteria for evaluating educational practices and for developing one's own philosophy of education. Prereq: permission. 4 cr.

988. Alternative Models of Teacher Development

Examines the historical and current directions in the education of teachers with an emphasis on analysis of alternative models of teacher education. 4 cr.

990. Developmental Perspectives on Adulthood

Research and theory about critical life issues; developmental tasks of the life cycle; periods of transition; stages of intellectual, moral, and personality development of the adult; and the design of significant learning experiences for adults within a variety of educational settings and institutions. Prereq: permission. 4 cr.

991. Curriculum Theory I

Explores models of curriculum theorizing, the relationship between curriculum theory and society and school practice, and current curriculum issues and reform initiatives. 4 cr.

992. Curriculum Theory II

Seminar in social and philosophic foundations of curriculum theory in which students explore the influence of social, cultural, and institutional contexts on the framing and organization of curricular knowledge; evaluate the social, educational and research implications of dominant knowledge paradigms; and apply a selected theoretic perspective to curricular analysis. 4 cr.

995. Independent Study in Education

Opportunity for intensive investigation of a special problem or issue in the field of education. Prereq: permission. May be repeated to a maximum of 8 cr. 1-4 cr.

998. Special Topics in Education

Study of a particular theoretical, methodological, or policy issue. May be offered off campus as professional development. 1-4 cr.

899. Thesis

Prereq: permission of the department. 6-10 cr. Cr/F.

999. Doctoral Research

Electrical and Computer Engineering (EE)

Chairperson: John R. LaCourse

Professors: Kent Chamberlin, Ronald R. Clark, L. Gordon Kraft, John R. LaCourse, W. Thomas Miller III, Paul J. Nahin, John L. Pokoski, Andrzej Rucinski, Kondagunta Sivaprasad
Adjunct Professor: Sidney W. Darlington

Associate Professors: Michael J. Carter, Allen D. Drake, Richard A. Messner

Adjunct Associate Professors: Thomas F. McCoy, Stuart M. Selikowitz

Assistant Professor: Jennifer T. Bernhard

Adjunct Assistant Professors: Paul W. Latham II, Barbara Dziurla Rucinska
Graduate Program Coordinator: W. Thomas Miller III

Degree Offered

The Department of Electrical and Computer Engineering offers a program of study leading to the master of science degree with a major in electrical engineering. Those who wish to pursue doctoral work should refer to the engineering Ph.D. program.

Opportunities for formal study, research, and individual or team projects are available in the following areas: biomedical engineering; wireless communication systems; digital signal processing; computer engineering, computer networks, digital systems, and logic synthesis; robotics and neural networks; image processing and pattern analysis; control systems; fiber optics; electromagnetics; geophysical sensing and propagation; space systems engineering; rapid prototyping technologies; VLSI circuits; reconfigurable, testable, and fault-tolerant computational structures; illumination engineering; ocean engineering and instrumentation.

For the most current information about specific opportunities, please visit the department's Web homepage at <<http://www.ece.unh.edu>>.

Admission Requirements

An applicant should have completed a baccalaureate degree in electrical engineering or have comparable training, which included courses in mathematics and physical science, network theory, digital systems, fields and waves, electronics, electrical circuits, with appropriate laboratory experiences. Students with a baccalaureate degree from non-U.S. universities must take and submit general scores from the Graduate Record Examination.

M.S. Degree Requirements

Each student meets with a faculty adviser to set up a program of study. No specific course requirements are mandated. Normally, a minimum of 12 credits of 900-level courses is required, not including thesis or project.

The department considers the development of professional communication

skills through technical presentations a basic component of a graduate education. Every master's student is required to participate in seminars or course lectures as needed to satisfy the technical presentation requirement.

In addition to taking advanced coursework, master's students must demonstrate their ability to do independent work and report their results. This can be done in either of two ways: (1) a minimum of 24 credits of coursework plus 6 credits of thesis (EE 899) or (2) a minimum of 27 credits of coursework plus a 3-credit, one-semester project (EE 995). With the consent of the graduate committee and approval of the Graduate School, a student who has demonstrated the ability to do independent work through sufficient industrial experience may substitute an approved course for EE 995.

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

804. Electromagnetic Fields and Waves II

Loop antennas; aperture and cylindrical antennas; self and mutual impedance; receiving antennas and antenna arrays; bounded plane waves; rectangular and cylindrical waveguides; waveguide discontinuities and impedance matching; solid state microwave sources. Prereq: electromagnetic fields and waves I. 4 cr.

807. Computer Engineering

Software engineering principles and practices; computer-aided design and computer-aided engineering methodologies; computer architecture comparisons and trade offs; sampled data systems. Prereq: computer organization; junior EE standing or permission. Lab 4 cr.

811. Digital Systems

Digital design principles and procedures, including top-down design techniques, prototyping and documentation methods, and realistic considerations such as grounding, noise reduction, loading, and timing; digital design and development tools; computer-aided design using microprocessor development systems and engineering workstations including practical experience with state-of-the-art design automation systems. Prereq: computer organization. Lab 4 cr.

814. Real-Time Computer Applications

Organization and programming of real-time computer-based systems. Special purpose peripherals, digital filters, program and data organization, priority interrupt processing of tasks, real-time monitor systems. Applications to communication, automated-measurement, and process-control systems. A semester design project is required. Prereq: computer organization; programming experience. Lab 4 cr.

815. Introduction to VLSI

Principles of VLSI (Very Large Scale Integrated) systems at the physical level. CMOS circuit and logic design, CAD tools, CMOS systems case studies. Students exercise the whole development cycle of a VLSI chip: design, layout, and testing. Design and layout are performed during semester I. The chips are fabricated off campus, and returned during semester II, when they are tested by the students. Prereq: computer organization; EE or CS majors only; permission required for 3 credits. 3–4 cr. IA.

817. Introduction to Digital Image Processing

Digital image representation; elements of digital processing systems; sampling and quantization, image transformation including the Fourier, the Walsh, and the Hough transforms; image enhancement techniques including image smoothing, sharpening, histogram equalization, and pseudo-color processing; image restoration fundamentals. Prereq: electronic networks; random processes in electrical engineering; introduction to computer programming or equivalent. Lab. 4 cr.

841. Nonlinear Systems Modeling

Modeling of hydraulic, pneumatic, and electromechanical systems. Solution methods including linearization and computer simulation on nonlinear equations. Methods of generalizing the nonlinear models for design purposes are developed. (Also offered as ME 841.) 4 cr.

845. Fundamentals of Acoustics

Acoustic wave equation for air; laws of reflection, refraction, and absorption; characteristics and measurement of acoustical sources; human perception of sound, loudness, intensity; microphones; acoustical materials; problems in environmental sound control; ultrasonics; architectural acoustics. Prereq: general physics II; differential equations. Lab. 4 cr.

857. Fundamentals of Communication Systems

Discussions of deterministic signals, Fourier spectra, random signals and noise, baseband communication, analog and digital modulation schemes, and system signal-to-noise ratio. Prereq: probability and discrete systems. Lab. 4 cr.

858. 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 I; EE 857 or equivalent. Lab. 4 cr.

860. Introduction to Fiber Optics

Basic physical and geometric optics, solution of Maxwell's equations for slab waveguides and cylindrical waveguides of both step-index and graded-index profiles, modes of propagation and cutoff, polarization effects, group and phase velocity, ray analysis, losses, fabrication, sources, detectors, couplers, splicing, cabling, applications, system design. Prereq: physics; differential equations with linear algebra; electricity and magnetism or electromagnetic fields and waves. Lab. 4 cr.

861. Optical Engineering

First-order imaging optics, thin and thick lenses, aberrations, mirrors, stops, apertures, gratings, prisms, resolution, interferometry, diffraction, ray tracing, design of optical instruments, image evalu-

ation, modulation transfer function, optical system design by computer. Prereq: physics; differential equations; introduction to computer programming or equivalent experience. Lab. 4 cr.

862. Illumination Engineering

Radiation, spectra, wave and particle nature of light, physics of light production, light sources and circuits, luminaires, science of seeing, color theory, measurements, control of light, light and health, lighting calculations. Prereq: differential equations with linear algebra and physics. Lab. 4 cr.

#863. Lighting Design and Application

Lighting design process, modeling, interior and exterior lighting calculation and design, flux transfer, form and configuration factors, lighting quantity and aesthetics, daylighting calculations, lighting economics, lighting power and energy analysis, selected applications of light in interior and exterior spaces. Prereq: EE 862. Design lab. 4 cr.

871. Linear Systems and Control

Fundamentals of linear system analysis and design in both continuous and discrete time. Design of feedback control systems. Topics include modeling; time and frequency analysis; Laplace and Z transforms; state variables; root locus; digital and analog servomechanisms; proportional, integral, and derivative controllers. Demonstrations and computer simulations included. (Also offered as ME 871.) 3 cr.

872. Control Systems

Extension of EE 871 to include more advanced control system design concepts such as Nyquist analysis; lead-lag compensation; state feedback; parameter sensitivity; controllability; observability; introduction to nonlinear and modern control. Includes interactive computer-aided design and real-time digital control. Prereq: EE 871. (Also offered as ME 872.) Lab. 4 cr.

#875. Applications of Integrated Circuits

Design and construction of linear and nonlinear electronic circuits using existing integrated circuits. Limitations and use of operational amplifiers. Laboratory course in practical applications of nondigital integrated circuit devices. Prereq: advanced electronics. Lab. 4 cr.

877. Collaborative Engineering

Collaborative engineering is a discipline that studies processes in which engineers from diverse disciplines cooperate to specify, design, manufacture, test, market, and maintain a product. Classes organized in both technical and nontechnical flexible modules. The technical topics are advanced and relevant to the project being developed, such as related research, technology, design methodology, and CAD tools. The nontechnical topics include ISO9000 quality system, engineering management, budget considerations, team building, communication and leadership skills, and concurrent engineering principles. Course utilizes collaborative engineering by team development of an engineering project, often a research oriented proof-of-concept prototype. The project developed using ISO9000 principles and the Internet, and accompanied by seminars and discussion sessions run by students who have been designated the project leaders. Prereq: graduate standing. 4 cr.

#881. Physical Instrumentation

Analysis and design of instrumentation systems. Sensors, circuits, and devices for measurement and

control. Elements of probability and statistics as applied to instrument design and data analysis. Transmission, display, storage, and processing of information. The design, implementation, testing, and evaluation of an instrument system is an integral part of the course. Prereq: advanced electronics I. (Also offered as OE 881.) Lab. 4 cr.

884. Biomedical Instrumentation

Principles of physiological and biological instrumentation design including transducers, signal conditioning, recording equipment, and patient safety. Laboratory includes the design and use of instrumentation for monitoring of electrocardiogram, electromyogram, electroencephalogram, pulse, and temperature. Current research topics, such as biotelemetry, ultrasonic diagnosis, and computer applications. Prereq: human anatomy and physiology or equivalent; advanced electronics. Lab. 4 cr.

#885. Underwater Acoustics

Vibrations, propagation, reflection, scattering, reverberation, attenuation, sonar equations, ray and mode theory, radiation of sound, transducers, and small- and large-signal considerations. (Also offered as OE 885.) 4 cr.

896. Special Topics in Electrical Engineering

New or specialized courses and/or independent study. 1–4 cr.

901. Electromagnetic Field Theory

Maxwell's equations; plane wave propagation; reflection and refraction; guided wave propagation; waveguides; simple resonators; elements of microwave circuits, linear and aperture antennas, arrays of dipoles; receiving antennas. Prereq: electromagnetic fields and waves I or equivalent. 3 cr.

#902. 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 901. 3 cr.

915. Advanced Active Circuits

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

936. Biomedical Engineering

Applications of engineering in such areas as surgery, critical-care units, neurophysiology, rehabilitation, modeling, and interaction of waves and biological tissues. Prereq: EE 884 and human anatomy and physiology or equivalent. 3 cr.

939. Statistical Theory of Communications

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.

940. Information Theory

Introduction to information theory concepts. Topics include message sources, entropy, channel capacity, fundamentals of encoding, Shannon's theorems. Prereq: EE 939 or permission. 3 cr.

941. Digital Signal Processing

Introduction to digital signal processing theory and practice, including coverage of discrete-time signals and systems, the Z-transform, the discrete Fourier

transform. Brief coverage of digital filters and terminology, random number generators and signal models, the FFT, the pitfalls of using the FFT, and applications of digital signal processing including convolution, correlation, power spectral estimation. Prereq: programming experience; communications; basic probability. 3 cr.

#944. Nonlinear Control Systems

Analysis and design of nonlinear control systems from the classical and modern viewpoints are discussed. 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 or ME 951. (Also offered as ME 944.) 4 cr.

951. Advanced Control Systems I

State-space representation of multivariable systems; analysis using state transition matrix. Controllability and observability; pole placement using state and output feedback; Luenberger observers. Introduction to computer-controlled systems (sampling, discrete state representation, hybrid systems), nonlinear analysis (Liapunov, Popov, describing function). Prereq: EE or ME 872. (Also offered as ME 951.) 3 cr.

952. Advanced Control Systems II

Special topics in control theory: continuous and discrete systems; optimal control systems, including calculus of variations, maximum principle, dynamic programming, Wiener and Kalman filtering techniques, stochastic systems, adaptive control systems. Prereq: EE or ME 951. (Also offered as ME 952.) 3 cr.

955. Estimation and Filtering

Stochastic systems course with application to control and communications. Topics include random variables, noise in linear systems, Bayesian and minimum variance estimation theory, optimal state estimators, Wiener and Kalman filters, combined estimation and control, prediction, parameter identification, and nonlinear filtering. Prereq: ME or EE 951; MATH 835 or equivalent. (Also offered as ME 955.) 3 cr.

960. Computer Architecture

Advanced topics in computer organization. Parallel and pipeline processing; associative and stack computers; microprogramming; virtual memory; current topics. Prereq: logical design of digital computers. 3 cr.

#962. Fault-Tolerant Computers

Test generation, design for stability, fault simulation, fault-tolerant systems, system diagnosis. An individual computer project is required. Prereq: computer organization. 3 cr.

965. Introduction to Pattern Recognition

Machine classification of data, feature space representation, multispectral feature extraction, Bayes decision theory, linear discriminant functions, parameter estimation, supervised and unsupervised learning, clustering, scene analysis, associative memory techniques, and syntactic methods of recognition. Prereq: Fourier analysis; multi-dimensional calculus; probability and statistics or equivalents. 3 cr.

#970. Introduction to Optical Signal Processing

Theory and application of optical signal processing;

foundations of scalar diffraction theory, the angular spectrum of plane waves, Fourier transforming properties of lenses, spatial filtering and optical information processing, the Vander-Lugt filter, holography principles and application, optical computers. Emphasis on coherent processing. Prereq: EE 941 or EE 857. 3 cr.

#980. Opto-Electronics

Advanced survey of light and its interaction with matter at the submicron level. Topics cover: light in its various descriptions including ray optics, wave optics, beam optics, and photons; optical waveguides and resonators; LEDs and lasers; photons in semiconductors; photorefractive materials and liquid crystals; nonlinear optics; acousto-optics; and photon switching. Prereq: EE 804 or EE 860 or PHYS 804;/or permission. 3 cr.

992. Advanced Topics in Electrical Engineering

Example of a recent topic: analog VLSI design. May be repeated. 3 cr.

993. Advanced Topics in Computer Engineering

Example of a recent topic: wireless communication networks. May be repeated. 3 cr.

994. Advanced Topics in Systems Engineering

Examples of recent topics: neural networks, advanced digital telecommunications. May be repeated. 3 cr.

995. Master's Project

Independent theoretical and/or experimental work under guidance of a faculty adviser. A written report is required, as is an oral examination on the work and related subjects. 3 cr.

998. Independent Study

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

899. Master's Thesis

6 cr. Cr/F.

999. Doctoral Research

the cooperation of a variety of disciplines. Students in systems design can elect either one of two professional directions. The first develops 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 develops 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.

Problems addressed in the other four areas of specialization follow the four classical departmental boundaries. Interested applicants should contact the area coordinator for information on current research activities in the area of interest.

Chemical Engineering: Stephen S. T. Fan, area coordinator

Civil Engineering: M. Robin Collins, area coordinator

Electrical Engineering: W. Thomas Miller III, area coordinator

Mechanical Engineering: David Watt, area coordinator

Systems Design: Barry K. Fussell, area coordinator

Admission 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, students must present evidence that they have sufficient background in the area in which they propose to specialize.

Ph.D. Degree Requirements

Following entrance into the program, a guidance committee is appointed for the student by the dean of the Graduate School upon recommendation of the student's area coordinator. This committee assists students in outlining their program and may specify individual coursework requirements in addition to those required by the area of specialization. The committee also conducts an annual in-depth review of each student's progress and, following substantial completion of a student's coursework, administers the qualifying examination. This committee is also responsible for administering the language examination and/or research-tool proficiency requirements. Coursework and language requirements should normally be com-

Engineering Ph.D. Program (ENGR)

Degree Offered

The College of Engineering and Physical Sciences offers a program of study leading to the degree of doctor of philosophy in engineering. The program has five areas of specialization: chemical engineering, civil engineering, electrical engineering, mechanical engineering, and systems design.

The systems design area is an interdepartmental program that addresses contemporary engineering and scientific problems that can be solved only through

pleted by the end of the second year of full-time graduate study and must be completed before the student can be advanced to candidacy.

Every doctoral student in civil and electrical engineering is required to participate in seminar and/or course presentations, as determined by the department, to satisfy a teaching requirement.

Upon the successful completion of the qualifying examination and other proficiency requirements, the student is advanced to candidacy and, upon the recommendation of the student's area coordinator, a doctoral committee is appointed by the dean of the Graduate School. The doctoral committee conducts an annual review of the student's progress, supervises and approves the doctoral dissertation, and administers the final dissertation defense.

To obtain a Ph.D. degree in engineering, a student must meet all of the general requirements as stated under academic regulations and degree requirements of the Graduate School. Students are normally expected to take coursework equivalent to two full-time academic years beyond the baccalaureate and to complete a dissertation on original research that will require at least one additional year of full-time study. A student should consult specific course offerings and descriptions of each department and should consult the area coordinator for additional information.

English (ENGL)

Chairperson: Rochelle Lieber

Professors: Janet Aikins, Thomas A. Carnicelli, Mary Morris Clark, Robert J. Connors, Michael V. DePorte, Karl C. Diller, Walter F. Eggers, Burt H. Feintuch, Michael K. Ferber, Lester A. Fisher, Melody G. Graulich, Elizabeth H. Hageman, Jean E. Kennard, Rochelle Lieber, Mekeel McBride, Andrew H. Merton, Thomas R. Newkirk, Susan Schibanoff, Patrocino P. Schweickart, Charles D. Simic, Mark R. Smith, David H. Watters

Associate Professors: John M. Archer, Brigitte Gabcke Bailey, Elizabeth Jane Bellamy, Margaret-Love G. Denman, John Richard Ernest, Diane P. Freedman, Jane T. Harrigan, Susan Margaret Hertz, Romana C. Huk, James Krasner, Douglas M. Lanier, John S. Lofty, Lisa

Watt MacFarlane, Sarah Way Sherman, Sandhya Shetty, Patricia A. Sullivan, Rachel Trubowitz

Assistant Professors: Peter J. Mascuch, Lisa C. Miller, Naomi G. Nagy

Graduate Program Coordinator:

Douglas M. Lanier

Degrees Offered

The Department of English offers three advanced degrees: master of arts with options in literature, English language and linguistics, and writing; master of science for teachers; and doctor of philosophy.

Admission Requirements

All applicants must submit writing samples in accordance with guidelines available from the English department graduate office. All applicants (except those in M.S.T.) are also required to submit Graduate Record Examination scores for the general test. Applicants for the doctor of philosophy degree program must also submit scores for the subject test of literature in English. A student admitted to the Ph.D. program must hold an M.A. degree or be in the final stage of completing requirements for the degree.

Applicants for the degree of master of science for teachers should consult the General Regulations of the Graduate School for special admission requirements.

Master of Arts Degree Requirements

Literature Option An M.A. candidate must complete 32 credit hours at the 800 or 900 level including two seminar courses and 4 credits of English 998 (Master's Paper). At least four courses must be literature courses offered by the English department (as distinct from courses in critical theory, linguistics, writing, or teaching methods). Each M.A. candidate must pass the master's seminar in the study of literature (ENGL 925), normally taken in the first semester of study, and 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, and no more than two literature courses should be taken in a combined 700/800 (split) level course. In special circumstances, however, a student may be allowed to apply

toward the degree up to two graduate courses offered by other departments.

M.A. candidates must pass a reading examination in a foreign language or demonstrate that they have passed a fourth-semester college-level language course with a grade of B or better. Students whose native language is not English may be exempt from this requirement.

Writing Option The master of arts in writing is designed for students who intend to become professional writers. Nine working writers supervise the program. Students must 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 specialty and may elect to take an additional workshop in another area as well. Form-and-theory courses and literature courses complete the program. The program consists of 32 credit hours at the 800 or 900 level.

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, a 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.

English Language and Linguistics

Option 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. Specialties include applied linguistics and the teaching of English as a second language as well as the traditional subfields of linguistics. Psycholinguistics courses are offered through the psychology department.

To earn the M.A. degree, students must complete at least 32 credit hours at the 800 or 900 level, including one seminar course, and 4 credits of ENGL 998, in which they are to produce a substantial

scholarly paper. Unless the student already has a strong background in linguistic theory, the program of study must include one course in phonetics and phonology (ENGL 893) and one in syntax and semantics (ENGL 894). Reading knowledge of one foreign language is required. This may be demonstrated by passing a departmental examination or by receiving a grade of B or better in a fourth-semester college-level language course. Students whose native language is not English may be exempt from this requirement. The student's course of study must be approved by the program adviser.

Master of Science for Teachers Degree Requirements

The master of science for teachers is designed for high school teachers. No foreign language is required. The student must complete 32 credit hours at the 800 or 900 level. At least 24 of these credits must be in the Department of English. Courses taken outside the department must be approved by the student's adviser.

Ph.D. Degree Requirements

The Ph.D. program combines the essential guidance and discipline of course work with the equally essential freedom of independent study and research. To be admitted to the doctoral program a student must hold an M.A. degree. Students choose between two areas, literature and composition studies. Students choosing either area or program must demonstrate basic proficiency in two languages or advanced proficiency in one. Basic proficiency may be demonstrated by passing a departmental examination or by receiving a grade of B or better in a fourth-semester college-level language course. Advanced proficiency may be demonstrated by advanced coursework or by passing a rigorous departmental examination.

The aim of the doctoral program in literature is to train students to be teachers and scholars in the fields of literature and language. Students in this program will complete eleven graduate courses of which four must be seminars. The other courses must be at the 800 or 900 level and must include Practicum in Teaching College Composition (English 910), a course in literary criticism, and an ungraded course in Bibliography and Professional Practices (English 924). Stu-

dents must in addition pass a general examination in English and American literature, a more specialized qualifying examination, and the final oral defense of their dissertation.

The program in composition studies is designed to train experts in the teaching of composition who are also qualified to teach general courses in literature or linguistics. Students in composition studies will complete ten graduate-level courses of which four must be seminars. The other courses must be at the 800 or 900 level and will include a Practicum in Teaching College Composition (English 910) and Research Methods in Composition (English 918). Students will take a combined general and qualifying examination that focuses both on the theory of composition and rhetoric, and on a secondary area of specialization, and will do their dissertation work in composition.

Ph.D. student normally hold assistantships and teach under supervision; such teaching is considered a vital part of the student's professional training.

600. English as a Second Language

A course designed for foreign graduate students in their first semester at UNH to give them English language skills necessary for effective graduate work at the university. Includes work on listening skills (understanding lectures, note-taking, etc.), reading skills, the writing of research papers, the making of oral reports, and general study skills, with work on grammar and pronunciation for those who need it. Credits may not be used to fulfill minimum degree requirements of a graduate program. Prereq: graduate students only. May be repeated for a maximum of 16 cr. Variable 1–16 cr. Cr/E.

803, 804. Advanced Nonfiction Writing

A workshop course for students intending to write publishable magazine articles or nonfiction books. Equal stress on research and writing techniques. Prereq: newswriting; written permission of instructor required. May be repeated for credit with the approval of the department chairperson. 4 cr.

805. Advanced Writing of Poetry

Workshop discussion of advanced writing problems and submitted poems. Individual conferences with instructor. Prereq: writing poetry or equivalent. Written permission of instructor required for registration. May be repeated for credit with the approval of the department chairperson. 4 cr.

807. Form and Theory of Fiction

A writer's view of the forms, techniques, and theories of fiction. The novels, short stories, and works of criticism studied vary, depending on the instructor. 4 cr.

808. Form and Theory of Nonfiction

A writer's view of contemporary nonfiction, emphasizing the choices the writer faces in the process of research and writing. 4 cr.

809. Form and Theory of Poetry

A writer's view of the problems, traditions, and structures of poetry. 4 cr.

810. Teaching Writing

An introduction to various methods of teaching writing. Combines a review of theories, methods, and texts with direct observation of teaching practice. 2–6 cr.

#812. Feminist Criticism Theory and Practice

Focuses on (a) historical development of feminist criticism and the evolution of gender as a literary and critical concern; and (b) the theoretical and practical implications of gender on literary production and reception. Possible texts include classic works by Woolf, De Beauvoir, Rich, and others; works on more recent theoretical trends and developments from other disciplines; and a selection of literary works to be read in conjunction with the criticism and theory. 4 cr.

813, 814. Literary Criticism

Major critics from Plato to the present; the chief critical approaches to literature. 4 cr. (Not offered every year.)

815. TESL: Theory and Methods

A study of how linguistic, psychological, sociological, and neurological theory influences or determines the choice of methods of language teaching. Research on second language acquisition and bilingualism, language aptitude, and the cultural context of language acquisition. Includes an introduction to standard and exotic methods of language teaching. 4 cr.

816. Curriculum Design, Materials, and Testing in English as a Second Language

A study of the problems in designing an effective teaching program for various types of ESL students. An introduction to competence and aptitude testing and to the choosing and adapting of materials for ESL classes. 4 cr.

818. English Linguistics and Literature

An introduction to linguistics for students of literature. Includes a survey of the grammar of English (phonology, morphology, syntax, dialect variation, historical change) with application to the analysis of the language of poetry and prose. 4 cr. (Not offered every year.)

819. Sociolinguistics Survey

How language varies according to the characteristics of its speakers: age, sex, ethnicity, attitude, time, and class. Quantitative analysis methods; relationship to theoretical linguistics. Focus is on English, but some other languages are examined. Prereq: introduction to linguistics or permission. 4 cr.

832. Folklore and Folklife

Examines the materials and methods used to study folklore and folklife, emphasizing the historical context and development of folklore studies in North America and Europe, field research, performance theory, and other topics. 4 cr.

#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. (Not offered every year.)

842. American Literature, 1815–1865

Fiction, nonfiction, and poetry in the period of romanticism, transcendentalism, nationalism. Individual works and cultural background. 4 cr. (Not offered every year.)

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.

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.

845. Contemporary American Literature

A gathering of forms, figures, and movements since 1945. Individual works and cultural background. 4 cr. (Not offered every year.)

#846. Studies in American Drama

Topics vary from year to year. Examples: 20th-century American drama; contemporary playwrights; theatricality in American life. 4 cr. (Not offered every year.)

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. (Not offered every year.)

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. (Not offered every year.)

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. (Not offered every year.)

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.

851. Medieval Epic and Romance

The two major types of medieval narrative; comparative study of works from England, France, Germany, and Iceland, including *Beowulf*, *Song of Roland*, *Nibelungenlied*, Gottfried's *Tristan*, *Njal's Saga*, and Malory's *Morte d'Arthur*. All works read in modern English translations. 4 cr. (Not offered every year.)

852. History of the English Language

Evolution of English from the Anglo-Saxon period to the present day. Relations between linguistic change and literary style. 4 cr.

853. Old English

Introduction to Old English language and literature through the readings of selected poetry and prose. 4 cr.

#854. Beowulf

A reading of the poem and an introduction to the scholarship. Prereq: ENGL 853. 4 cr.

856. Chaucer

A study of *The Canterbury Tales* in its original language. 4 cr. (Not offered every year.)

858. Shakespeare

A few plays studied intensively. Live and filmed performances included as available. 4 cr.

#859. Milton

Milton and his age. Generous selection of Milton's prose and poetry, with secondary readings of his sources and the scholarship. 4 cr. (Not offered every year.)

863. 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. (Not offered every year.)

864. Prose and Poetry of the Elizabethans

Shakespeare and his contemporaries. Major works, including Spenser's *Faerie Queene*, Sidney's *Astrophil and Stella*, Shakespeare's *Sonnets*, Marlowe's *Dr. Faustus*: their literary and intellectual backgrounds. 4 cr. (Not offered every year.)

865. English Literature in the 17th Century

Major writers of the 17th century, including Donne, Jonson, Herbert, Bacon, and Hobbes. 4 cr. (Not offered every year.)

#867. Literature of the Restoration and Early 18th Century

Poetry, dramas, fiction, letters, journals, and essays from the period following the restoration of Charles II to the throne of England after the English Civil War. Works by such figures as John Dryden, Aphra Behn, Daniel Defoe, Jonathan Swift, Alexander Pope, and Lady Mary Wortley Montagu studied in historical context. Examples from the colonial world and the continent (in translation) when appropriate. 4 cr. (Not offered every year.)

868. Literature of the Later 18th Century

Poetry, drama, fiction, letters, journals, essays, and biography from the period that culminated in the American and French revolutions. Works by such figures as Henry Fielding, Samuel Johnson, Frances Burney, Laurence Sterne, William Blake, and Mary Wollstonecraft studied in historical context. Examples from the colonial world and the continent (in translation) when appropriate. 4 cr. (Not offered every year.)

869, 870. The English Romantic Period

Major literary trends and authors, 1798 to 1832. Focus on poetry but attention also to prose works and critical theories. 869: Wordsworth, Coleridge, Lamb, Hazlitt, DeQuincey. 870: Byron, Shelley, Keats. 4 cr. (Not offered every year.)

871. Victorian Prose and Poetry

Major writers; social and cultural history. Selections vary from year to year. 4 cr. (Not offered every year.)

873, 874. British Literature of the 20th Century

Poets and novelists of the modernist and

postmodernist periods. 873: W. B. Yeats, James Joyce, Virginia Woolf, E. M. Forster, D. H. Lawrence, and other modernists. 874: a selection of postmodernist or contemporary writers, such as William Golding, Doris Lessing, John Fowles, Philip Larkin, Seamus Heaney, Margaret Drabble, and others. 4 cr. (Not offered every year.)

#875. Irish Literature

Survey from the beginnings to the present; works in Irish (read in translation) such as *The Cattle Raid of Cooley*, medieval lyrics, and *Mad Sweeney*; and works in English from Swift to the present. Twentieth-century authors: Joyce, Yeats, Synge, O'Casey, Beckett, and Flann O'Brien. 4 cr. (Not offered every year.)

878. Brain and Language

An introduction to neurolinguistics, a study of how language is related to the structure of the brain. The biological foundations of linguistic universals and language acquisition. Examination of evidence from aphasia and from normal language use. 4 cr.

879. Linguistic Field Methods

Devoted to the study, with use of an informant, of some non-Indo-European language that is unfamiliar to both the students and the instructor at the beginning of the class. The primary aim of the course is to give students a practical introduction to linguistic analysis without the support of a text. Theoretical concepts are introduced as needed. Special fee. 4 cr.

#880. English Drama to 1640

Development of the drama through the Renaissance, emphasizing the Elizabethan and Jacobean dramatists. 4 cr. (Not offered every year.)

#881. English Drama from 1660 to 1800

Study of selected plays, their performance and their publication. Works by such figures as William Wycherley, Thomas Otway, Mary Pix, George Lillo, Susanna Centlivre, Richard Sheridan, and Elizabeth Inchbald. Special attention to the new prominence of women in the drama of this period, changes in theater architecture, forms of nondramatic spectacle, and the political and social significance of drama. 4 cr. (Not offered every year.)

#882. Modern Drama

Major English, American, and (translated) European plays of the modern period by such playwrights as Shaw, Ibsen, Chekhov, Strindberg, Pirandello, O'Neill, Brecht, Beckett, Williams, Miller, Pinter. Live and filmed performances studied as available. 4 cr. (Not offered every year.)

883. The English Novel of the 18th Century

Study of the rise and development of the novel in the eighteenth century. Works by such figures as Daniel Defoe, Eliza Haywood, Samuel Richardson, Henry Fielding, Charlotte Lennox, Laurence Sterne, Frances Burney, and Jane Austen. Focus on writers who published their work in England but with examples from the colonial world and the continent (in translation) when appropriate. 4 cr. (Not offered every year.)

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.

885. Major Women Writers

Intensive study of one or more women writers. Selections vary from year to year. 4 cr.

#886. Twentieth-Century British Fiction

Traces the development of the novel from the turn of the century to the present day. Representative novels by Lawrence, Joyce, Conrad, Woolf, West, Forster, Huxley, Waugh, Murdoch, Burgess, and Lessing. 4 cr.

890. Special Topics in Linguistic Theory

An advanced course on a topic to be chosen by the instructor. Inquire at the English department office for a full course description each time the course is offered. Topics such as word formation, dialectology, linguistic theory and language acquisition, language and culture, cross-disciplinary studies relating to linguistics. Barring duplication of subject, may be repeated for credit. 4 cr. (Not offered every year.)

891. English Grammar

A survey of the grammar of English (pronunciation, vocabulary, sentence structure, punctuation, dialect variation, historical change) with special attention to the distinction between descriptive and prescriptive grammar and to the problems students have with formal expository writing. 4 cr.

892. Teaching Secondary School English

Methods of teaching language, composition, and literature in grades 7–12. Required of all students in the English teaching major. Open to others with permission. 4 cr.

893. Phonetics and Phonology

The sounds and sound systems of English in the context of linguistic theory: comparisons of English to other languages. Prereq: a basic linguistic course or permission. 4 cr. (Not offered every year.)

894. Syntax and Semantic Theory

The relationship of grammar and meaning as viewed from the standpoint of modern linguistic theory. Emphasis on the syntax and semantics of English, with special attention to the construction of arguments for or against particular analyses. Prereq: a basic linguistic course or permission. 4 cr.

897. Special Studies in Literature

A) Old English Literature; B) Medieval Literature; C) 16th Century; D) 17th Century; E) 18th Century; F) English Romantic Period; G) Victorian Period; H) 20th Century; I) Drama; J) Novel; K) Poetry; L) Nonfiction; M) American Literature; N) A Literary Problem; O) Literature of the Renaissance. The precise topics and methods of each section vary. Barring duplication of subject, may be repeated for credit. For details, see the course descriptions available in the English department. 2–6 cr.

901. Advanced Writing of Fiction

Workshop discussion of advanced writing problems and readings of students' fiction. Individual conferences with instructor. Prereq: writing fiction or equivalent. Written permission of instructor required for registration. May be repeated for credit with the approval of the department chairperson. 4 cr.

910. Practicum in Teaching College Composition

Focus on problem issues and methods for teaching

writing to first-year students. Open only to teachers in Freshman English program. 4 cr.

911. Writing for Teachers

Opportunity for teachers of composition to work intensively on their writing, to read as writers, and to discover the principles appropriate to the writing genre they are teaching. Because of its special focus, this course may not be applied to the M.A. in English/writing option. 4 cr.

912. Historical and Theoretical Studies in Rhetoric

The rhetorical tradition in Western culture, with a special focus on three critical periods: the classical period (Aristotle, Cicero, Quintillian), the eighteenth century (Blair and Campbell), and the modern era (Burke, Booth, Perelman, Ong, Weaver). 4 cr.

913. Theory and Practice of Composition

Examination of major theoretical and pedagogical works in the field of composition. To include works on the writing process, writing development, response to writing, and other topics. 4 cr.

914. Special Topics in Composition and Rhetoric

Topics chosen by instructor may include: A) Political, Philosophical, and Ethical Issues in Composition; B) Gender and Writing; C) Cognition and Composition; and D) Ethnographics of Literacy. 2–6 cr.

#916. History of Composition

Composition teaching and theory in American colleges and academies from the 18th century to the present. 4 cr.

918. Research Methods in Composition

Overview of major research approaches including historical, case study, ethnographic, and textual; special emphasis on research design. 4 cr.

919. Teaching the Writing Process

Focus both on the writing of the participants and on the teaching of writing in grades K–12. Special attention is given to strategies for prewriting, revision, evaluation, and conducting writing conferences. 2–6 cr.

920. Issues in Teaching English and the Language Arts

Special topics in the teaching of English and the language arts. Inquire at the department to see what topics in the teaching of reading, writing, literature, or language arts 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.

921. Practicum in Teaching English and the Language Arts

A site-based course for practicing teachers that features in-class observations and demonstrations, individual consultation, and group meetings in the schools. Prereq: permission. May be repeated to a maximum of 8 credits. 2–6 cr.

923. Advanced Essay Writing

Writing and reading course in which students are encouraged to experiment with a variety of styles and forms. Discusses outside reading by focusing on techniques that the student might want to apply to his or her own material. Prereq: permission. 4 cr.

924. Bibliography and Methods

Introduction to enumerative and physical bibliography and major research and reference works of the field, to prepare the student for original research in the graduate program and later. Required of all Ph.D. students. 2 cr. Cr/F.

925. The Graduate Study of Literature

Techniques, resources, and purposes of literary study: close reading; practical criticism; critical theories and their values; pertinence of intellectual and historical backgrounds. Approaches applied to a specific area of literary study, which varies from year to year. 4 cr.

928. Issues in Teaching at the College Level

English 928 helps prepare students to teach general level courses. The seminar explores practical and theoretical issues: responding to students' writing; handling group discussion; designing assignments; developing a syllabus and exploring relationships between critical theory and approaches to instruction. Material useful to teachers interested in community college work. Prereq: graduate students only. 2 cr. Cr/F.

994. Practicum in Teaching English to Speakers of Other Languages

Students have an opportunity to observe and discuss ESL classes and to design and carry out their own lessons, with follow-up evaluation. 2–6 cr. Cr/F.

Seminars

914. Seminar—Rhetorical and Composition Theory
4 cr.

926. Seminar—Literary Theory
May be repeated. 4 cr.

927. Seminar—Feminist Criticism Theory and Practice
May be repeated. 4 cr.

#932. Seminar—Folklore and Folklife
May be repeated. 4 cr.

935. Seminar—Studies in American Literature
May be repeated. 4 cr.

936. Seminar—Literature of Early America.
May be repeated. 4 cr.

937. Seminar—Studies in 19th-Century American Literature
May be repeated. 4 cr.

#938. Seminar—Studies in 20th-Century American Literature
May be repeated. 4 cr.

953. Seminar—Studies in Old English
May be repeated. 4 cr.

956. Seminar—Studies in Medieval Literature
May be repeated. 4 cr.

958. Seminar—Studies in Shakespeare
May be repeated. 4 cr.

959. Seminar—Studies in Milton
May be repeated. 4 cr.

960. Seminar—Studies in English Drama
May be repeated. 4 cr.

#964. Seminar—Studies in 16th-Century Literature
May be repeated. 4 cr.

965. Seminar—Studies in Early 17th-Century Literature
May be repeated. 4 cr.

968. Seminar—Studies in 18th-Century Literature
May be repeated. 4 cr.

970. Seminar—Studies in the Romantic Period
May be repeated. 4 cr.

971. Seminar—Studies in the Victorian Period
May be repeated. 4 cr.

974. Seminar—Studies in 20th-Century British Literature
May be repeated. 4 cr.

981. Seminar—Studies in Post-Colonial Literatures in English
May be repeated. 4 cr.

990. Seminar—Linguistics
May be repeated. 4 cr.

992. Seminar—20th-Century Linguistics
May be repeated. 4 cr.

#993. Seminar—Current Issues in Second Language Acquisition
May be repeated. 4 cr.

995. Independent Study
To be elected only with permission of the director of graduate studies and of the supervising faculty member. 1–8 cr.

996. Reading and Research
2, 4, or 8 cr. Cr/F.

998. Master's Paper
4 cr. Cr/F. 1A.

999. Doctoral Research

Family Studies (FS)

Chairperson: Larry J. Hansen
Associate Professors: Kristine M. Baber, Elizabeth M. Dolan, Barbara R. Frankel, Larry J. Hansen, Michael F. Kalinowski, Victor R. Messier
Assistant Professors: Kerry Cielinski, Mary Kay Degenova
Graduate Program Coordinator: Michael F. Kalinowski

Degree Offered

The Department of Family Studies offers two programs of study leading to a mas-

ter of science degree in family studies. The thesis program is designed to develop general competence in understanding and applying theory and research regarding child and family issues. The marriage and family therapy option is a clinical program that prepares students to work with families in a clinical setting. The goal of both programs is to provide students with an understanding of theory and methods relevant to child and family studies and to prepare them to work with families in therapeutic, educational, and other community and corporate settings. The clinical program requires a minimum of two years of full-time study, including two summers. Alternative plans of study may be possible.

Admission Requirements

Students in good academic standing with undergraduate degrees in any related field are encouraged to apply. If a student's undergraduate program does not include an introductory statistics course or the equivalent, successful completion of such a course is required before beginning graduate work. Students seeking admission must submit recent scores from the Graduate Record Examination general test. Additional admissions information and personal interviews are required of applicants for the marriage and family therapy option. Information should be obtained by contacting the department's graduate coordinator.

M.S. Degree Requirements

Each student will complete coursework appropriate to his or her area of specialization. In the thesis program, requirements include (1) completion of the 12-credit core curriculum that includes 991, Professional Issues for Family Specialists; 993, Theoretical Approaches to Family Studies; 994, Research Seminar; (2) 22 additional semester hours of coursework including 4 semester hours of Practicum (807) and an advanced statistics course; and (3) successful completion and defense of a research thesis (6–10 credits in 899).

Marriage and Family Therapy Option This option specifically prepares students to work in mental health, family service, medical, and human service settings. The emphasis is on structural,

strategic, and systemic approaches to marriage and family therapy. Program requirements include (1) the 12-credit core curriculum (described above); (2) 28 additional semester hours of coursework including 841, Marital and Family Therapy; 846, Human Sexuality; 942, Advanced Systems of Marital and Family Therapy; 945, Family Therapy Practice I; 946, Critical Problems in Family Life; 947, Family Therapy Practice II; and (3) successful completion of at least 10 credits of 898 (500 hours of clinical practice) and an integrative paper and presentation. Clinical training is provided under the direction of an approved supervisor of the American Association for Marriage and Family Therapy in the department's Marriage and Family Therapy Clinic.

807. Practicum

Supervised in-depth experience in teaching, research, or advocacy in a professional setting to increase the student's understanding of children, families, or consumer issues. A) Child; B) Family; C) Consumer Studies. Prereq: permission. 1–6 cr. Cr/F.

808. Child and Family Center Internship

Supervised positions within the UNH Child and Family Center nursery school programs. A) videotape assistant; B) assessment assistant; C) toddler assistant; D) 3–5 year old assistant. Can be repeated up to a total of 9 cr. Prereq: permission. 1–6 cr. Cr/F.

809. Child Study and Development Center Internship

Supervised positions within the UNH Child Study and Development Center child care programs. A) videotape assistant; B) assessment assistant; C) infant assistant; D) toddler assistant; E) 3–5 year old assistant; F) kindergarten assistant; G) health issues assistant. May be repeated up to a total of 9 credits. Prereq: human development, developmental perspectives on infancy and early childhood, teaching/learning in social constructivist classrooms, permission. 1–6 cr. Cr/F.

810. Community Internship

Supervised position in community early childhood settings. A) infant-toddler assistant; B) preschool-child care assistant; C) kindergarten assistant. May be repeated up to a total of 8 credits. 1–6 cr. Cr/F

833. Supervising Programs for Young Children

Philosophical bases and theoretical rationales of various programs for young children; program alternatives and resources; issues in administration including supervision, finances, and regulations. Prereq: permission. 4 cr. (Fall semester only.)

834. Curriculum for Young Children

Designing and implementing developmentally appropriate activities for young children; assessing the effectiveness of activities; evaluating materials and equipment. Prereq: FS 833; permission. 4 cr. (Spring semester only.)

841. Marital and Family Therapy

Introduction to the theory and practice of marital and family therapy; major approaches to be examined include strategic, transgenerational, structural, experiential/humanistic, and behavioral. Prereq: family relations or equivalent; permission. 4 cr.

843. Families, Schools, and Community

Emphasis on the critical value of effective family-school-community partnerships in enhancing the education of young children. The literature assessing the interactive nature of the parent and school resources with cultural influences examined. Current models of family-school-community partnerships explored. Students required to participate in parent/school/community activities within early childhood education centers and schools. Prereq: permission. 4 cr. (Fall semester only.)

846. Human Sexuality

Investigation of physiological, psychological, and sociological aspects of human sexuality. Particular attention to various social practices, policies, and programs that affect sexual attitudes and behaviors. 4 cr.

857. Race, Class, Gender, and Families

Explores the intersection of race, class, and gender in family life in the United States. Theory, research, and other relevant literature used to examine the variety of family configurations in our society today and the diverse experiences that families have as the result of existing social, political, and economic institutions. The strengths of various family types considered, as well as the particular challenges these families may encounter in contemporary society. Prereq: permission. 4 cr.

871. Observation and Assessment of Young Children

A comprehensive view of various observation techniques for determining children's strengths and emerging skills. Exploration of issues regarding the use of formal assessments and testing with young children, retention and transitional placements, and the parent's role in testing. Prereq: human development, developmental perspectives on infancy and early childhood, teaching/learning in social constructivist classrooms, permission. 4 cr. (Fall semester only.)

872. International Approaches to Child Advocacy

Investigation into the rationales for advocacy, types of advocacy, advocacy techniques and strategies, and current domestic and international advocacy issues and approaches. Prereq: permission. 4 cr.

873. International Perspectives on Children and Families

Investigation of historical and modern conceptions of children and families in selected African, Asian, European, and Latin countries. Emphasis placed on the contribution of these populations to the changing ethnic portrait of America. Prereq: permission. 4 cr.

894. Families and the Law

Exploration of laws that affect families as members interact with each other and with society in general. Prereq: management and decision making; family relations; and permission. 4 cr.

897. Special Topics

Highly focused examination of a particular theo-

retical, methodological, or policy issue. Prereq: permission. 4 cr.

898. Marriage and Family Therapy Practicum

Clinical experience under direct faculty supervision. Trainees develop competency in treating individuals in the context of their families and larger systems. Prereq: permission. May be repeated. 1-4 cr.

942. Advanced Systems of Marital and Family Therapy

Critical analysis and integration of selected systems of marital and family therapy. Prereq: FS 841; permission. 4 cr.

#943. American Families in Poverty

Seminar in contemporary issues related to economic deprivation in families. Exploration of causes and effects of poverty in American families. Prereq: permission. 4 cr. (Not offered every year.)

#944. Children in the Family

Advanced seminar focusing on the family environment as a context for child development; relationships between parents and children, current theories, and research. Prereq: permission. 4 cr. (Not offered every year.)

945. Family Therapy Practice I

Designed to develop beginning practice skills in structural, strategic, systematic family therapies; and assessment and treatment skills necessary to manage specialized problems (e.g., divorce, remarriage, substance abuse, suicidal behavior) encountered in practice. Prereq: permission. 4 cr.

946. Critical Problems in Family Life

Evaluation of the needs and resources of families with critical problems; maturational and situational sources of stress influencing the contemporary American family; students demonstrate mastery of theoretical concepts by developing self-help strategies to be used by families experiencing stress. Prereq: permission. 4 cr.

947. Family Therapy Practice II

Designed to develop advanced skills in integrating structural, strategic, and systematic family therapies; sensitivity to gender differences and cultural diversity; and assessment and treatment skills necessary to manage specialized problems (e.g., physical, emotional, and sexual abuse; sexual dysfunction) encountered in practice. Prereq: permission. 4 cr.

991. Professional Issues for Family Specialists

Exploration of major ethical, legal, and professional issues facing child, family, and consumer specialists. Focus on ethical decision making, values clarification, and development of professional identity. Prereq: permission. 4 cr.

993. Theoretical Approaches to Family Studies

Scientific knowledge and the scientific method, the relationship between theory and research as it applies to family studies; why and how theories change; major theories in historical context. Prereq: permission. 4 cr.

994. Research Seminar

Introduction to social science research methods; analysis of research reports and other professional papers in family and consumer studies; develop-

ment and evaluation of research proposals. Prereq: FS 993 and permission. 4 cr.

995. Seminar and Special Problems

A) Consumer Research; B) Family Relations; C) Education; D) Family Resource Management; and E) Human Development. The student contributes 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 are open to graduate students with sufficient background and are not scheduled every semester. One or more semesters, maximum of 4 credits in one area. Prereq: permission. 2-4 cr.

997. Advanced Research Seminar

Interdisciplinary approach to research in child, family, and consumer studies. Emphasis on the multidimensionality of family problems, appropriate research strategies, and critical analysis of current literature. Prereq: permission. 4 cr.

899. Master's Thesis

6 cr. Cr/F.

Genetics Program (GEN)

Chairperson: Anita S. Klein

Professors: Clyde L. Denis, Thomas P. Fairchild, J. Brent Loy, Subhash C. Minocha, Robert L. Taylor, Jr., Robert M. Zsigray

Research Professor: Ann C. Bucklin

Associate Professors: John J. Collins, Thomas M. Davis, Anita S. Klein, Thomas D. Kocher

Research Associate Professor: William A. Gilbert

Assistant Professors: Estelle M. Hrabak, Louis S. Tisa

Graduate Program Coordinator: Anita S. Klein

Degrees Offered

The interdepartmental genetics program offers graduate work leading to the degrees of master of science and doctor of philosophy.

The program is conducted by faculty members from animal sciences, biochemistry and molecular biology, microbiology, plant biology, and zoology.

Admission Requirements

Qualified applicants are admitted with the approval of the genetics faculty. Undergraduate preparation should include mathematics through calculus, chemistry through organic, physics, animal or plant biology courses and laboratories, genetics laboratory experience, and prepara-

tion in statistics and computer science are desirable. The general and subject (biology or biochemistry, cell, and molecular biology) tests of the Graduate Record Examination are required.

M.S. Degree Requirements

The program for the master of science degree is formulated by the student with the approval of the guidance committee. Master's students are required to take a minimum of 30 credits, including a core of at least three genetics courses, for a minimum of 10 credits (seminars and thesis excluded). Candidates for the degree will be required to complete a thesis and pass an oral examination covering graduate courses and thesis.

Ph.D. Degree Requirements

The chairperson of the genetics program, with the concurrence of the chairperson of the department of major interest, nominates the student's guidance and doctoral committees, which administer the qualifying and final examinations. Specific course requirements are developed by the student and the guidance committee. Doctoral students are expected to have a broad exposure to genetics courses, exceeding that required of master's students. Students must complete a dissertation on original research in genetics.

The guidance committee for each graduate student determines whether a foreign language will be required.

Teaching Experience

All students are required to participate in a one-year directed teaching experience and are required to attend genetics seminars.

802. Genetics Lab

An experimental approach to understanding the fundamental principles of heredity. The lecture covers theoretical aspects of genetics hypothesis testing, data analysis, and techniques of isozyme and DNA electrophoresis and polymerase chain reaction (PCR). In lab, students conduct mating and mutagenesis experiments with plants, animals, and yeast; do human DNA fingerprinting; employ techniques of DNA isolation, electrophoresis, PCR, cytogenetics, and statistical analysis to generate and interpret genetic data. Prereq: principles of genetics or equivalent. (Also offered as BIOL 802.) Special fee. Lab. 4 cr.

804. Microbial Genetics

Expression and transfer of genetic elements (chromosomal and nonchromosomal) in prokaryotic and eukaryotic microorganisms; consideration of factors influencing public health, industry, the environment, and society. Students earning credit for PBIO 754/854; BCHM 754/854; GEN 754/854 may not receive credit for MICR 704/804. Prereq: general microbiology; biochemistry (Also offered as MICR 804.) Lab. 4 cr.

805. Population Genetics

An exploration of the forces affecting the frequency and distribution of allelic variation in natural populations. The relative role of mutation, selection, random drift, and inbreeding in structuring genetic variation. Quantification of the genetic structure of populations. Prereq: principles of genetics; applied biostatistics I recommended. (Also offered as ZOOL 805) Special fee. 4 cr. (Not offered every year.)

806. Human Genetics

The genetic basis of human traits and diseases. New understanding added by molecular genetic approaches. Human genome project, gene therapy. Discussion of genetic components of quantitative and behavioral traits, and human evolution. Prereq: principles of genetics or permission. (Also offered as BCHM 806) 3 cr. (Not offered every year.)

811. Genetics of Eukaryotic Microbes

Expression and transfer of genetic material in eukaryotic microbes including fungi, algae, protozoa, and *Caenorhabditis elegans*. Laboratory experience in DNA sequence entry retrieval and analysis. Macintosh workstations are used for accessing and retrieving data from the National Laboratory of Medicine and other sources via the Internet. Prereq: general microbiology; principles of genetics. (Also offered as BCHM 811 and MICR 811.) Special fee. Lab. 4 cr.

815. Molecular Evolution

Rates and patterns of evolutionary change in biomolecules. Forces affecting the size and structure of genomes. Molecular mechanisms of organismal evolution. Emphasis on integrating evidence from biochemistry, molecular genetics and organismal studies. Methods for reconstructing phylogeny from molecular sequences. Prereq: principles of genetics. Some knowledge of statistics and familiarity with personal computers is recommended. (Also offered as ZOOL 815.) Special fee. Lab. 4 cr. (Not offered every year.)

822. Immunogenetics

Cellular interactions and immune regulatory mechanisms. Genetics of the major histocompatibility complex, antibody diversity, and immune responses. (Also offered as ANSC 822.) 4 cr. (Offered alternate years.)

823. Quantitative Genetics

Analysis of continuous variation in populations simultaneously segregating at multiple loci. Genetic and nongenetic factors and the complex interactions between them. Models and methods of analysis, for both theoretical and practical applications. Prereq: principles of genetics; applied biostatistics I, strongly suggested. (Also offered as ZOOL 823.) Special fee. Lab. 4 cr. (Not offered every year.)

853. Cytogenetics

Chromosome structure, function, and evolution. Eukaryotic genome organization. Theory of, and laboratory techniques for, cytogenetic analysis in plants and animals. Prereq: principles of genetics. (Also offered as PBIO 853.) Special fee. Lab. 4 cr. (Not offered every year.)

854. Laboratory in Biochemistry and Molecular Biology of Nucleic Acids

Application of modern techniques to the analysis of biomolecules, with an emphasis on nucleic acids; includes DNA isolation and analysis, cloning and sequencing and analysis of gene products. Students may not receive credit for this course and microbial genetics. Prereq: general biochemistry, principles of biochemistry or permission. Special fee. Lab. 5 cr.

871. Molecular Genetics

Structure, organization, replication, dynamics, and expression of genetic information in eukaryotes. Focus on molecular genetic *mechanisms* of gene expression and its control; molecular genetics *methods*; molecular genetic control of cell division and differentiation during development. Prereq: general biochemistry or 851; principles of genetics; or permission. (Also offered as BCHM 871.) 3 cr.

874. Plant Cell Culture and Genetic Engineering

Theory and techniques of cell/tissue culture and genetic manipulation in plants, transformation vectors, somatic cell genetics, regulation of foreign gene expression, molecular basis of agriculturally important traits, environmental and social implications of genetic engineering in plants. Prereq: genetics or permission. Coreq: GEN 875. (Also offered as PBIO 874.) 3 cr.

875. Plant Cell Culture and Genetic Engineering Lab

Techniques of plant cell and tissue culture, protoplast fusion, genetic transformation. Mutant cell selection, analysis of foreign gene expression. Coreq: GEN 874. (Also offered as PBIO 875.) Special fee. 2 cr.

882. Developmental Genetics

The molecular genetic basis of metazoan development. Focuses on how genes direct the process of development and how this problem is analyzed in model organisms using molecular approaches. Topics include: control of cell division, maternal factors, cell-cell interactions, and differential gene expression. Prereq: principles of genetics; general biochemistry; BCHM 851. (Also offered as BCHM 882.) 3 cr.

#904. Advanced Microbial Genetics

Advanced studies in expression, regulation, recombination, and transmission of genetic information in prokaryotic microorganisms. Prereq: GEN 804; permission. (Also offered as MICR 904.) Special fee. Lab. 4 cr. (Not offered every year.)

942. Biochemical Regulatory Mechanisms

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: BCHM 852 or permission. (Also offered as BCHM 942.) 3 cr.

991. Advanced Topics in Molecular Genetics

Selected topics of current research in molecular genetics including gene structure and function, chromosome structure, and gene expression. Emphasis on eukaryotic model organisms such as worms, flies, zebra, fish, and mice. Prereq: permission. (Also offered as BCHM 991.) May be repeated to a maximum of 6 credits. 3 cr.

992. Advanced Topics in Molecular Biology

Selected topics of current research on the molecular biology of gene regulation, protein interactions, and the AIDS virus. Emphasis on eukaryotic systems such as yeast and mammals. Prereq: permission. (Also offered as BCHM 992.) May be repeated to a maximum of 6 credits. 3 cr.

995, 996. 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. 2–4 cr.

998. Genetics Seminar

Presentation and discussion of selected genetic topics. May be repeated. 1 cr. Cr/F.

899. Master's Thesis

6–10 cr. Cr/F.

999. Doctoral Research**Courses Available in Related Areas**

These courses are fully described below and under the appropriate department for the convenience of the student.

*Natural Resources***811. Statistical Methods II**

Intermediate course; basic concepts of sampling, linear models and analyses for one-way and multiway classification, factorial arrangement of treatments, multiple regression, and covariance. Computer programs used in analyzing data. Examples from environmental sciences. Prereq: applied statistics or equivalent. 4 cr.

*Plant Biology***873. Breeding Improved Varieties**

Techniques for creating new varieties of crop and ornamental plants. Discussion and assigned readings in crop breeding. Prereq: genetics. 4 cr.

Graduate School and College Teaching (GRAD)**Graduate Program Coordinator:**

Harry J. Richards

Degrees Offered

The college teaching program prepares graduate students for academic teaching positions. Students must be ready to eff-

fectively teach in their field or discipline upon completion of program requirements. The transfer and relationship between theory and research and instructional practice is emphasized in all courses. It is a university-wide program coordinated by the Office of the Dean of the Graduate School involving the University Teaching Excellence Program and faculty members from many fields and disciplines. Two academic programs are offered: the Cognate in College Teaching and the Master of Science for Teachers.

The Cognate in College Teaching Requirements

This program requires the satisfactory completion of 12 academic credits and emphasizes the development of classroom teaching skills in a specific field or discipline. Students elect, with the permission of their graduate coordinator, to add the cognate to their graduate degree. All doctoral programs are eligible to offer this program to their students. Students are admitted after one year of graduate study based upon the recommendation of the coordinator of their graduate program. Special permission is needed to add the Cognate in College Teaching to a master's degree. The cognate will be awarded at the time of the award of the qualifying graduate degree.

Requirements include 3 credits in the GRAD 950 series, including GRAD 950, Issues in College Teaching. Students also complete a minimum of 3 credits in field and disciplinary studies related to teaching in their specific area of graduate study. A list of approved graduate level courses for field and disciplinary studies is available and includes courses in the GRAD 970 and 980 series. All students also must complete 6 credits in GRAD 990, College Teaching Praxis.

Master of Science for Teachers Degree Requirements

This program is available to doctoral students as a dual degree. Doctoral students interested in earning the M.S.T. apply after completing one year of doctoral studies. All applications require the endorsement of the student's doctoral program coordinator. Under special circumstances, admission is granted by the dean of the Graduate School to others having career goals involving teaching in post secondary education.

Building upon the basic foundation in college teaching, the M.S.T. program adds advanced studies in specific content related to teaching and learning from many fields, the evolving role and function of the professor in higher education and post secondary academic institution, and specific methods related to pedagogical improvement and research. Completion of the M.S.T. as a dual degree with the Ph.D. may lengthen the time usually needed to earn the doctoral degree. Under no circumstances will the M.S.T. be awarded to a doctoral student who fails to complete the doctoral degree.

Requirements include core requirements of 12 credits earned using 4 credits from the GRAD 950 series of courses and 8 credits earned from the GRAD 960 series of courses. All GRAD 960 courses are available using alternative scheduling and may rely upon computer-mediated interaction with the instructors. Students also complete a minimum of 8 credits in field and disciplinary studies related to their specific area of graduate study. A list of approved courses for field and disciplinary studies is available and includes courses in the GRAD 970 and 980 series. All students also must complete 12 credits in GRAD 990, College Teaching Praxis.

Some graduate programs have requirements that complement the requirements of these university-wide future faculty programs. In these instances, formal articulating agreements insure fully coordinated programs so that students are not required to duplicate requirements. Information on existing articulation agreements is available from the coordinator of this program or specific graduate program director.

Permission to enroll in GRAD 990, Teaching Praxis, is dependent upon the student's readiness to be an effective instructor. Readiness is determined by the coordinator based upon the recommendation of the faculty. Permission to enroll in GRAD 990 is also based upon the satisfactory completion of prerequisite requirements and the ability to communicate effectively in a college classroom as an instructor. Students may be required to submit evidence to verify this ability to communicate effectively in a classroom as a prerequisite. Responsibilities as a teaching assistant are insufficient to demonstrate the competencies needed to complete GRAD 990, College Teaching Praxis.

800. Continuing Enrollment

All continuing graduate students who are not enrolled for course credits, thesis credits, Doctoral Research (999), or Master's Continuing Research (GRAD 900) are required to register for GRAD 800 each semester of the academic year (or each summer for students in Math M.S.T. and English M.S.T. programs). Students registered for GRAD 800 are considered part time. 0 cr. Not graded.

900. Master's Continuing Research

Master's students who have completed all course requirements, registered for all maximum number of thesis or project credits, and are in residence completing their master's program must register for Master's Continuing Research. Students registered for GRAD 900 are considered full time. 0 cr. Not graded.

950. Issues in College Teaching

Issues faced within the classroom including evaluation methods, classroom climate and diversity, instructional approaches, teaching and learning resources, and student behavior. Case studies. Prereq: permission. May be repeated to a maximum of 4 credits. 1 cr. Cr/F.

951. Teaching with Writing

Examination of the issues, principles, and practices of using writing to enhance learning. Appropriate for all fields and disciplines. Participants design and field test assignments. Seminar requires field work and independent research. 1 cr. Cr/F.

952. College Teaching Mentorship

Individual interaction with a senior professor to develop insights related to college-level teaching. Students observe and analyze instructional approaches based upon the professor's teaching philosophy and teaching traditions within a specific field or discipline. Micro teaching may be required. Prereq: permission. May be repeated for a maximum of 2 credits. 1 cr. Cr/F.

953. Readings in College Teaching

Seminar involving perspectives offered by specific scholars related to teaching and learning in higher education. Selected works include scholars from the many fields including the social and natural sciences, humanities, and applied and professional fields. A major paper is required. Prereq: permission. May be repeated for a maximum of 2 credits. 1 cr. Cr/F.

960. Research in College Teaching

Examination of research related to college teaching. Includes research related to learning theories, classroom assessment methods, the role of the professor in colleges and universities, institutions of higher educator, and college students. Offered in modules. Prereq: permission. May be repeated to a maximum of 10 credits. 2–4 cr.

961. Cognition, Teaching, and Learning

Cognitive theories and their application to classroom instruction. Examination of historical relation between cognition and education as well as current application of cognitive theory in the learning process. Cognitive skills involved in the learning process. Teaching strategies that enhance the use of cognitive skills and improve learning and teaching effectiveness. Prereq: permission. 2 cr.

962. Academic Citizenship

Issues facing professors as a group within today's

academic world. Topics include defining higher education in contemporary terms, the variety of American academic institutions and their diverse missions, associated career paths, the academic ethic, and the status of academic freedom in today's climate. Examination of the rights and responsibilities of the contemporary professor. Prereq: permission. 2 cr.

963. College Students and the Undergraduate Culture

Examination of the contemporary undergraduate culture and related issues. Consideration of recent research. Content includes research on educational outcomes, student responsibilities, and related topics. Prereq: permission. 2 cr.

964. Teaching with Technology

Examination of the multiple roles of technology in teaching and learning. Research related to the efficacy of using technology. Case studies and demonstrations. Students assess technological options available to enhance teaching a specific course. Prereq: permission. 2 cr.

965. Classroom Research and Assessment Methods

Examination of methods used in classroom assessment and classroom research. The focus is on the improvement of teaching and learning in a teacher's own classroom. Research project is required. Prereq: permission. 2 cr.

970. Special Topics in College Teaching

Formal courses in college teaching: A) field studies; B) disciplinary studies, C–Z other. Prereq: permission. May be repeated to a maximum of 10 credits. 2–4 cr.

971. Teaching and Learning in Science

Issues, activities, and research in science education, including history of curricula, student and teacher knowledge and beliefs, epistemologic and cognitive bases of science learning, and related instructional approaches. Extensive reading, writing, discussion, and reflection are included. Not open to all students who have completed CHEM 971. Prereq: permission. 3–4 cr.

972. Laboratory and Field Experience in the Sciences

Focus on developing effective relevant exercises and demonstrations in both physical and biological sciences. Theories and examples of successful design strategies as well as issues of health, safety and liability. Students develop potential syllabus for laboratory-lecture course and prepare and lead a sample laboratory or field exercise. Not open to students who have completed NR 972. Prereq: permission. May be repeated to a maximum of 3 cr. 1 cr.

973. Large Enrollment Classes in the Sciences

Unique issues associated with teaching large classes in the sciences. Strategies to attain rapport with the class, stimulate student interest, and promote effective learning. Specific techniques for managing the large class. Students prepare and deliver sessions in their respective fields. Not open to students who have completed NR 973. Prereq: permission. May be repeated for a maximum of 3 credits. 1 cr.

974. Teaching Practicum in Sociology

Helping graduate students deal with teaching is-

ues, explore teaching techniques, and improve their teaching skills. Topics include setting course goals, designing lectures, evaluating student work, leading discussion, and experimenting with innovative teaching techniques. Not open to students who have completed SOC 990. May be repeated to a maximum of 8 credits. 4 cr.

975. College Teaching in the Life Sciences and Agriculture

Analysis of teaching strategies at the collegiate level. The planning, execution, and evaluation of instruction for meeting the needs of the young adult learner. Recommended for all who wish to teach in a collegiate setting. Discussion of lecturers of selected distinguished UNH lecturers. Not open to students who have completed AOE 900. Prereq: permission. May be repeated for a maximum of 4 credits. 2 cr.

976. Seminar in the Teaching of Social and Behavioral Science

Examination of issues and strategies related to teaching introductory level courses in the social sciences. Seminar focuses on both practical and theoretical issues of significance in the teaching/learning process at the college level. Not open to student who have completed PSYC 991 or 992. Prereq: permission. May be repeated. 3 cr.

977. Physics Teaching Seminar

Course for new graduate students provides an introduction to their role as teaching assistants. The course is designed to raise awareness of professional responsibilities, to provide instruction on theory-based teaching and learning, and to provide opportunities for reflective practice. Not open to students who have completed PHYS 901. May be repeated to a maximum of 3 credits. 1 cr. Cr/F.

978. Teaching Economics

Analysis of the content, methodology, and pedagogy in college economics courses. Effects upon college students of economics. Exploration of relevance of other social sciences, the humanities, the natural sciences, and mathematics for undergraduate economic education. Not open to students who have taken ECON 898. Prereq: permission. 4 cr.

980. Independent Study

Faculty supervised independent studies in college teaching. Prereq: permission. May be repeated to a maximum of 12 credits. 1–4 cr.

990. College Teaching Praxis

Formal experience in teaching a college level course. Development of a teaching portfolio. Prereq: permission. May be repeated for a maximum of 12 credits. 1–3 cr.

Health Administration (HMP)

Chairperson: Jeffrey Colman Salloway
Professors: David A. Pearson, Jeffrey Colman Salloway, John W. Seavey, Lee F. Seidel

Associate Professors: Marc D. Hiller, James B. Lewis

Research Associate Professor: Michelle R. Solloway

Assistant Professor: Theodore D. Peters

Graduate Program Coordinator: Jeffrey Colman Salloway

Degree Offered

The Department of Health Management and Policy offers a program leading to the master of health administration (M.H.A.), the professional degree of the field, in a format designed primarily for the experienced and practicing individual in health management and policy. The objective of the program is to enable students to improve their effectiveness and performance in the management of health care organizations, services, programs, and policies.

Admission Requirements

The department is pleased to review for admission individuals who: (1) have a baccalaureate degree from an accredited college or university; (2) submit scores from either the Graduate Management Admissions Test (GMAT) or the general test of the Graduate Record Examination (GRE); (3) have successfully completed undergraduate courses from an accredited college or university in each of the following areas: financial accounting, statistics; (4) have satisfactory health-related professional experience (minimum of two years); and (5) have acceptable recommendations from three individuals, one of whom must be a member of an academic faculty and another must be experienced in the field of health management and policy. Applicants are expected to be computer literate. The department maintains a computer lab with twenty-one PCs currently running applications in Windows 95 (Word, Excel, Access, Power Point, etc.).

M.H.A. Degree Requirements

Directed primarily at the employed professional, the M.H.A. curriculum consists of a coordinated and sequenced grouping of twenty courses normally completed over twenty-two months of study involving two weekends per month (Friday/Saturday) from September through late May, plus two one-week residential periods—one in late August, the other in late May. Competencies from the functional areas of management (accounting, finance, human resources

management, marketing) are linked with skill courses involving the planning, administration, and evaluation of health and medical care services. Satisfactory completion of a field study experience (praxis) is also required.

810. Financial Management for Clinicians

Includes basic elements of health care financial management and cost accounting, including cost concepts and product costing, budgeting, and variance analysis with an emphasis on the departmental level of health care organizations. Contains an overview of basic principles of accounting, focusing on the balance sheet and statement of revenues and expenses to include their analysis using the tools of ratio analysis. Concludes with the basic concepts of capital project analysis and health care reimbursement. Note: This course is not part of the M.H.A. sequence. Prereq: enrollment in nursing master's program; HMP majors not allowed. 3 cr.

900. Health Care in the United States

Identification and examination of elements that comprise the health care system in the United States. Analysis of interaction between health organizations with political, economic, and other social systems. 3 cr.

901. Health Economics

Application of economic concepts and principles to the study of health services; emphasis on the financing and delivery of personal medical care systems. 3 cr.

903. Health Care Planning

Theoretical and historical foundations of health planning; the relationship of health planning and regulation; application of planning methods; and use of strategic planning and its relationship to marketing. Prereq: permission. 3 cr.

904. Health Policy

Analysis of the public policy process and development of health policies in the United States, discussion of specific health policy issues. 3 cr.

#905. Long-Term Care Policy

Seminar on public policy including home-based, community-based, and institutionally based services; selected federal and regional policy issues in planning for and responding to the needs of an aging population. 3 cr.

#906. Comparative Health Care Systems

Analysis and comparison of world health problems and delivery systems using nations with different cultures, political and economic systems, and stages of economic development. Methods for developing and evaluating health care systems. 3 cr.

#907. Managed Health Care

Discussion of the historical antecedents of managed health care; exploration of current techniques directed at controlling health care costs. 3 cr.

908. Health Care Quality Assurance and Assessment

Historical antecedents of quality measurement and assurance programs. Describes and evaluates current approaches to assessing and improving the quality and management of health care including application of total quality management. 3 cr.

910. Epidemiology

Distribution and determinants of disease, illness, and health in the community. Community health and illness measures, status, and data. Applications to health services management. 3 cr.

911. Statistics in Health Care Management

Application to health administration and policy of statistical tools. Includes frequency distributions, measures of central tendency, measures of variability, and probability plus linear correlation, regression, analysis of variance, and other statistics. 3 cr.

912. Quantitative Methods in Health Care Management

Applications of statistical methods, operations research, and quantitative management sciences within health management and policy contexts. 3 cr.

920. Organization Theory in Health Care

Application of organization theory and behavior to health organizations. Motivation and leadership, work group dynamics, communications, and negotiations within the health care organization as an open system; concentrates on topics involving organizational design, change, and innovation. 3 cr.

921. Managing Health Services

The role and function of the manager, governance, and the management of operations in health care organizations. Determinants of management strategy and action. 3 cr.

923. Health Services Marketing

Theories and practices of marketing and marketing research. Marketing strategies and outcomes examined from the perspective of the health care organization and professional. 3 cr.

924. Human Resources Management in Health Care

Role of human resources management in meeting goals in health care organizations, functions of human resources management, organization of personnel activities and staff, relationship of managers to personnel administration staff and activities. 3 cr.

925. Ambulatory Care Management

Synthesis and integration of the subject and application of theory to actual situations through the use of case studies that raise management issues and problems in a wide variety of ambulatory care settings. 3 cr.

926. Health Care Management Information Systems

Concepts and implementation of information systems to support managerial planning, control, and decision making. Processes for information system analysis, design, and implementation. 3 cr.

927. Management of Mental Health Services

Synthesis and integration of the subject and application of theory to actual mental health administration situations through the use of case studies. 3 cr.

928. Long-Term Care Management

Use of case studies to describe situations and problems faced by long-term care managers; synthesis and integration of the subject matter and application of theory to actual long-term care management situations. 3 cr.

#929. Hospital Management

Synthesis and integration of the subject matter and application of theory to actual hospital management situations through the use of case studies. 3 cr.

930. Managerial Accounting for Health Care Organizations

Cost accounting, cost analysis, and budgeting in planning and controlling health services. Techniques of variance analysis, cost allocation, ratio analysis, and management of working capital, rate setting, and reimbursement. 3 cr.

931. Health Care Finance

Capital investment decision analysis, sources, and uses of capital to finance health organizations. Theories of finance related to the management of health organizations. 3 cr.

932. Health Care Reimbursement

Analysis and discussion of payment techniques used by third-party payers to pay for services rendered to insured or program beneficiaries by health care organizations and individual providers. 3 cr.

940. Legal Strategies in Health Care

Legal issues that affect the management of health care organizations. Topics include corporate liability, anti-trust, contract law, tort issues, and labor law. 3 cr.

950. Ethics and Health Care

Professional and ethical issues confronting health services administrators. Case studies apply different models of ethical decision making. Analysis of competing organizational and professional interests, values, and responsibilities. 3 cr.

960. Advanced Topics in Health Management and Policy

Discussion of current topics in selected areas of health management and policy. 1–3 cr.

975. The Praxis

An applied experience consisting of field study and the development of management or policy case studies and supporting analysis to explore the relationship between theory and professional practice. 1–3 cr. Cr/F. IA.

995. Independent Study

Directed readings and other activities to explore a specific topic related to health management and policy. Prereq: permission. 1–3 cr.

998. Strategic Management of Health Care

Examination of the operations of health service organizations through the role of the manager. Uses case studies and other techniques to integrate content covered in previous courses. 3 cr.

Adjunct Professors: Michael J.

Donnelly, Stephen H. Hardy, Laurel Ulrich

Associate Professors: W. Jeffrey

Bolster, Ellen Fitzpatrick, Cathy A. Frierson, Jan V. Golinski, J. William Harris, Jr., Gregory McMahon, Lucy E. Salyer, Marc L. Schwarz

Adjunct Associate Professor:

William R. Woodward

Assistant Professors: Funso Afolayan,

Kurk Dorsey, David Frankfurter, Eliga H. Gould, Yan Lu, Bernard Schlager, Ethel Sara Wolper

Adjunct Assistant Professor:

Deborah J. Coon

Graduate Program Coordinator:

W. Jeffrey Bolster

Degrees Offered

The Department of History offers the master of arts and doctor of philosophy degrees. The master of arts is offered in many fields. Doctoral dissertations may be written on the history of the United States or on topics comparing the United States with other societies or areas.

Admission Requirements

The department usually requires evidence of substantial preparation in history at the undergraduate level, together with some preparation in other areas of humanities and social sciences.

Applicants for admission to any graduate program in history should have a minimum of a B average in history, allied humanities, and social sciences. In addition, applicants must submit general test scores from the Graduate Record Examination. 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 coursework as a special student, but such coursework 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. Students in seminar or reading courses in other than American history may be required to have a reading knowledge of at least one foreign language appropriate to the particular course. Applicants should include with their applications a personal statement indicating their reason for undertaking graduate study at the Univer-

sity of New Hampshire. Normally an entering student intending to be a candidate for the doctorate will complete an M.A. program as a prerequisite. However, students with the M.A. from another institution, or with exceptionally strong preparation at the undergraduate level, can begin the doctoral program immediately. In addition, a student in residence can, with the consent of the department, omit the M.A. and proceed directly toward the Ph.D.

M.A. Degree Requirements

A master's student designs a specific program to meet one of three plans. Plan A allows substantial training and research in a single subfield of history but within a foundation of broader coursework. Plan B allows substantial breadth over at least two subfields. The subfields in history include the following: the ancient world, medieval Europe, early modern Europe, modern Europe, European intellectual history, medieval England, early modern England, modern England, early modern France, modern France, early modern Germany, modern Germany, Iberia, Russia, early U.S., modern U.S., colonial Latin America, modern Latin America, the Far East, the Near East, sub-Saharan Africa, and the history of science. Plan C allows students who enter the doctoral program without an M.A. to pursue the M.A. and Ph.D. degrees simultaneously.

Plan A: At least eight courses in history numbered 800 or above, including at least one research seminar; a thesis in a single subfield (equivalent to two courses).

Plan B: At least ten courses in history numbered 800 or above, including at least one research seminar; oral examination demonstrating competence in two subfields of history.

Plan C: At least 30 credits of coursework during preparation for the Ph.D. qualifying examinations, as described below; submission of a seminar or other research paper as a demonstration of competence in basic research techniques; passing Ph.D. qualifying examinations.

History (HIST)

Chairperson: J. William Harris, Jr.

Professors: Charles E. Clark, Jeffrey M. Diefendorf, Francis D. McCann, Jr., Robert M. Mennel, Janet L. Polasky, Harvard Sitkoff, Douglas L. Wheeler

Ph.D. Degree Requirements

A doctoral student's program, which must be approved by the graduate committee of the department, shall include each of the following requirements:

- 1) two research seminars; one in early U.S. history and one in modern U.S. history;
- 2) a course in historical methods;
- 3) correction of any deficiencies in the student's previous program;
- 4) two languages or one language and a special research technique, whichever is deemed most relevant to the area of research;
- 5) preparation through reading and coursework in the entirety of U.S. history, with accent upon either early or modern U.S.;
- 6) preparation through reading and coursework of two subfields outside of U.S. history, one of which may be a cognate field outside of history entirely;
- 7) qualifying exams;
- 8) dissertation and successful defense.

Note: In the definition of fields above, "United States" and "U.S." are understood to mean the United States and its colonial antecedents.

Apprenticeship

The department considers that graduate work in history, and particularly doctoral work, is professional training. 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.

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 requirement.

800. Advanced Exploration in History

See department listings for semester topic. Barring duplication of subject, may be repeated for credit up to 12 credits. 1–4 cr.

803. The European Conquest of North America

A study of the social consequences of colonization, migration, and war in America, 1500–1775. Emphasis on the interaction of British colonists with competing European cultures (French, Dutch, Portuguese, and Spanish), with Native Americans, and with African and Afro-American slaves. 4 cr.

805. Revolutionary America, 1750–1788

Examines the social, political, and cultural transformation of thirteen British colonies into the United States, up to the adoption of the Constitution. 4 cr.

806. History of the Early Republic

Explorations in the histories of people and institutions that transformed the new United States from a coastal republic of largely independent freeholders to a transcontinental democracy increasingly riven by class. Topics include slavery, the family, reform movements, and the formulation of national identity. 4 cr.

809. U.S. Legal History Special Topics

In-depth thematic exploration of the role of law in American life. Topics include Race and Equality in American Law; Community, Pluralism, and American Law; Property, Liberty, and Law; Gender and Law. May be repeated for credit with instructor's permission. Consult department listing for topics. 4 cr.

811. Civil War and Reconstruction in the United States

A survey of the period from the presidency of Andrew Jackson to the end of the Reconstruction, focusing on the causes, course, and consequences of the Civil War. Topics include slavery in the Old South, antebellum reform movements, creation and breakdown of the Second Party System, social and economic (as well as military) events during the war, and major developments during Reconstruction after the war. 4 cr.

812. The Emergence of Industrial America

Investigates the economic transformation of 19th-century America from a rural, agricultural to an urban, industrial society. Explores the sweeping economic changes, focusing on such topics as changes in work and leisure, westward expansion and its effects on native Americans, shifts in gender roles, growth of a consumer culture, rise of labor unions and populism, immigration, movements for reform and regulation, growth of American imperialism, and intellectual developments. 4 cr.

815, 816. 20th-Century United States

Advanced study of the U.S. after 1900; cultural, political, and social factors causing major changes in American life. Semester I: progressivism through the New Deal. Semester II: World War II to the present. 4 cr.

817. The Vietnam War

An advanced interdisciplinary study of the American experience in Vietnam which uses fiction, film, music, and historical analysis to examine such matters as how and why the United States became involved in Vietnam, went to war there, and failed to win, as well as the consequences and legacies of that fateful conflict. It is strongly suggested that students first complete courses in modern American history. 4 cr.

819, 820. The Foreign Relations of the United States

The history of American diplomacy from the colonial era to the present, with the dividing point at 1900. The focus will be on both the foreign and domestic influences that shaped American diplomacy. 4 cr.

821, 822. History of American Thought

Advanced study in the history of American thought. Significant American thinkers considered in their social context. Semester I: 1600–1860. Semester II: 1860–present. 4 cr.

#823. Anglo-American Social History

Study of everyday life in British America and the early United States, 1600–1820, with an emphasis on gender, class, and race. Consideration of child-bearing, labor systems, religious observance, crime, and other themes in the light of recent social theory. Readings in both primary and secondary literature, with an emphasis on local records and on material culture. 4 cr.

824. Topics in Modern U.S. Social History

Advanced study of topics in U.S. social history since the Age of Jackson. Topics will vary; and may include such examples as slavery and the antebellum South; reform movements in U.S. history; family history; labor history; the impact of war on American society; race in recent U.S. history. May be repeated as topics change. 4 cr.

825. Southern History and Literature since 1850

Equal focus on the history and literature of the South. Topics include slavery, the Civil War, Reconstruction, the age of segregation, and the civil rights movement. Literary focus is on the "Southern Renaissance" of the 1930s and after, including works by William Faulkner, Robert Penn Warren, Flannery O'Connor, and Richard Wright. 4 cr.

831. History of Brazil

Brazil has the fifth largest territory, the sixth largest population, and the eighth largest industrial economy in the world. Its colorful history has many distinctive features: the only country in the Americas to have been the capital of a European monarchy and then to have its own emperor for most of the last century; an outwardly peaceful image masking internal violence and turmoil; a suspicion of foreigners balanced by a desire to be accepted by them as equals; seemingly benevolent racial attitudes that serve to keep people of color on society's lower range; a tremendous cultural creativity that has given the world samba, film star Carmen Miranda, composer Heitor Villa-Lobos, songwriter Antonio Carlos Jobim, poet Vinícius de Moraes, and novelist Jorge Amado. The course also examines the roles of the various elites; political, social, economic, in a country, where, it has been said, "the unexpected always happens." 4 cr.

832. Latin American History: Topics

Topics vary (see department listing for current semester.) Seminar involves reading, discussion, and research on literature and documents related to the selected topic. It provides students with the opportunity to do research under close direction. 4 cr.

839, 840. Three Medieval Civilizations

Advanced study in medieval civilizations. 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.

841. Europe After the Black Death

Explores the dramatic changes that characterized Western Europe as it rebounded in the fifteenth through the seventeenth centuries from the ravages of the Black Death of 1348. Examines the social, political, and artistic developments in late medieval and Renaissance Italy before "crossing the Alps" to trace the expansion of Renaissance culture in Northern Europe. Topics covered in the course include the humanist movement, new patterns of social organization, the revival of classical antiquity in the arts, architecture, religion and political theory, the effects on European society of the encounter with the "New World," shifting roles for men and women in early modern European societies, and religious war and conflict. 4 cr.

842. Religious Conflict in Early Modern Europe

The religious, social, and political maps of Europe were profoundly and permanently altered in the sixteenth and seventeenth centuries due to the split of the Protestant churches from the Roman Catholic church initiated in 1517 by Martin Luther. Explores the background to the Protestant Reformation of the sixteenth century and then investigates the various personalities—the Protestant and Catholic reformers, the Princes, the artisans and peasants, the Anabaptist radicals—that shaped this era of religious change and conflict. Also explores the important effects of religious change on European society and culture, including changes in gender roles, family life, and popular cultural practices such as magic and witchcraft in the sixteenth and seventeenth centuries. 4 cr.

847. Early Modern France

An exploration of the culture and politics of early modern French society. Popular culture, religion, gender relations, the family, state-building, political theory, and revolution will be emphasized. Primary documents in translation will be read and discussion encouraged. 4 cr.

848. Modern France

Advanced study of French society from Napoleon to Mitterrand, including the Revolution of 1848 and the Paris Commune; world wars and the Vichy regime; existentialism, DeGaulle, and the Revolt of May–June 1968. 4 cr.

849. Comparative Topics in the History of Early Modern Europe

Topics will vary, but may include enlightenment and revolution; the peasantry; gender and the family; crime and deviance; science and society. May be repeated for a maximum of 8 cr. 4 cr.

850. History of European Socialism

History of socialist thought and movements in Europe in the 19th and 20th centuries. Examines Utopian Socialism, development of Marxism, emergence of the New Left, and new socialist developments in the late 20th century. 4 cr.

851, 852. Topics in European Intellectual History

Explores major developments such as the Enlightenment, Russian intellectual history, ancient world views and cosmologies, and the relationship be-

tween gender and intellectual history. 851 includes topics up to the Scientific Revolution; 852 includes topics since the Renaissance. Because topics vary, students should check the department newsletter or office for course theme in any given term. May be repeated for credit as topics change. 4 cr.

854. Topics in History of Science

Study of a selected topic in the history of European science since the Renaissance. 4 cr.

855. British History, 1688-1832

Examines British history from the Glorious Revolution to the passage of the First Reform Bill. Topics include the consolidation of parliamentary democracy, the rise of the middle class family, the emergence of a broad-based consumer society. Also the integration of England, Scotland, and Ireland into a single British state, as well as the consequences of Britain's growing imperial power in North America, India, and Africa. 4 cr.

#856. 20th-Century Europe

Advanced study of 20th-century Europe. World War I, European totalitarianism, World War II, the loss of European primacy, and the search for a new Europe. 4 cr.

859. History of Spain and Portugal

Advanced study of Iberian states and their peoples from the coming of liberalism to the present. Failure of Iberian and liberal government. Political and social change, imperial and intellectual movements, influence of western European thought and activity. 4 cr.

861, 862. England in the Tudor and Stuart Periods

Advanced study of England during the Tudor and Stuart periods. Political, religious, socioeconomic, and intellectual forces for change at work in England from the accession of Henry VII to the revolution of 1688–89. 4 cr.

863. Russia: Origins to 1905

Russia from its foundation through the revolution of 1905. Political, social, and economic developments; intellectual and ideological currents. 4 cr.

864. Russia: Modernization through Soviet Empire

The challenges of modernization; experience and legacy of Leninist and Stalinist revolutions; Soviet consolidation and decline through the Gorbachev era. 4 cr.

865. Themes in Women's History

In-depth examination of a selected topic in women's history, such as women and health, women in modern European political theory, comparative history of women and revolution. See *Time and Room Schedule* or department for specific topic. May be repeated for credit with permission of instructor. 4 cr.

867. Germany from the Late Medieval Period through the Reign of Frederick the Great of Prussia

Concentrates on the political, economic and social structure of the Holy Roman Empire, the Reformation in Germany, the Thirty-Years War, and the rise of Prussia. 4 cr.

868. Germany from 1786 to 1918

Concentrates on the end of Holy Roman Empire and Napoleonic domination of much of Germany, the Prussian Reform Era, industrialization, the revolutions of 1848, national unification under Bismarck, the Second Empire, and World War I. 4 cr.

869 Germany from 1918 to the Present

Begins with the revolution of 1918 and then explores the political, social, and intellectual character of the Weimar Republic, the rise and nature of Nazism, the Holocaust, the foundation of both the German Democratic Republic and Federal Republic and their evolution in the shadow of the Cold War, and concludes with the unification of Germany after the fall of the Berlin Wall in 1989. 4 cr.

870. Historical Thinking for Teachers

Examines the courses, methods, and interpretative strategies of the historian. Emphasis on texts and topics relevant to the middle- and high-school classroom. Designed for history teachers as well as individuals in the Master of Arts in Teaching (M.A.T.) program. No credit for students who have completed HIST 875. 4 cr.

871. Museum Studies

Introduction to theory, methods, and practice of museum studies. Examination of various museum functions, as well as historical controversies. Prereq: graduate students only. 4 cr.

872. Studies in Regional Material Culture

Designed to acquaint students with artifacts commonly used in New England homes during the period 1750–1860 and to present these artifacts in their contemporary cultural context, including their relationships with designers, clients, patrons, manufacturers, craftsmen, and consumers. 4 cr.

873 The Early History of Ancient Greece

Greek history from the Minoan and Mycenaean eras through the Persian Wars of the early fifth century. Emphasis on original sources including the Homeric epics, Plutarch, Sappho, and Herodotus. Examination of the distinctive developments of political systems in Sparta and Athens, as well as issues of colonization, diplomacy, religion and culture. Thorough discussion of types of available evidence and their integration into historical understanding. 4 cr.

874. Historiography

Analysis of ancient and modern historians. 4 cr. (Not offered every year.)

875. Historical Methods

Introduction to contemporary historical methods. Required of all entering Ph.D. candidates; open to undergraduates with permission. 4 cr.

876. The Classical and Hellenistic Greek Worlds

Greek History from the Persian Wars of the early fifth century through the life of Alexander the Great and the creation of the Hellenistic world. Emphasis on original sources including Herodotus, Thucydides, the Athenian playwrights, and Plato. Examination of the transformation from city-state political organization to large Hellenistic kingdoms, as well as discussion of Greek historiography, intellectual life, and social theory. Thorough discussion of types of available evidence and their integration into historical understanding. 4 cr.

877. The Roman Republic

Covers pre-Roman Italy, the Etruscans, and the foundation of the Republic. Rome's expansion through the Punic Wars, and relations with the Hellenistic kingdoms. Disintegration and final collapse of the Republic. Includes discussion of Roman art, engineering, and political theory. Emphasis on Latin sources in philosophy, history, and literature. 4 cr.

878. The Roman Empire

Collapse of the Roman Republic and creation of the Augustan principate. History of the principate through the division of the empire, with discussion of the fall of Rome in the west, and the eastern empire through Justinian. Discussion of Roman art, literature, philosophy, religious developments such as the proliferation of mystery religions and the rise of Christianity. 4 cr.

879. Workshop in History and Historical Methods

Workshop for teachers in History. Intensive work designed to introduce teachers to advanced current work in history. Topics vary. May be repeated with permission of the instructor or the graduate director in the history department. 1-6 cr.

881. Modern China Topics

Problems in modern Chinese history from 1800 to the present. Topics may vary. Students will read translated primary sources, analyze literary works, and write critical essays and a research paper. 4 cr.

882. Cults and Charisma

Examines religious sects and charismatic leaders using case studies from history and the contemporary world, as well as analytical principles from religious studies and anthropology. Explores various approaches to the question, "what makes a person powerful over others?", in connection with the formation of messianic sects, the genesis of the "cult," the traditional authority of priests and kings, sainthood, the events at Jonestown and Waco, and the popular image of the "cult." Students learn to employ a variety of tools and models to understand historical situations of charismatic leadership. 4 cr.

883. Religion in World History

Advanced study in the religious experience of man from the perspective of world history. The major modes of religion; development of the major religious traditions and institutions. 4 cr.

884. History of Southern Africa since 1820

Advanced study of southern Africa. Struggle for political and economic control in the only region of Africa where European groups remain in power. Effect of European imperialism, European settler nationalism, racial conflict, economic competition and industrialization, apartheid, and assimilation with special attention to development of European hegemony. Official American policy. 4 cr.

885. The Modern Middle East

Advanced study of the Middle East from 18th century to the present. Problems created by modernization and reform of the traditional society; conservative reaction to reform, impact of nationalism, and appearance of new ideologies. 4 cr.

886. States and Societies in Precolonial West Africa

An in-depth exploration of the nature and dynamics of state formation processes in West Africa. Focuses on major states such as Ghana, Mali, Songhai, Asante, Dahomey, Oyo, Benin, Borno and the Hausa States. Through a critical analysis of primary and secondary sources, film footage and video documentaries, the course examines the significance of such issues as oral tradition, migrations, religion, art, class, slavery, gender, trade, state, kingship, and warfare in African history. 4 cr.

887. Quantitative Methods and Computers for Historians

The historian's use of computers and statistics: opportunities and problems in using and analyzing quantitative sources; elementary statistical techniques; practical applications involving microcomputers and applications programs. No previous knowledge of computers or college mathematics is assumed or required. Prereq: admission as a graduate student in history or permission of instructor. 4 cr.

892. Seminar in the History of Science

In-depth examination of a selected topic in the history of science. Subject varies. No special background in science required. 4 cr.

939. Readings in Early American History

Introduces the chief themes and issues in the secondary literature of early American history from European settlement through the Early Republic. Students write a series of short analytical papers. Expected of all graduate students preparing a field in Early America. 3 cr.

940. Readings in Modern American History

An introduction to major historians and historiographical issues in the history of the U.S. since 1820. Intended to serve as a foundation for research in the field and as preparation for graduate examinations. 3 cr.

949. Colloquium in U.S. History

Topics include 1) Early American Society; 2) Early American Culture; 3) Revolutionary Period; 4) 19th Century; 5) 20th Century. Focuses on existing scholarly historical literature on a given topic, such as American slavery. Students normally read extensively, discuss major issues and the literature in class meetings, and write essays that examine the literature critically. 3 cr.

951. Colloquium in European History

Topics include 1) Medieval; 2) Early Modern; and 3) Modern. The course focuses on the existing historical literature on a given topic, such as the French Revolution. Students normally read extensively, discuss major issues and the literature in class meetings, and write essays that examine the literature critically. May be repeated if a different topic is selected. 3 cr.

952. Colloquium in Comparative History

Intensive reading in comparative studies of U.S. history. Compares the experience of the United States and that of some other area or nation. For example, comparing legal history of Britain and the U.S.; the impact of colonization on native peoples in North and South America; the nature of slavery in the U.S., the Caribbean, and Brazil; or

the experience of women in Europe and America. Topics vary and the course may be repeated with permission. 3 cr.

#953. Colloquium in African, Asian, Latin American History

Topics include 1) African; 2) Asian; 3) Latin American; 4) Middle Eastern. Focuses on the existing scholarly historical literature on a given topic, such as nationalism or slavery. Students normally read extensively, discuss major issues and the literature in class meetings, and write essays that examine the literature critically. 3 cr.

988. Historical and Descriptive Literature of Early America

The chief English-language writings about North America from John Smith and William Bradford to the book-length literature of the American Revolution, considered as sources, as documents of intellectual history and historiography, and as literary genres. Emphasis on development of skills of analytical and critical reading and professional-level scholarly writing. 3 cr.

989, 990. Research Seminar in American History

1) Early American Society; 2) Early American Culture; 3) Revolutionary Period; 4) 19th Century; 5) 20th Century. Focuses on original research on a given topic using primary materials supplemented by secondary works. The objective is to produce a major research paper that might serve as the basis for a publishable article. May be repeated with a different topic. 3 cr.

991. Research Seminar in European History

1) Medieval; 2) Early Modern; 3) Modern. Focuses on original research on a given topic using primary materials supplemented by secondary works. The objective is to produce a major research paper that might serve as the basis for a publishable article. May be repeated with a different topic. 3 cr.

992. Research Seminar in Comparative History

Comparative studies of U.S. history, emphasizing primary research. Colloquium compares the experience of the United States and that of some other area or nation. For example, comparing the legal histories of Britain and the U.S.; the impact of colonization on native peoples in North and South America; the nature of slavery in the U.S., the Caribbean, and Brazil, or the experiences of women in Europe and America. Topics vary, and the course may be repeated for credit. 3 cr.

993, #994. Research Seminar in African, Asian, Latin American History

1) African; 2) Asian; 3) Latin American; 4) Middle East. Focuses on original research on a given topic using primary materials supplemented by secondary works. The objective is to produce a major research paper that might serve as the basis for a publishable article. May be repeated with a different topic. 3 cr.

995. Tutorial Reading and Research in History

A) Early American History; B) American National History; C) Canada; D) Latin America; E) Medieval History; F) Early Modern Europe; G) Modern European History; H) Ancient History; I) Far East and India; J) Near East and Africa; K) European Historiography; L) American Historiography; M) Russia; N) World History; O) English History; P)

New Hampshire History; Q) Historical Methodology; R) Irish History; S) History of Science; T) Maritime. Prereq: permission. 1–6 cr.

997. Directed Readings in Early American History

Directed readings in Early American History. Supervised readings for students preparing for the Ph.D. examinations in Early American History. 1–6 cr.

998. Directed Readings in Modern U.S. History
Supervised readings for students preparing for Ph.D. examinations in Modern U.S. History. 1–6 cr.

899. Master's Thesis
6 cr. Cr/F.

999. Doctoral Research

Hydrology

(See Earth Sciences.)

Kinesiology (KIN)

Chairperson: Ronald V. Croce

Professors: Ronald V. Croce, Michael A. Gass, Stephen H. Hardy, Robert Kertzer

Associate Professors: Timothy J. Quinn, Neil B. Vroman

Assistant Professors: Heather Barber, Toni Bruce, Benedict P. Dyson, Daniel E. Garvey, Robert W. Kenefick, John P. Miller

Graduate Program Coordinator: Timothy J. Quinn

Degree Offered

The Department of Kinesiology offers a master of science degree with the following areas of concentration: exercise science, outdoor education, sport studies, and special physical education.

Admission Requirements

Admission is based on undergraduate preparation, academic record, Graduate Record Examination general test scores, and letters of recommendation. Applicants must be above-average students and show adequate preparation in the basic support courses of the selected concentration area. Applicants who have not met specific course prerequisites should expect to take additional undergraduate work without receiving graduate credit.

M.S. Degree Requirements

Students may follow either the thesis or the nonthesis plan. All degree candidates will be required to take KIN 800, Applied Statistics; KIN 901, Analysis of Professional Literature; the designated concentration core; and electives as required.

Exercise science core: 822, Graded Exercise Testing and Exercise Prescription; 832, Electrocardiography; 833, Environmental Physiology; two semesters of 902, Colloquium.

Sport studies core: 841, Sport in Society; 880, Psychological Factors in Sport; one adviser-approved KIN elective at the 800 or 900 level; two semesters of 902, Colloquium.

Special physical education core: 902, Colloquium; 909, Special Physical Education Practicum/Seminar; 842, Diagnostic Motor Assessment; 844, Medical and Exercise Issues of Disabling Conditions; and 12 credits of adviser-approved electives.

Any remaining coursework in the concentrations should be taken within the Department of Kinesiology; however, approval may be granted to take relevant courses outside the department.

Thesis plan: A minimum of 30 approved graduate credits including a thesis (24 graduate course credits plus 6 thesis credits) is required in the thesis plan plus an oral defense of the thesis.

Nonthesis plan: A minimum of eight approved graduate courses (with a minimum of 30 credits) is required in the nonthesis plan. Four credits of 895, Advanced Studies, are required. A student may take 895 only after completing at least three approved graduate courses including 901. Exercise science students who elect this plan must take 6 credits of 896, Advanced Research in Exercise Science. In addition, the exercise science student must orally defend his or her research.

800. Applied Statistics

Statistical procedures and associated elements of basic research design with direct, practical application to areas within physical education and other health disciplines. Prereq: measurement procedures or equivalent. 4 cr.

806. Neurology

A detailed study of the development, morphology,

internal configuration, physiology, histology, function, and pathology of the human nervous system. Labs consist of clinical case studies, brain dissections, and videos/slides to enhance the understanding of material. Prereq: human anatomy and physiology. Special fee. Lab. 4 cr.

821. Science and Practice of Strength Development

Designed to provide students exposure to the knowledge and practical experience necessary for establishing strength development programs in a variety of populations including healthy, athletic, and higher risk individuals. Program design, correct lifting techniques, physiological adaptations, and organization and administration of programs will be highlighted. Fundamentals regarding the selection of programs and equipment, spotting techniques, as well as ways to assess strength and power in humans without expensive equipment included. Prereq: physiology of exercise, exercise laboratory techniques. Permission. 3 cr.

822. Graded Exercise Testing and Exercise Prescription

Graded exercise testing and its application to the prescription of exercise. Special emphasis on the patient with cardiovascular disease. Prereq: physiology of exercise; permission. 4 cr.

824. Metabolic Adaptations to Exercise

An overview of the metabolic processes that occur during exercise and metabolic changes that occur as a result of exercise training. Topics covered include glycogenolysis and glycolysis in muscle, cellular oxidation of pyruvate, lipid metabolism, metabolism of proteins and amino acids, neural and endocrine control of metabolism, and fatigue during muscular exercise. Prereq: physiology of exercise and general chemistry. 4 cr.

825. Motor Control Issues in Dysfunction

An in-depth analysis of current motor control/learning theories from the fields of neurophysiology, psychology, and motor development as they relate to normal and pathological movement; discussions of important cognitive, anatomical, biomechanical, and physiological variables constraining movement organization; and, the application of basic research findings for appropriate therapeutic approaches to motor dysfunction. Prereq: kinesiology and neurology or motor learning or equivalent. Lab. 4 cr.

831. Advanced Exercise Science Laboratory Procedures

Students gain knowledge regarding laboratory equipment, theory and design. Technical laboratory skills developed. Topics include metabolic analyses, pulmonary function, body composition assessment, phlebotomy, and various blood/urine assays. Prereq: physiology of exercise, exercise laboratory techniques or equivalent. Special fee. Lab. 3 cr.

832. Electrocardiography

Introduction to electrocardiographic interpretation. Prereq: physiology of exercise or equivalent; permission. 4 cr.

833. Environmental Physiology

The human physiological response to both the acute and chronic effects of various environmental conditions, such as heat, cold, altitude, and air pollution. Prereq: physiology of exercise or permission. 4 cr.

840. Athletic Administration

Introduces basic management components and processes used in the successful administration of school and college athletic programs. Topics include: planning, organizing, and managing sports programs, personnel, and policies; game scheduling; finances and facilities; equipment and event management; student services; and key legal issues. Prereq: permission. 4 cr.

841. Sport in Society

An investigation into interrelationships among sport, culture, and society in an attempt to understand better the role and function of sport in contemporary society. Broad overview of selected sociocultural factors that influence participation and result from participation in sports. Prereq: introduction to sociology or permission. 4 cr.

842. Diagnostic Motor Assessment

Overview of diagnostic and prescriptive procedures used in special physical education. Psychomotor assessment instruments utilized by practitioners in the field are described, which can be applied when discerning level of performance in children with special needs. Prereq: measurement procedures in physical education. Lab. 3 cr.

843. Sport Marketing

A survey of concepts and processes used in the successful marketing of sport programs and events. Special emphasis placed on the unique or unusual aspects of sport products, markets, and consumers. Prereq: survey of marketing and methods or permission. 4 cr.

844. Medical and Exercise Issues of Disabling Conditions

A study of disabilities caused by anomalies found within neurological, cardiorespiratory, sensory, and musculoskeletal systems. Exercise and programming techniques necessary for physical and motor development relative to present physiological and kinesiological functioning addressed. Prereq: kinesiology or exercise physiology or equivalent. 3 cr.

850. Theories of Motivation in Sport and Exercise

Social cognitive theories of achievement motivation as they relate to sport and exercise participation. Special consideration given to the ways coaches, exercise leaders, and physical education teachers should motivate individuals. Prereq: introduction to psychology. 4 cr.

854. Advanced Human Motion Analysis

An in-depth analysis of human motion and the techniques of motion analysis. Focuses on the biomechanical aspects of human movement such as the kinematic variables of velocity, acceleration, and position, and on the myoelectrical components of voluntary movement. Students learn how motion analysis techniques are used in clinical and laboratory settings to quantitatively analyze both a normal and pathological movement pattern. Prereq: kinesiology or biomechanics; anatomy. Special fee. Lab. 4 cr.

870. Psychological Skills in Performance

Provides essential elements of psychological skills training in performance. Focuses on mental aspects that enhance or inhibit physical performance. Theory, direct skill acquisition, and skill application are all integral to this course. Topics include

progressive relaxation, meditation, hypnosis, goal setting, and stress inoculation testing. Prereq: introduction to psychology or psychological factors in sport. Special fee. 4 cr.

875. Sports Writing

Introduction to the basic concepts and skills of sports writing, particularly related to regular beat coverage of sports. Students learn how to write columns, advance, game and feature stories, to develop and retain sources, conduct interviews, and write well crafted stories. Students are exposed to sports journalism history and research into the dominant forms of representation of gender, race and class in the print sports media. 4 cr.

880. Psychological Factors in Sport

Factors of outstanding athletic achievement; psychological variables in competition; the actions and interactions of sport, spectator, and athlete. Special attention directed to strategies for coaches, teachers, and athletic trainers to utilize sport psychology in their professional practice. Prereq: introduction to psychology or perceptual motor learning. 4 cr.

881. Special Physical Education Pedagogy

Overview of special physical education. Corrective, developmental, and adapted approaches addressed in accordance with the physical and motor behaviors of children with special needs. Prereq: permission. 4 cr.

882. Therapeutic Applications of Adventure Programming

Examines the use of adventure activities as elements of therapeutic treatment plans. Incorporates theoretical seminars and associated practical experiences. Prereq: outdoor education philosophy; methods or theory of adventure education; permission. 4 cr.

884. Programs in Outdoor Education

Provides an understanding of outdoor education program models currently being used, analyzing the principles underlying the curriculum development and strategies for implementing such models. Prereq: permission. 4 cr.

885. Foundations of Adventure Education

Examination of the writings of thinkers such as Plato, Rousseau, and John Dewey and discussion of their applications to the field of adventure education. Topics include learning theory, human nature, aims of education, critical analysis and evaluation techniques. Prereq: permission. 4 cr.

886. Organization and Administration of Outdoor Education

Study of the administration of outdoor education programs using a variety of organizational models. Students develop and, through simulated exercises, manage a program. Field experience. Prereq: permission. Special fee. 4 cr.

890. Social and Health Issues in Sport Psychology

Current trends in social and health psychology as they pertain to the competitive sports environment. Examines areas such as adherence motivation, bulimia and anorexia in athletes, self-theory, exercise and depression, and substance abuse in athletes. Prereq: introduction to psychology or motor learning and control. 4 cr.

895. Advanced Studies

Independent study problems. Prereq: permission

of graduate adviser. May be repeated up to 8 cr. 2-4 cr.

896. Advanced Research in Exercise Science

Students design and conduct original research that culminates in a paper of publishable quality. Completion of either this course or KIN 899 satisfies the department's research requirement for the master's degree. May be taken for 3 credits per semester in each of two semesters or 6 credits in one semester. Maximum 6 cr. Cr/F. IA.

898. Special Topics

New or specialized courses not normally covered in regular course offerings. Prereq: permission. May be repeated up to 8 cr. 1-4 cr.

901. Analysis of Professional Literature

Critical interpretation of professional literature. 4 cr.

902. Colloquium

Seminar format with readings, discussions, laboratory tutorials, and presentations of current research topics. A) exercise science; B) outdoor education; C) special physical education; D) sport studies. 1 cr. Cr/F.

909. Special Physical Education Practicum/Seminar

Prepares master teachers to employ teaching skills so that they can interact effectively in educational environments. Methods for a special physical education teacher to design and implement an educational program for children with disabilities that are congruent with the idiosyncrasies of the public schools. May be taken twice for credit. 2 cr. Cr/F.

950. Internship

Experiential learning in a setting appropriate to the student's objectives. A 4-credit internship requires a minimum of 300 hours experience. Fewer credits require proportionally fewer hours. A) Exercise Science. Clinical work, normally in a hospital or laboratory setting, involving exercise physiology, graded exercise testing, exercise prescription, and/or cardiac rehabilitation. Must have completed all required coursework except thesis. B) Special Physical Education. C) Sport Studies. 2-4 cr. Cr/F.

986. Outdoor Education Seminar

Students are involved in an in-depth analysis of a particular aspect of outdoor education through a series of experiential and seminar activities. Prereq: permission. 4 cr.

899. Master's Thesis

6 cr. Cr/F.

Liberal Studies (LS)

Chairperson: Paul T. Brockelman
Professors: David S. Andrew, Art and Art History; Paul T. Brockelman, Philosophy; Charles E. Clark, History; Barbara T. Cooper, French; Michael K. Ferber, English; Barbara E. Houston, Education; Mara R. Witzling, Art and Art History

Degree offered

The liberal studies program offers a master of arts degree. The master of arts in liberal studies is an innovative, interdisciplinary graduate program. It is centered within the College of Liberal Arts with its spectrum of diverse programs and wealth of faculty resources and education.

The program is designed to promote broad intellectual comprehension and personal enrichment rather than academic or professional training within a particular field or discipline. It is aimed at meeting the special needs of students who seek to deepen their knowledge in a supportive and flexible cross-disciplinary learning environment.

Admission Requirements

Admission to the master of arts in liberal studies is selective. A bachelor's degree or equivalent experience is required for admission. Students will be asked to provide relevant transcripts of their educational experience, a résumé, and letters of recommendation. They will also be asked to submit a brief essay describing why they are particularly interested in this program and indicating (tentatively) the sort of interdisciplinary focus or area of learning in which they might like to concentrate their study. The Graduate Record Exam (GRE) is optional, but is not required.

M.A. Degree Requirements

The program consists of seven courses (30 credits) divided into three parts: 1) a core seminar specifically designed for and required of every student, to be taken within one year of entrance to the program; 2) a concentration made up of five elective courses chosen from various disciplines across the liberal arts that centers on an interdisciplinary theme or topic; and 3) a master's thesis or project which is intended to act as an integrating capstone experience for liberal studies students.

1. *Core seminars 800 (4 credits)*: Each liberal studies student is required to take one core seminar as an introduction to the program as a whole. The seminar must be taken within the first year of a student's matriculation in the program, preferably in their first semester. Although all the core seminars focus on interdisciplinary issues and themes, each

is meant to introduce students not only to different topics but also divergent disciplines from across the liberal arts such as literature, the arts, philosophy, history, women's studies, political science, sociology, and so on.

2. *Concentration (20 credits)*: In conjunction with the director of the program and a concentration and thesis adviser, students develop a proposed, interdisciplinary concentration program of study made up of five, graduate-level elective courses offered in various departments throughout the college and university. The concentration is an interdisciplinary study which focuses on a significant topic, issue, perspective, or cultural development. A concentration may be selected from a menu of suggested concentrations or may be self-designed and tailor-made for each student with the help of his or her advisor. The five courses which constitute the concentration are to be selected from 700-900-level courses regularly offered within departments and colleges across the university, including up to three independent study courses carried out as a tutorial with particular faculty members (with permission).

This cluster of five concentration courses, then, is designed to fit the particular interests and experience of each liberal studies student and should, in combination, constitute a sustained thematic exploration. It is expected that a student's concentration will culminate in a concluding final project or thesis.

The following are typical examples of cross-disciplinary concentration programs of study: American studies, the humanities, ecology and values, justice studies, labor studies, religious studies, urban studies, women's studies.

3. *LS 898 Project or LS 899 Thesis (6 credits)*: This is meant to be a capstone experience in which, with the support of their concentration and thesis adviser, students work out a final project consistent with their concentration and interests. The project can be a scholarly thesis or equivalent creative endeavor which integrates the student's learning in a particular concentration. The director of the program will meet periodically with those students enrolled for thesis credit in order to provide a forum for discussing their research and writing.

800 Liberal Studies Core Seminar

An introductory seminar specially designed for and limited to students within the LS program. Core

seminars are interdisciplinary explorations of significant issues, topics, themes, or perspectives in human life in general and the contemporary world in particular. Topics may change from semester to semester. The seminar must be taken within the first year of a student's matriculation in the program, preferably in the first semester. 4 cr.

845, 846. Special Topics

New or specialized courses not normally covered in regular course offerings. Prereq: permission. May be repeated to a maximum of 8 credits. 2-4 cr.

895, 896. Independent Study

Independent study for graduate students in LS as part of their concentration. Prereq: permission. May be repeated to a maximum of 8 credits. 1-6 cr.

898. Master's Project

For LS students to work out a final project consistent with concentration and interests. Prereq: liberal studies students only; permission. 1-6 cr.

899. Master's Thesis

For LS students to work out a final thesis consistent with their concentration and interests. Prereq: LS students only; permission. 1-6 cr.

Mathematics (MATH)

Chairperson: Kenneth I. Appel

Professors: Kenneth I. Appel, Albert B. Bennett, Jr., Arthur H. Copeland, Jr., Joan Ferrini-Mundy, Marie A. Gaudard, Donald W. Hadwin, A. Robb Jacoby, James R. C. Leitzel, Joan R. Leitzel, Loren D. Meeker, Eric A. Nordgren, Samuel D. Shore, Donovan H. Van Osdol

Associate Professors: William E. Bonnie, David V. Feldman, William E. Geeslin, Karen J. Graham, Rita A. Hibscheiler, Edward K. Hinson, Ernst Linder, Berrien Moore III, Lee L. Zia

Assistant Professors: Kelly J. Black, Matthias Pfau, Kevin M. Short, Debajyoti Sinha

Graduate Program Coordinator:

Edward K. Hinson

Degrees Offered

The Department of Mathematics offers programs leading to a master of science for teachers (M.S.T.) in mathematics, master of science (M.S.) in mathematics, an M.S. in mathematics with an option in applied mathematics, a doctor of philosophy (Ph.D.) in mathematics, and a doctor of philosophy (Ph.D.) in mathematics education.

In general, the master's degree programs offer the student a high level of preparation for professional employment

as well as appropriate preparation for programs leading to the Ph.D. degree. The Ph.D. programs prepare the student primarily for a career in university teaching and research.

The graduate programs have limited enrollments, allowing students to work closely with the faculty members in their areas of expertise. Research is currently being conducted in operator theory, Hilbert spaces, complex analysis, geometric function theory, ring theory, commutative algebra, arithmetic geometry, number theory, combinatorics, topology, numerical analysis, nonlinear dynamics and chaos, applied mathematics, industrial statistics, environmental statistics, spatial statistics, Bayesian survival analysis, and in calculus learning, K–12 mathematics education reform, and mathematics education.

Admission Requirements

Applicants for the M.S. and Ph.D. degrees must have completed significant undergraduate coursework in mathematics, preferably in algebra, analysis, and topology. Applicants for the M.S. with applied mathematics option must have completed significant coursework in analysis or applied analysis and, preferably, coursework in algebra. Among applicants for the Ph.D. degree in mathematics education preference will be given to those who have completed courses in mathematics education and have teaching experience. Applicants for the degree of master of science for teachers must have completed education courses sufficient for certification, or have three years of teaching experience, or currently hold a full-time teaching position.

M.S. Degree Requirements

The program requires ten semester courses approved by the department and chosen from courses numbered 801–888 or 931–979; at least six of the ten courses must be from the 931–979 group. A comprehensive master's examination is required (except as indicated).

M.S. with Applied Mathematics Option Degree Requirements

The program requires ten semester courses approved by the department and a research project or thesis equivalent to two semester courses. The required

courses are 853, 854, 931, 932, 951, 953, 954, 963, 967, and 977; the last two of these are topics courses which may be replaced by approved courses in other departments. The research project or thesis must constitute original research in applied mathematics, conducted under the supervision of a faculty adviser. There is no comprehensive exam in this option.

Master of Science for Teachers Degree Requirements

The program requires ten semester courses approved by the department. These will normally be taken from the courses numbered 903–929 and will usually include the six courses numbered 903–908. A concluding experience consisting of a mathematics portfolio and a comprehensive problem set is required. The courses in this program are offered primarily during summer sessions.

Ph.D. Degree Requirements

In each Ph.D. program, requirements (1)–(4) must be completed for advancement to candidacy.

Basic degree requirements for the Ph.D. program: (1) all of the courses numbered 951–955; (2) written comprehensive examinations in algebra, analysis, topology, and an advanced elective subject (advanced algebra, algebraic topology, complex analysis, functional analysis, applied mathematics, mathematics education, statistics, etc.).

Additional degree requirements for the Ph.D. in mathematics: (3) proficiency in a foreign language, which includes translation of research mathematics written in the language; (4) advanced coursework in a major field (that of the dissertation) and a minor field (usually in mathematics, but possibly in mathematics education or another approved field), followed by a qualifying examination; (5) experience in teaching equivalent to at least half-time for one year; and (6) a dissertation that includes original results in mathematics.

Additional degree requirements for the Ph.D. in mathematics education: (3) proficiency in a foreign language, which includes translation of mathematics education research written in the language, and mastery of an approved research tool; (4) advanced coursework in the ma-

ior field (mathematics education), including MATH 958, 968A, and 968B, and in a minor field (usually a related one, such as educational psychology or research methodology, but possibly in mathematics) followed by a qualifying examination; (5) experience in teaching equivalent to at least half-time for one year; and (6) a dissertation that includes original research in mathematics education.

A maximum of four 800-level courses (excluding MATH 898/899) may be applied to the degree of master of science in mathematics.

805. Probability, Data Analysis, and Discrete Mathematics for the Middle School

Probability, counting techniques, analysis of statistical data, elementary graph theory, and school curriculum materials for middle school teachers. Prereq: permission. 3 cr.

839. Regression Analysis

Estimation, testing, and diagnostic methods for regression models. Simple linear regression, residual analysis and model validation, multiple linear regression, model selection, multicollinearity, polynomial regression, categorical predictors, analysis of variance, analysis of covariance. 3 cr.

840. Industrial Statistics and Design of Experiments

Quality control methods; design of experiments for quality improvement; randomization and blocking; factorial designs; nested designs; fixed-, random- and mixed-effects models; fractional factorial designs; response surface methods. Industrial and engineering applications. 3 cr.

841. Biostatistical Methods

Concepts and methods of nonparametric statistics, categorical data analysis and failure-time data analysis: Censored data analysis. Biostatistical techniques. Reliability and life testing. Poisson regression. 3 cr. (Offered alternate years.)

842. Multivariate Statistics and Modern Regression Methods

Random vectors and matrices, multivariate normal distribution, Hotelling's T^2 , multivariate analysis of variance (MANOVA), principal components, discriminant analysis, factor analysis, partial least squares, empirical orthogonal functions, additive and generalized additive models. 3 cr. (Offered alternate years.)

845-846. Foundations of Applied Mathematics

Basic concepts and techniques of applied mathematics intended for graduate students of mathematics, engineering, and the sciences. Fourier series and transforms, Laplace transforms, optimization, linear spaces, eigenvalues, Sturm-Liouville systems, numerical methods, conformal mapping, residue theory. 3 cr.

847. Introduction to Nonlinear Dynamics and Chaos

An introduction to the mathematics of chaos and nonlinear dynamics. Topics include: linear and nonlinear systems of ordinary differential equa-

tions; discrete maps; chaos; phase plane analysis; bifurcations; and computer simulations. Prereq: elementary differential equations; linear algebra; multidimensional calculus. 3 cr. (Not offered every year.)

853. Introduction to Numerical Methods

Introduction to mathematical algorithms and methods of approximation. A wide survey of approximation methods are examined including, but not limited to, polynomial interpolation, root finding, numerical integration, approximation of differential equations, and techniques used in conjunction with linear systems. Included in each case is a study of the accuracy and stability of a given technique, as well as its efficiency and complexity. It is assumed that the student is familiar and comfortable with programming a high-level computer language. (Also offered as CS 853.) 3 cr.

854. Introduction to Scientific Computing

Introduction to the tools and methodology of scientific computing via the examination of interdisciplinary case studies from science and engineering. Emphasis on numerical approaches to solving linear systems, eigenvalue-eigenvector problems, and differential equations. Problems solved on various hardware platforms using a combination of software and data visualization packages. Prereq: linear algebra; differential equations; introduction to scientific programming; /or permission. (Also offered as CS 854, PHYS 854.) 3 cr.

855. Probability and Stochastic Processes

Introduction to the theory of probability, random variables, expectation, discrete and continuous probability distributions, correlation, Markov chains, introduction to stochastic processes, birth-death processes, moment-generating functions, limit theorems. 3 cr.

856. Principles of Statistical Inference

Theory of statistical inference, principles of point estimation, maximum likelihood and other methods, exact and approximate methods, confidence regions, significance testing, computational methods, Bayesian inference, decision theory. Prereq: probability and stochastic processes. 3 cr.

861. Abstract Algebra

Basic properties of groups, rings, fields, and their homomorphisms. 3 cr.

862. Linear Algebra

Abstract vector spaces, linear transformations, and matrices. Determinants, eigenvalues, and eigenvectors. Prereq: MATH 861. 3 cr.

864. Advanced Algebra

Topics to be selected from among rings, modules, algebraic fields, and group theory. Prereq: MATH 861. 3 cr. (Not offered every year.)

867. One-Dimensional Real Analysis

Theory of limits, continuity, differentiability, integrability. 3 cr.

876. Logic

Induction and recursion; sentential logic; first-order logic; completeness, consistency, and decidability; recursive function. 3 cr. (Not offered every year.)

883. Set Theory

Axiomatic set theory, including its history, Zermelo-Fraenkel axioms, ordinal and cardinal numbers, consistency, independence, and undecidability. 3 cr. (Not offered every year.)

884. Topology

Open sets, closure, base, and continuous functions. Connectedness, compactness, separation axioms, and metrizable. 3 cr.

888. 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. Prereq: MATH 867. 3 cr.

896. Topics in Mathematics

New or specialized courses not covered in regular course offerings. Prereq: permission. May be repeated to 6 credits. 3 cr.

Courses numbered 903 through 929 may be applied to the degree of master of science for teachers in mathematics and to no other degree in mathematics.

903-904. Higher Algebra for Teachers

The integers, integral domains, and topics from number theory; equivalence relations and congruences; real numbers, complex numbers, fields, and polynomials; group theory; matrix theory; vectors and vector spaces; rings; Boolean algebra. 3 cr.

905-906. 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.

907-908. Higher Analysis for Teachers

The real number system; functions and limits; elements of set theory; numerical sequences and series; continuity; the derivative and the Riemann integral; maxima and minima. 3 cr.

909. Probability and Statistics for Teachers

Permutations and combinations; finite sample spaces; random variables; binomial distributions; statistical applications. 3 cr.

910. Mathematics Education

Current developments and issues in mathematics education; content, curricula, methods, and psychology of teaching mathematics. 1-4 cr.

911. Technology in Teaching Mathematics

Consideration of the role of technology in teaching mathematics; preparation of classroom materials for Macintosh and IBM; exchange of ideas and software. 3 cr.

#914. Topology for Teachers

Fundamental concepts of elementary topology; network and map problems; sets, spaces, and transformations. 3 cr.

916. Theory of Numbers for Teachers

Divisibility and primes; congruences; quadratic reciprocity; number theoretic functions; Diophantine equations; perfect and amicable numbers. 3 cr.

917. Theory of Sets and Elementary Logic

An introduction to the methods of mathematical proof, and fundamentals of set theory and logic. 3 cr.

#919. The Real Number System

A postulational approach to fundamentals of algebraic structure; sequences, limits, and continuity. 3 cr.

920. History of Mathematics

A problem-study approach to mathematical problems from the period of Greek mathematics until the modern era. 3 cr.

#921. A Modern Approach to Geometry

The foundations and development of Euclidean geometry, with emphasis on the recent recommendations in the field of high school geometry. 3 cr.

#926. 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.

#927. 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.

928. 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.

929. Directed Reading

A directed reading project on a selected topic in mathematics or mathematics education, planned in collaboration with a faculty member. 3 cr.

Courses numbered 931 through 958 are introductory courses for the M.S. degree in mathematics and the Ph.D. degrees in mathematics and mathematics education.

931-932. Mathematical Physics

Complex variables, differential equations, asymptotic methods, integral transforms, special functions, linear vector spaces and matrices, Green's functions, and additional topics selected from integral equations, variational methods, numerical methods, tensor analysis, and group theory. Prereq: differential equations; linear algebra; multidimensional calculus. (Also offered as PHYS 931-932.) 3 cr.

951. Algebra I

Groups and their homomorphisms, products and sums, structure of groups; rings and their homomorphisms, ideals, factorization properties. Prereq: MATH 861. 3 cr.

952. Algebra II

Field extensions; Galois theory; module theory. Prereq: MATH 951. 3 cr.

953. Analysis I

Measurable spaces and functions, measures, Lebesgue integrals, convergence theorems. Prereq: MATH 867. 3 cr.

954. Analysis II

Cauchy theory and local properties of analytic functions, Riemann mapping theorem, representation theorems, harmonic functions. Prereq: MATH 888. 3 cr.

955. Topology I

Subspace, product, and quotient topologies; embedding; separation and countability axioms; connectedness; compactness and compactifications; paracompactness, metrization, and metric completions. Prereq: MATH 884. 3 cr.

956. Topology II

Chain complexes; homology of simplicial complexes, singular homology and cohomology; axiomatic homology; cup and cap products. Prereq: MATH 861 and 884. 3 cr.

958. Foundations of Mathematics Education

Topics include: major issues, trends, and programs in mathematics education research, the research process, theoretical perspectives to guide research, the profession and infrastructure of mathematics education, cultural and historical aspects of mathematics education, and the research-practice interface. Examples span the K-16 spectrum. Prereq: permission. 3 cr.

Courses numbered 961 through 979 are more specialized topics courses that are offered periodically in response to faculty and student interests. Content may vary from year to year. With the permission of the instructor, these courses may be taken more than once.

961. Topics in Algebra I

An introduction to topics chosen from algebra and number theory. Prereq: MATH 951-952. May be repeated. 3 cr.

963. Functional Analysis

Banach and Hilbert spaces, Hahn-Banach theorem, open mapping and closed graph theorems, dual spaces, topological vector spaces. Prereq: MATH 953. 3 cr.

964. Topics in Analysis I

An introduction to topics in analysis. Prereq: permission. May be repeated. 3 cr.

965. Topics in General Topology I

An introduction to topics in general topology. Prereq: MATH 955. May be repeated. 3 cr.

966. Topics in Algebraic Topology I

An introduction to topics in algebraic topology. Prereq: MATH 956. May be repeated. 3 cr.

967. Topics in Applied Mathematics I

An introduction to topics in applied mathematics. Prereq: permission. May be repeated. 3 cr.

968. Topics in Mathematics Education I

A) The Teaching and Learning of Mathematics; B) Curriculum and History in Mathematics Education. Topics selected from: epistemologies of knowledge applied to mathematics; theories of learning and teaching mathematics; theoretical perspectives in research; mathematics education research programs K-16; research methods for studying mathematics teaching, learning, and curricula; theoretical frameworks for curriculum development, implementation of new curricula, and

research on curricula; historical perspectives of research in mathematics education; the evolution and history of K-16 mathematics curricula both in the United States and internationally. Versions A and B offered alternately. Prereq: MATH 958 or permission. May be repeated. 3 cr.

969. Topics in Probability and Statistics I

Selected advanced topics from one or several of the following areas: probability, stochastic processes, design of experiments, biostatistics, Bayesian theory and methods, spatial and spatio-temporal statistics, time series analysis, nonparametric statistics. Prereq: permission. May be repeated. 3 cr.

971. Topics in Algebra II

An introduction to advanced topics chosen from algebra and number theory. Prereq: MATH 951-952; permission. May be repeated. 3 cr.

973. Topics in Operator Theory

Selected topics in operator theory. Prereq: MATH 963. May be repeated. 3 cr.

977. Topics in Applied Mathematics II

An exploration of an area of research in applied mathematics. Prereq: permission. May be repeated. 3 cr.

978. Topics in Mathematics Education II

An exploration of an area of research in mathematics education. Prereq: permission. May be repeated. 3 cr.

979 Research Topics in Statistics

An exploration of the main statistical issues and computational methods associated with research problems from such areas as survival analysis, reliability, longitudinal data, categorical data, spatio-temporal data, and industrial processes. Student term projects require: literature searches, presentation, use of modern statistical software, and written reports. Prereq: permission. May be repeated. 3 cr.

998. Reading Courses

A) Algebra; B) Analysis; C) Operator Theory; D) Geometry; E) General Topology; F) Algebraic Topology; G) Applied Mathematics; H) Mathematics Education; I) Probability and Statistics. Prereq: permission. 1-6 cr.

898, 899. Master's Project

1-6 cr. May be repeated to a maximum of 6 cr. IA

999. Doctoral Research

Mechanical Engineering (ME)

Chairperson: David E. Limbert

Professors: Barbaros Celikkol, Todd Stuart Gross, Robert Jerard, David E. Limbert, Godfrey H. Savage, M. Robinson Swift

Associate Professors: Kenneth C. Baldwin, Barry K. Fussell, James E. Krzanowski, John Philip McHugh, David W. Watt, John A. Wilson

Assistant Professor: Igor Tsukrov
Graduate Program Coordinator: David W. Watt

Degree Offered

The Department of Mechanical Engineering offers the master of science degree. The program leading to the doctorate in engineering is described in the section entitled Engineering Ph.D. Program.

The department offers studies leading to specialization in the following areas: fluid mechanics, thermal science, solid mechanics, material science, controls, system modeling, dynamics, and design.

Admission Requirements

In general, applicants have a bachelor of science degree in mechanical engineering. Outstanding candidates with a bachelor's degree in the other engineering and science disciplines and math are encouraged to apply. Special curricula are developed for such students to provide sufficient background in mechanical engineering.

All applicants are required to submit scores from the general test of the Graduate Record Examination.

M.S. Degree Requirements

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 coursework in addition to 8 semester hours of ME 899, Master's Thesis; the project plan requires 28 semester hours of coursework in addition to 4 semester hours of ME 992, Master's Project. Individuals who can demonstrate accomplishments from professional engineering experience comparable to that expected from a master's project may petition the department to substitute an additional 900-level course for the project requirement.

At least 8 credits must be earned in 900-level courses other than ME 992, Master's Project or the 900-level course substituted for the master's project course. No more than two graduate courses taken prior to admission to the Graduate School may be applied to the

master's degree. An oral examination covering the candidate's graduate work will be given for both the thesis and project plans.

801. Macroscopic Thermodynamics

Thermodynamic principles using an analytic, postulational approach, and Legendre transformations to obtain thermodynamic potentials. Prereq: thermodynamics or permission. 4 cr.

802. Statistical Thermodynamics

Macroscopic thermodynamic principles developed by means of microscopic analysis. Prereq: thermodynamics. 4 cr.

807. Analytical Fluid Dynamics

Kinematics of flow; constitutive relationships; development of the Navier-Stokes equations; vorticity theorems; potential flow. Prereq: fluid dynamics. 4 cr.

808. Gas Dynamics

Study of one-dimensional subsonic and supersonic flows of compressible ideal and real fluids. Wave phenomena; linear approach to two-dimensional problems; applications in propulsion systems. Prereq: fluid dynamics or permission. 4 cr.

809. Computational Fluid Dynamics

Review of matrix methods, basics of finite differences, basics of spectral methods, stability, accuracy, Navier-Stokes solvers. Prereq: heat transfer or permission. 3 cr.

811. Coherent Optical Methods

Introduction to electro-optic experimental techniques in mechanics. Optic fundamentals including elements of scalar diffraction theory, interferometry, holography, Doppler shifts, coherence, and laser speckle. Applications include mechanical strain measurements, vibrational mode determination, fluid pressure and temperature measurements, and fluid velocity measurements. Concepts from course are demonstrated in laboratory. Prereq: permission. 3 cr.

823. 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 III or permission. 4 cr.

824. Vibration Theory and Applications

Discrete vibrating systems. Linear system concepts; single-degree-of-freedom systems with general excitation. Matrix theory and eigenvalue problems. Many degrees of freedom, normal mode theory for free and forced vibration. Numerical methods; introduction to continuous systems; applications to structural and mechanical systems. Prereq: mechanics II; mechanics III or permission 4 cr.

827. Advanced Mechanics of Solids

Stress, strain, stress-strain relations, anisotropic behavior, introduction to elasticity, plane stress/strain, bending and torsion of members with general cross-sections, introduction to thin plates and shells, energy methods. Prereq: mechanics II or permission. 4 cr.

830. 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 the continuum mechanics on the macroscopic scale. Elasticity, plasticity, viscoelasticity, creep, fracture, and damping. Anisotropic and heterogeneous materials. Prereq: mechanics II; introduction to materials science or permission. 4 cr.

831. Fracture and Fatigue of Engineering Materials

Reviews fundamentals of linear elastic fracture mechanics and strain energy release rate analyses. Discusses basic methods of design and fatigue for preventing failure by fast fracture and fatigue for metals, ceramics, and polymers, with attention to the effect of material properties and subsequent modification on each design method. Prereq: mechanics II, introduction to materials science or permission. 4 cr.

841. Nonlinear Systems Modeling

Modeling of hydraulic, pneumatic, and electromechanical systems. Solution methods including linearization and computer simulation of nonlinear equations. Methods of generalizing the nonlinear models for design purposes are developed. Prereq: systems modeling, simulation, and control or permission. (Also offered as EE 841) 4 cr.

844. Corrosion

Three part course: (1) reviews and develops basic concepts of electrochemistry, kinetics, and measurement methods; (2) covers the details of specific corrosion mechanisms and phenomena including passivity, galvanic corrosion, concentration cell corrosion, pitting and crevice corrosion, and environmentally induced cracking; (3) focuses on the effects of metallurgical structure on corrosion, corrosion in selected environments, corrosion prevention methods, and materials selection and design. Prereq: general chemistry or permission. 4 cr.

#857. Coastal Engineering and Processes

Introduction to small amplitude and finite amplitude wave theories. Wave forecasting by significant wave method and wave spectrum method. Coastal processes and shoreline protection. Wave forces and wave structure interaction. Introduction to mathematical and physical modeling. Prereq: fluid dynamics or permission. (Also offered as CIE 857; OE 857.) 3 cr.

860. Physical Metallurgy I

Introduction to physical metallurgy: dislocations, thermodynamics of materials, diffusion, phase transformations, and strengthening mechanisms in solids. Prereq: introduction to materials science or permission. Lab. 4 cr.

861. Diffraction and Imaging Methods in Materials Science

Introduction to x-ray diffraction and electron microscopy. Basic crystallography; reciprocal lattice; x-ray and electron diffraction; x-ray methods; transmission and scanning electron microscopy. Prereq: intro. to materials science, engineering materials, or principles of mineralogy. Prereq: general physics II; general chemistry or permission. Lab. 4 cr.

862. Electronic Properties of Materials

Introduction to the electronic properties of materials and their application in electronic devices. Crystallography, atomic bonding and energy band diagrams for semiconductors; intrinsic and extrinsic semiconductors; the p-n junction; diodes and transistors. Methods used in the manufacture of semiconductor devices, such as ion implantation, thermal oxidation, metallization, and packaging. Prereq: general physics I & II; differential equations with linear algebra; general chemistry or permission. 3 cr.

863. Thin Film Science and Technology

The processing, structure, and properties of thin solid films. Vacuum technology, deposition methods, film formation mechanisms, characterization of thin films, and thin-film reactions. Mechanical, electrical, and optical properties of thin films. Prereq: introduction to materials science or permission. 4 cr.

871. Linear Systems and Control

Fundamentals of linear system analysis and design in both continuous and discrete time. Design of feedback control systems. Topics include modeling; time and frequency analysis; Laplace and Z transforms; state variables; root locus; digital and analog servomechanisms; proportional, integral, and derivative controllers. Includes demonstrations and computer simulations. Prereq: permission. (Also offered as EE 871.) 3 cr.

872. Control Systems

Extension of ME 871 to include more advanced control system design concepts such as Nyquist analysis; lead-lag compensation; state feedback; parameter sensitivity; controllability; observability; introduction to nonlinear and modern control. Includes interactive computer-aided design and real-time digital control. Prereq: ME 871; systems modeling, simulation, and control or permission. (Also offered as EE 872) Lab. 4 cr.

873. Electromechanical Analysis and Design

Analysis and design of electromechanical systems using lumped parameter models and magnetic finite element analysis (FEA). Electrostatic and magnetic field equations discussed and used to derive magnetic and electric lumped model elements. A brushless dc motor analyzed using lumped models and FEA. Various drive types discussed and the motor system analyzed to obtain torque-speed curves. Design principles given and utilized in a design project. Prereq: systems modeling, simulation, and control or permission. 4 cr.

881. Mathematical Methods in Engineering Science I

Complex variables, Fourier series and transforms, ordinary and partial differential equations, vector space theory. Prereq: differential equations with linear algebra, multidimensional calculus or permission. 4 cr.

883. Geometric Modeling

Includes curves, surfaces, solids, analytic and relational properties, intersections, transformations, and solid modeling. Applications in computer graphics and CAD/CAM systems are emphasized. Familiarity with calculus, analytic geometry, vec-

tors, matrix methods, and computer programming is required. Prereq: introduction to scientific programming; multidimensional calculus or permission. 4 cr.

886. Introduction to Finite Element Analysis
Topics include basic matrix theory, Galerkin method, direct stiffness method, calculus of variations, development of finite element theory and modeling techniques. Applications in solid mechanics, heat transfer, fluids, dynamics, and electromagnetic devices, via both commercially available codes and student-written codes. Prereq: introduction to scientific programming; heat transfer or permission. 4 cr.

895. Special Topics in Mechanical Engineering
New or specialized courses and/or independent study. May be repeated for credit. 2–4 cr.

904. 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.

906. 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.

908. 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.

909. Viscous Flow
Exact solutions of the Navier-Stokes equations; laminar boundary layers; wakes and jets; Stoke's flow; stability of parallel flows and boundary layers; transition to turbulence. Prereq: ME 807 or permission. 3 cr.

910. Turbulent Flow Analysis
Physical aspects and methods of analyzing turbulence. Turbulent transport of heat and momentum; second-order modeling techniques and computation of turbulent flows. Applications to problems in engineering science. Prereq: ME 807 and/or ME 809 or permission. 4 cr.

911. Theory of Hydrodynamic Stability
Equations of hydrodynamics in general coordinates; general instabilities caused by gravitational, surface tension, and hydromagnetic influences; instability of parallel viscous flows including the Orr-Sommerfeld equation and Tollmein-Schlichting waves; instability of free-surface waves; instability of stratified flows; instabilities in porous media. Prereq: ME 807 or permission. 3 cr.

922. 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 nonlinear 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.

924. 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.

926. 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 are used. 4 cr.

927. 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.

929. 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.

#944. Nonlinear Control Systems
Analysis and design of nonlinear control systems from the classical and modern viewpoints are discussed. 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 or ME 951. (Also offered as EE 944.) 4 cr.

951. Advanced Control Systems I
State-space representation of multivariable systems; analysis using state transition matrix. Controllability and observability; pole placement using state and output feedback; Luenberger observers. Introduction to computer-controlled systems (sampling, discrete state representation, hybrid systems); nonlinear analysis (Liapunov, Popov, describing function). Prereq: EE or ME 882. (Also offered as EE 951.) 3 cr.

952. Advanced Control Systems II
Special topics in control theory: continuous and discrete systems: optimal control systems, including calculus of variations, maximum principle, dynamic programming, Weiner and Kalman filtering techniques, stochastic systems, adaptive control systems. Prereq: EE or ME 951. (Also offered as EE 952.) 3 cr.

955. Estimation and Filtering
Stochastic systems course with application to control and communications. Topics include random variables, noise in linear systems, Bayesian and minimum variance estimation theory, optimal state estimators, Weiner and Kalman filters, combined estimation and control, prediction, parameter identification, and nonlinear filtering. Prereq: ME or EE 951; MATH 835 or equivalent. (Also offered as EE 955.) 3 cr.

#961. Physical Metallurgy II
Thermodynamics of solid solutions and mixtures, kinetics of selected solid state reactions including precipitation and recrystallization, martensite transformations. 4 cr.

#965. Microscopic Mechanisms of Plastic Deformation
The mechanisms of plastic deformation in crystalline materials. Review of elasticity theory; point, line, and planar defects; dislocation interactions; strengthening mechanisms; creep mechanisms; application of deformation mechanisms to the development of constitutive models. Prereq: permission. 4 cr.

982. Mathematical Methods in Engineering Science II
Continuation of ME 881. Complex variable techniques, integral transform techniques for the solution of differential and partial differential equations, Green's functions. Weiner-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 881. 4 cr.

986. Advanced Finite Element Analysis
Topics include introduction to dynamics, treatment of nonlinear material behavior, and plate and shell element technology. Emphasis given to problems in solid mechanics and heat transfer. Prereq: ME 886 or equivalent. 4 cr.

992. 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. 4 cr. IA.

995. Graduate Special Topics
Investigation of graduate-level problems or topics in mechanical engineering. 2–4 cr.

899. Master's Thesis
8 cr. Cr/F.

999. Doctoral Research

Microbiology (MICR)

Chairperson: Robert M. Zsigray

Professors: Richard P. Blakemore, Thomas G. Pistole, Frank G. Rodgers, Robert M. Zsigray

Associate Professor: Aaron B. Margolin

Assistant Professors: Frank Caccavo, Louis S. Tisa

Graduate Program Coordinator:

Louis S. Tisa

Degrees Offered

The Department of Microbiology offers the master of science and the doctor of philosophy degrees. Research opportunities are available in a broad range of areas, including plant-microbe interactions, nitrogen fixation, signal transduction, microbial development, *Yersinia* genetics, microbial immunity, molecular mechanisms of pathogenesis, environmental and molecular virology, microbial growth and regulation, marine microbial ecology, physiology and biochemistry, biotechnology, and bioremediation.

Admission Requirements

Applicants are expected to have had adequate preparation in the biological and physical sciences. This typically includes general and organic chemistry, physics, one semester of calculus, a year of general biology, a semester or more of biochemistry, and general microbiology. Formal courses in quantitative analysis and statistics are recommended. Applicants with deficiencies in these background courses who are admitted to the program may be required to complete appropriate coursework without graduate credit. Submission of Graduate Record Examination scores on the general test is required. Each applicant to the graduate program must be sponsored by a faculty member in the department. The sponsor's decision is usually based on the "Statement of Interest" section of the Application to Graduate School form. Persons planning to apply to the program should contact the graduate program coordinator in microbiology to obtain information on the department.

M.S. Degree Requirements

Students admitted to the M.S. program are required to conduct an independent

research project in conjunction with a faculty adviser and must submit a thesis based on this research to a faculty examining committee, which determines its acceptability. Students also defend their completed thesis work in a formal departmental seminar. Specific coursework is determined in conjunction with the faculty adviser. A minimum of 30 credits, including thesis credits, is required.

Ph.D. Degree Requirements

Students with appropriate academic training at the baccalaureate or master's level may be considered for admission to the doctoral program. Persons enrolled in the doctoral program are required to develop and execute an independent research project in conjunction with a faculty adviser, to complete and defend successfully a dissertation based on this research, to pass a written qualifying examination administered by the student's guidance committee, and to complete one semester of teaching.

The department's acceptance of the dissertation is contingent on (1) its approval by the doctoral committee and (2) evidence that at least one manuscript based on the thesis research has been submitted to a refereed scientific journal appropriate to the topic.

All graduate students are expected to enroll in MICR 997, Microbiology Seminar, each semester.

802. Infectious Disease and Health

Principles underlying the nature of infectious agents and the diseases they cause. Pathogenic strategies employed by these microorganisms, response of the host at the animal and cellular levels, intracellular parasitism, epidemiology, role of control measures including vaccines and chemotherapy, mode of action of antimicrobial chemotherapeutic agents, pharmacokinetics, and drug metabolism. Both well-established pathogens as well as newer and emerging human and animal disease agents are covered. Prereq: pathogenic microbiology; permission. Special fee. Lab. 5 cr.

804. Microbial Genetics

Expression and transfer of genetic elements (chromosomal and nonchromosomal) in prokaryotic and eukaryotic microorganisms; consideration of factors influencing public health, industry, the environment, and society. Students earning credit for PBIO 754/854; BCHM 754/854; GEN 754/854 may not receive credit for MICR 704/804. Prereq: general microbiology; biochemistry (Also offered as GEN 804.) Special fee. Lab. 4 cr.

805. Immunology

Examination of the immune response in vertebrates. Characterization of the major components of the immune system; study of host-defense

mechanisms and immunopathology. Serological and animal laboratory studies. Prereq: general microbiology. Special fee. Lab. 5 cr.

806. Virology

Principles of animal and, in selected instances, plant and bacterial virology in relation to infection and disease. Emphasis on the molecular biology of viruses, viral replication, isolation, propagation, assay, pathogenesis, diagnosis, detection, epidemiology, and control. Prereq: general microbiology 3 cr.

807. Marine Microbiology

Qualitative and quantitative evaluation of the physiological activities of microorganisms that influence the state of carbon, nitrogen, sulfur, iron, manganese, phosphorous, hydrogen, oxygen, and other elements in the sea and its sediments. Provides an understanding of the interrelationships between marine microorganisms and their surroundings by integrating microbiological phenomena with known aspects of physical, chemical, and biological oceanography. Introduces students to the primary scientific literature in marine microbiology, teaches each student how to think provocatively and concertedly, and convey those thoughts clearly and concisely in both oral and written form. Prereq: general microbiology. Special fee. Lab. 4 cr.

808. Virology Lab

Principles and practices of animal, selected plants, and bacterial virological methods for the propagation, detection, and enumeration of viruses. Prereq: general microbiology Coreq: virology. Special fee. 2 cr.

809. Advanced Virology

Provides in-depth study of virology. Selected RNA, DNA, retroviruses, and nonretroviruses capable of causing cancer. Enables students to (1) understand genetic regulatory events occurring during virus-cell interactions, and to (2) understand the specific pathogenicity, epidemiology, prevention, and control of selected (model) viruses. Prereq: virology; permission. Special fee. Lab. 4 cr. (Not offered every year.)

810. Electron Microscopy and Microbial Cytology

Ultrastructure of eukaryotes, prokaryotes, and viruses. Role of bacterial appendages; cell membranes and cell walls; cytoplasmic inclusions; cell division and sporulation and virus ultrastructure. Preparative electron microscopy techniques for biological material (and microorganisms) described in detail. Prereq: general microbiology; permission. 3 cr. (Not offered every year.)

811. Genetics of Eukaryotic Microbes

Expression and transfer of genetic material in eukaryotic microbes including fungi, algae, protozoa, and *Caenorhabditis elegans*. Laboratory experience in DNA sequence entry retrieval and analysis. Macintosh workstations are used for accessing and retrieving data from the National Laboratory of Medicine and other sources via the Internet. Prereq: general microbiology; principles of genetics. (Also offered as BCHM 811 and GEN 811.) Special fee. Lab. 4 cr.

812. Electron Microscopy Laboratory

Operation of electron microscopes; manipulation of instrumentation and specimens. Application of shadowing, negative staining, embedding, thin-sectioning, labeling, freeze-fracture/etching to biological specimens; photographic techniques; inter-

pretation of micrographs. Project work. Prereq: general microbiology. Coreq: MICR 810; permission. Special fee. 3 cr. (Not offered every year.)

813. Microbes and the Environment

Principles of microbial ecology in relation to human ecology. Physiological ecology as required to understand microbial roles in matter and energy flow through ecosystems. Environmental sensing and behavioral or metabolic responses by independent cells and social microbes. Aquatic, terrestrial, and biotic habitats in which microbes have influence. Biotic interactions including syntrophy, consortial mixtures, and stable symbioses between prokaryotes and eukaryotes. Coreq: MICR majors only; microbial ecology laboratory. Prereq: general microbiology. 3 cr.

814. Water Pollution Microbiology

Application of general principles of microbial ecology, disease, genetics, and physiology and of organic and inorganic chemistry to water pollution and its abatement. Prereq: general microbiology. Special fee. Lab. 4 cr.

815. Microbial Ecology Laboratory

Methods of evaluating microbial community composition, structure, and activity. Enrichment, isolation, and consideration of particular microbial groups important in the biogeochemistry of major elements including metals. Molecular methods of evaluating microbe-environment interactions. Pre- or coreq: MICR 813. Special fee. Lab. May be repeated to a maximum of 2 credits. 1 cr.

816. Advanced Immunology

Selected topics in immunology based on current trends and class interest. Includes recent advances in the field as well as issues of ethics and misconduct in science. Recurring topics include AIDS, tumor immunology, vaccine development, and antimicrobial immunity. Laboratory experience includes protein (antibody) purification, immunoassays, development and evaluation of immunologic probes. Prereq: general immunology; general biochemistry. Special fee. Lab. 4 cr. (Not offered every year.)

817. Microbial Physiology

Fundamental physiological and metabolic processes of bacteria and fungi with a strong emphasis on prokaryotes. Literature-based course. Topics include regulation and coordination of microbial metabolism, bacterial cell cycle, function of prokaryotic cell structure, diversity of energy metabolism, and microbial cell differentiation. Prereq: general microbiology; general biochemistry or principles of biochemistry; permission. Special fee. Lab. 4 cr.

818. Ethics and Issues in Microbiology

Multiple forces affect the transfer of information from the research laboratory to the practical world. Who evaluates scientific findings? Who determines their validity? What political, economic, and societal factors influence the availability of newly acquired scientific information? These and related questions presented and discussed in a format to provide factual information and opportunities to evaluate selected issues. Topics selected from current literature and suggestions made by class members. Prereq: general microbiology. 3 cr.

851. Cell Culture

Theory and principles fundamental to the culture of

cells in vitro. Introduction to techniques of preparation and maintenance of animal, plant, insect, fish cell cultures. Application of cell culture to contemporary research in biological sciences. Prereq: general microbiology; permission. (Also offered as ANSC 851 and PBIO 851.) Special fee. Lab. 4 cr.

852. Mammalian Cell Culture

Basic concepts and techniques associated with the cultivation of mammalian cells in vitro, including media preparation, cell viability, transfer, cloning, cryopreservation; use of transformed cells harboring cloning vectors for production of bio-products. (No credit if already taken MICR 851.) Prereq: general microbiology. (Also offered as ANSC 852) Special fee. Lab. 5 cr.

893. Advanced Problems and Techniques in Microbial Cytology

Research with electron microscopy. Includes reading, organized seminars in microbial cytology, recent advances in electron microscopy, and laboratory project work. Prereq: MICR 810; permission. May be repeated to a maximum of 8 credits. 1-4 cr.

895. Special Topics in Microbiology

Advanced studies in specific areas. Prereq: permission. May be repeated to a maximum of 8 credits. 1-4 cr.

#904. Advanced Microbial Genetics

Advanced studies in expression, regulation, recombination, and transmission of genetic information in prokaryotic microorganisms. Prereq: MICR 804; permission. (Also offered as GEN 904.) Special fee. Lab. 4 cr. (Not offered every year.)

905. Current Topics in Microbiology

Discussion of current developments in microbiology: A) Microbial Ecology; B) Immunology; C) Pathogenic Mechanisms; D) Microbial Genetics; E) Water-borne Diseases; F) Microbial Physiology. May be repeated. 1 cr.

907. Instrumentation

Introduction to safety and principles of use of instrumentation in microbiology. May be repeated to a maximum of 5 credits. 1 cr. Cr/F.

997. Microbiology Seminar

Presentation and discussion of selected topics in microbiology. Required of all graduate students in microbiology. May be repeated. 1-2 cr. Cr/F.

899. Master's Thesis

6-10 cr. Cr/F.

999. Doctoral Research

6-10 cr. Cr/F.

Music (MUSI)

Chairperson: Peggy A. Vagts
Professors: Cleveland L. Howard, Keith Polk, Mary H. Rasmussen, John E. Rogers, David E. Seiler, Robert Stibler, Peggy A. Vagts

Associate Professors: Mark S. DeTurk, Robert W. Eshbach, Stanley D. Hettinger, Christopher Kies, Nicholas N. Orovich, W. Niel Sir, Kathleen

Wilson Spillane, Peter W. Urquhart, Larry J. Veal

Assistant Professors: Michael J.

Annicchiarico, David K. Ripley

Graduate Program Coordinator:

Robert Stibler

Degrees Offered

The Department of Music offers programs leading to the degrees of master of arts in music and master of science in music education. In both programs, at least one-half of the required credits are in courses intended for graduate students only.

Admission Requirements

Master of Arts in Music A bachelor of arts degree in music or its equivalent from an accredited institution is required for admission to this program. A theory placement examination is required of all applicants. Students will not be allowed to enroll in MUSI 994, a required course, until this examination is 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 study in musicology beyond the M.A. degree. Applicants planning to emphasize music history or theory/composition should submit a sample of their work to the graduate coordinator. Applicants wishing to pursue performance studies should arrange for an audition with the appropriate faculty member.

Master of Science in Music Education Admission to this program requires a bachelor's degree in music education or its equivalent from an accredited institution. A theory placement examination is required of all applicants. Students will not be allowed to enroll in MUSI 994, a required course, until this examination is passed to the satisfaction of the department. An audition is required before beginning performance studies.

M.A. Degree Requirements

The degree of master of arts in music, while designed basically for students in-

terested in broadening their knowledge of the history of music, has proven valuable to students who wish to augment undergraduate degrees in performance and/or music education with more intensive studies in music theory, composition, music literature, instrumental and vocal performance, historical performance practices, and conducting. The following courses (or their approved equivalents) are required: MUSI 955, 956, 957, 958, 991, and 994. Courses at the 800 and 900 levels in music, or at the 700, 800, and 900 levels in other departments, may be elected, with the approval of the student's adviser, to augment the required courses for a minimum total of 30 credits. Students emphasizing performance are encouraged to give a graduate recital. Completion of the program requires both a written essay of substantive nature on a topic of the candidate's special interest and a comprehensive oral exam. The latter includes analysis and historical discussion of scores from all periods of music. It is recommended that more than two semesters be allowed for completion of the degree.

M.S. Degree Requirements

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, and theory. The following courses are required: MUED 983 or 984; MUED 995 and 996; and MUSI 955 and 994. Also required are two graduate-level courses in the Department of Education as approved by the adviser. Vocal or instrumental study at the 800 level is required to a minimum of 4 credits. Each candidate will be required to complete an independent project (MUED 995) of a substantive nature in an area of the candidate's special interest as approved by the adviser. Sufficient electives must be taken to bring the total credits to 30. A comprehensive exam concerning the application of philosophical, sociological, psychological, and technical aspects of music education completes the program.

History and Literature

801. Music of the Medieval Period

Nature of the beginnings of polyphony. The pre-eminent 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. 3 cr.

803. Music of the Renaissance

Works of the 15th- and 16th-century composers from Dunstable to Palestrina. 3 cr.

805. Music of the Baroque

Music of Europe from de Rore to Bach. 3 cr.

807. Music of the Classical Period

Growth of musical styles and forms from early classicism through the high classicism of Haydn, Mozart, and the young Beethoven. 3 cr.

809. Music of the Romantic Period

A survey of Romanticism in music from Beethoven's late period to the end of the 19th century. The works of Schubert, Berlioz, Schumann, Mendelssohn, Chopin, Wagner, Verdi, Brahms, Austrian symphonists, French pre-impressionists, and national styles in European music. 3 cr.

811. Music of the 20th Century

Styles and techniques of composers from Debussy to the present. Special emphasis on tonal music before World War I; neoclassical trends; the emergence of atonality and serial techniques; anti-rationalist music; electronic music. 3 cr.

813. The Art Song

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. 3 cr.

815. Survey of Opera

History of the genre from Monteverdi to the present. Representative masterpieces by Handel, Mozart, Beethoven, Weber, Wagner, Verdi, Mussorgsky, Debussy, Berg, and others. 3 cr.

817. Survey of Piano Literature

Keyboard literature from the baroque to the present. Analysis, discussion, and illustration of works by Bach, Haydn, Mozart, Beethoven, the romantic composers, and contemporary writers. 3 cr.

895. Special Studies in Music

A) J. S. Bach; B) Franz Schubert; C) Debussy and Ravel; D) The World of Jazz; E) The Iconography of Western European Musical Instruments; F) 19th-Century French Music; G) Advanced Analysis; H) Advanced Study in Electronic Music; I) Composition through Computer-Generated Sound; J) Woodwind Literature; K) Brass Literature; L) String Literature; M) Medieval Performance Practice; N) Renaissance Performance Practice; O) Baroque Performance Practice; P) Classical Performance Practice; Q) 19th-Century Performance Practice; R) 20th-Century Performance Practice; S) Woodwind Repair; T) String Repair; U) Advanced Jazz Improvisation; V) Advanced Piano Pedagogy; W) Advanced Accompanying; X) Advanced Conducting; Y) Independent Study. Prereq: permission. May be repeated for credit with permission. 1–4 cr.

955. 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.

956. Readings in Music History: Antiquity to 1600

An opportunity to read and study in detail a restricted number of monographs and editions. 3 cr.

957. Readings in Music History: 1600–1820

An opportunity to read and study in detail a restricted number of monographs and editions. 3 cr.

958. 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.

991. Research Seminar

Guidance in individual research projects. Prereq: permission. 1–4 cr.

995. Independent Study in the History and Theory of Music

Opportunity for especially qualified students to investigate, with guidance, specific areas of their scholarly concern. Prereq: permission. 1–4 cr.

Theory and Composition

871-#872. 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: music theory II or permission. 2 cr.

875-876. Composition

Construction of phrases, periods, and short compositions following classical models. Problems of text-setting. Prereq: music theory II or permission. 3 cr.

877. Advanced Composition

Continuation of MUSI 876. Individual compositional projects. Prereq: MUSI 876 and permission. May be repeated for credit. 3 cr.

879. Orchestration

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: music theory II or permission. 3 cr.

881, 882. Analysis: Form and Structure

An introduction to analytical techniques through the study of representative masterworks; formal and structural elements and their interrelationships. Semester I: analysis of 18th- and 19th-century works; semester II: analysis of 20th-century works. Prereq: music theory II or permission. 3 cr.

885. Electronic Sound Synthesis

Computers and digital synthesizers, methods of sound synthesis (e.g., fm synthesis, sampling), MIDI programming in VisualBASIC and C++, control programs for synthesizers, notation using computers (e.g., finale for PC and Macintosh). 4 cr. (Generally offered in the spring.)

895. Special Studies in Music

Refer to History and Literature section.

994. Theory Seminar

Theory and practice from the baroque to contemporary music. Performance practice in the baroque and later periods. Score analysis. Prereq: permission. 3 cr.

995. Independent Study in the History and Theory of Music

Refer to History and Literature section.

Performance**831-832. Conducting**

Physical aspects, equipment of conductor, fundamental gestures and beats, baton techniques. Reading and analysis of full and condensed scores, study of transposition, psychology of rehearsal. Prereq: advanced music theory. 2 cr.

835. Collegium Musicum

Instrumentalists and singers perform small ensemble music from all periods, with emphasis on Renaissance and Baroque music. May be repeated to a maximum of 4 credits. 1 cr.

836-864. Applied Music for Graduate Credit

Courses 836-864 (private instruction in performance) offer advanced study in technique, interpretation, and repertory in the various applied areas; the functional use of an instrument in the school room may also be a course objective. Private lessons are given weekly and are one-hour or one-half-hour in length; an hour master class is given on alternate weeks. One semester hour of credit may be earned with the half-hour lesson; 2, 3, or 4 semester hours may be earned with the one-hour lesson. Five one-hour practice periods are expected for each credit of private study. The special fee for private study is \$105 per credit hour. This fee includes the use of a practice room for the required preparation. Prereq: an audition is required. The student must exhibit sufficient proficiency to warrant graduate study and must have permission of the department chairperson and the student's graduate adviser. A student may register for credit in the same course in successive semesters with the approval of the major adviser. Special fee. 1-4 cr.

836. Graduate Early Wind Instruments

Special fee. 1-4 cr.

837. Graduate Early String Instruments

Special fee. 1-4 cr.

841. Graduate Piano

Special fee. 1-4 cr.

842. Graduate Harpsichord

Special fee. 1-4 cr.

843. Graduate Organ

Special fee. 1-4 cr.

844. Graduate Harp

Special fee. 1-4 cr.

845. Graduate Voice

Special fee. 1-4 cr.

846. Graduate Violin

Special fee. 1-4 cr.

847. Graduate Viola

Special fee. 1-4 cr.

848. Graduate Cello

Special fee. 1-4 cr.

849. Graduate Bass

Special fee. 1-4 cr.

850. Graduate Classical Guitar

Special fee. 1-4 cr.

851. Graduate Flute

Special fee. 1-4 cr.

852. Graduate Clarinet

Special fee. 1-4 cr.

853. Graduate Saxophone

Special fee. 1-4 cr.

854. Graduate Oboe

Special fee. 1-4 cr.

855. Graduate Bassoon

Special fee. 1-4 cr.

856. Graduate French Horn

Special fee. 1-4 cr.

857. Graduate Trumpet

Special fee. 1-4 cr.

858. Graduate Trombone

Special fee. 1-4 cr.

859. Graduate Euphonium

Special fee. 1-4 cr.

860. Graduate Tuba

Special fee. 1-4 cr.

861. Graduate Percussion

Special fee. 1-4 cr.

862. Graduate Keyboards

Special fee. 1-4 cr.

863. Graduate Jazz Guitar

Special fee. 1-4 cr.

864. Graduate Drum Set

Special fee. 1-4 cr.

895. Special Studies in Music

Refer to History and Literature section.

Music Education (MUED)**841-842. 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.

843. 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.

845-846. Techniques and Methods in String Instruments

Class and individual instruction. Four hours of 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.

847-848. 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.

849. Techniques and Methods in Brass Instruments

Basic course in embouchure formation, tone, tonguing, fingering, 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. 2 cr.

851. Techniques and Methods in Percussion Instruments

Basic performance skills on snare drum, timpani, mallet instruments, and other percussion instruments used in bands and orchestras. Materials and methods of instruction. 2 cr.

885. Music for the Elementary Classroom Teacher

Designed for the nonspecialist. Correlation and integration of music in the school curriculum, and basic skills and techniques necessary. 4 cr.

890. Teaching Elementary School Music

Experiential approach toward learning creative strategies for teaching elementary school music. Includes various curricula and methods; philosophy and psychology of music; demonstration of materials and instruments. Observation and teaching in schools. Prereq: piano proficiency. 3 cr.

891. Teaching Secondary School Music

Assembling, managing, and teaching the junior/senior high school music curriculum. Academic issues of philosophy, curriculum building, application of learning theories, administration, evaluation, motivation, and classroom management combined with field experience in lesson planning and teaching/rehearsal techniques. Prereq: piano proficiency; conducting methods. 3 cr.

892. Seminar in Music Teaching

Group discussion and demonstration of effective music teaching. On-site examination of school music teaching. Organization and teaching of curriculum units. Normally taken during student teaching semester. 2 cr.

895. Special Studies in Music Education

Allows upper-level students to explore individually or in groups areas related to their specific professional interests. Prereq: permission. 1-4 cr.

983. 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.

984. Choral Literature and Its Performance

Analysis, discussion, and conducting of excerpts from choral masterpieces from all major periods and styles. Students 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.

995. Special Projects in Music Education

Independent study, investigation, or research in music education. Creative projects may be included. Prereq: permission. 1–4 cr.

996. Foundations and Perspectives of Music Education

Philosophical, sociological, and psychological foundations and principles of music education and the relationship of these principles to music learning and teaching. 4 cr.

Natural Resources (NR)

Chairperson: Theodore E. Howard

Professors: John D. Aber, James P. Barrett, John E. Carroll, Robert T. Eckert, Robert D. Harter, William W. Mautz

Adjunct Professors: C. Anthony Federer, James W. Hornbeck, William B. Leak, Sidney A. L. Pilgrim

Associate Professors: William B. Bowden, Russell G. Congalton, Christine V. Evans, Theodore E. Howard, Paul C. Johnson, John A. Litvaitis, William H. McDowell, Peter J. Pekins, Barrett N. Rock, Richard R. Weyrick

Research Associate Professors: Stephen H. Jones, Frederick T. Short

Assistant Professors: Kimberly J. Babbitt, Mimi Larsen Becker, Daniel J. Zarin

Graduate Program Coordinator:

Robert D. Harter

Degrees Offered

The Department of Natural Resources offers a master of science in natural resources with options in five areas.

Forestry: forest resource economics and management, biometrics, genetics, forest ecosystem dynamics, and remote sensing.

Environmental conservation: natural resource policy, conservation biology, sustainability, ecological ethics and values, and international environmental affairs.

Soil science: soil chemistry, soil classification and genesis, forest soils, and soil microbiology.

Water resources: wetlands, land-water interactions, groundwater chemistry, and biogeochemistry.

Wildlife: habitat evaluation and management, wildlife energetics, and population dynamics.

Admission Requirements

Applicants 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. All entering students must have taken at least one statistics course or do so at the graduate level. The Graduate Record Examination general test may be required of some applicants.

Students entering the forestry option may elect to develop concentrations within any of the above-listed areas. Applicants are expected to have backgrounds in forestry or related biological sciences. Entering students in soil science and water resources are required to have adequate preparation in chemistry and mathematics as well as biological or earth sciences. Students interested in wildlife are expected to have adequate preparation in biological sciences, chemistry, and mathematics. Students interested in environmental conservation should have a background appropriate for their area of interest. Since environmental conservation covers such a broad area, applicants are always reviewed carefully on an individual basis.

M.S. Degree Requirements

An 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 equivalents: NR 993, Seminar, 1 cr.; NR 903, Approach to Research, 3 cr.; a quantitative methods course; NR 996, Natural Resource Education, 1 cr.; (2) NR 998, Directed Research, or NR 899, Thesis, up to 10 credits with permission if warranted; and (3) a final oral and/or written examination.

Cooperative Doctoral Programs

The Department of Natural Resources participates in three doctoral degree programs in cooperation with other departments in the university. The departmental faculty are an integral part of the interdisciplinary natural resources Ph.D. program (see page 96), and opportunities for doctoral studies under all Department of Natural Resources faculty members are available through this program. In addition, a Ph.D. program in genetics (see page 72) is available to students in forestry through the genetics program, and a Ph.D. in environmental chemistry (see page 41) is available to soil science and water resources students through the chemistry department. Natural resource students specializing in forest ecosystem dynamics may conduct research through the Institute for the Study of Earth, Oceans, and Space.

Courses in Natural Resources (NR)**802. Natural Resource Workshops**

Short-term courses (generally a few days to two weeks) offered off-campus by the A) New Hampshire Audubon Society and B) Appalachian Mountain Club, as well as C) Nature Study covering a broad variety of environmental and natural resource topics. May be repeated. 1–4 cr., Cr/F.

809. Fire Ecology Seminar

Lectures, guest lectures, and student presentations dealing with the natural role of fires in wildland communities, fire adaptations in plant and animal species. Human responses to wildland fires and prescribed fire applications. Optional set of one-half to one-day field trips for an additional 1 cr. Prereq: basic ecology course. Special fee. (Not offered every year.) 2–3 cr.

812. Sampling Techniques

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. Prereq: applied statistics or equivalent. 2–4 cr. (Not offered every year.)

#813. Quantitative Ecology

Applied quantitative techniques: basic concepts in probability and statistics applied to ecological systems; population dynamics; spatial patterns; species abundance and diversity; classification and ordination; production; and energy and nutrient flow. Additional credit for in-depth mathematical analysis of a particular topic. Prereq: intro. courses in calculus, statistics, and ecology. 3 or 4 cr. (Not offered every year.)

830. Terrestrial Ecosystems

Processes controlling the energy, water, and nutrient dynamics of terrestrial ecosystems; concepts of study at the ecosystem level, controls on primary production, transpiration, decomposition, herbivory; links to Earth-system science, acid deposition, agriculture. Prereq: forest ecology; introduc-

tion to botany; principles of biology;/or permission. Special fee. Lab. 3 cr.

853. Decision Sciences in Natural Resource Management

Application of decision-science methods (optimization, simulation, input-output, and statistics) to natural resources problems. Emphasis is on practical work in evaluating projects, dealing with risk and uncertainty, analyzing regional impacts, valuing nonmarket resources, and exploring sustainability of managed forest. Prereq: economics of forestry or intermediate microeconomics. Special fee. Lab. 4 cr.

857. Photo Interpretation and Photogrammetry

Practical and conceptual presentation of techniques for using remote sensing, specifically aerial photographs, in natural resources. Includes photo measures of scale, area, parallax and object heights; flight planning; photo geometry; an introduction to the electromagnetic spectrum; and photo interpretation and mapping. Concludes with an introduction to digital remote sensing including multispectral scanners, radar, and thermal imagery and a brief discussion of geographic information systems (GIS). Applications to forestry, wildlife, land-use planning, earth sciences, soils, hydrology, and engineering. Prereq: algebra. Special fee. Lab. 4 cr.

859. Digital Image Processing for Natural Resources

Introduction to digital remote sensing including multispectral scanners (Landsat and SPOT) radar and thermal imagery. Hands-on image processing including filtering, image display, ratios, classification, registration, and accuracy assessment. GIS as it applies to image-processing. Discussion of practical application. Use of ERDAS image-processing software. Knowledge of PCs and DOS required. Prereq: NR 857 or equivalent and permission. Special fee. 4 cr.

860. Geographic Information Systems in Natural Resources

Introduction to the use of geographic information systems (GIS) for use with natural resources including data input, manipulation, storage, analysis, and display. Accuracy of spatial data and use of digital elevation models. Discussion of practical applications. Use of PC Arc/Info software. Prereq: permission. Special fee. Lab. 4 cr.

901. Special Topics in Natural Resources

Study of any one of a variety of special topics dealing with the general areas of natural resources and the environment. Course involves hands-on learning experience with a combination of lecture, lab, and field exercises. Generally offered off campus as professional development. 1–4 cr. Cr/F.

902. Ecological Ethics and Values

Increasingly fundamental philosophical questions, including spiritual values questions, are posited concerning the ecological/environmental challenge of our time, its causes, and its resolution. Examination of these questions, put forth with ethics and values approaches. Students work to develop responses to both problem identification and resolution. Lab. 4 cr.

903. 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. Prereq: permission. 3 cr.

906. Introduction to Environmental Education

Exploration of the (1) historic, current, and potential future status of environmental education in the United States, (2) the availability of, and the most commonly used, environmental education materials and resources. Includes a brief review of basic ecological principles, environmental interpretation techniques, and program development. Meets second half of the semester. 2 cr. Cr/F.

947. Current Issues in Ecosystem Ecology

Examines current issues in ecosystem ecology and biogeochemistry by weekly discussion of primary research articles. Topics covered include elemental interactions in biogeochemical processes, mechanisms regulating nitrogen losses from terrestrial ecosystems, and hydrologic-chemical interactions in streams and groundwater. Special fee. 1 cr.

972. Laboratory Experiences Science

Focus on developing effective, relevant exercises and demonstrations in both physical and biological sciences. Readings, lectures, and discussion present theory and examples of successful design strategies, as well as issues of health, safety, and liability. Each student develops a potential syllabus for a laboratory-lecture course in his/her discipline. Students also prepare and lead the rest of the class in at least one sample laboratory or field exercise which will be critiqued. Prereq: AOE 900 or equivalent. (Also offered as GRAD 972.) 1 cr. (Not offered every year.)

973. Large Enrollment Classes in the Sciences

Focus on developing effective, relevant exercises and demonstrations in both physical and biological sciences. Readings, lectures, and discussion present theory and examples of successful design strategies, as well as issues of health, safety, and liability. Each student develops a potential syllabus for a laboratory-lecture course in his/her discipline. Students also prepare and lead the rest of the class in at least one sample laboratory or field exercise which will be critiqued. Prereq: AOE 900 or equivalent. (Also offered as GRAD 973.) 1 cr. (Not offered every year.)

993. Natural and Environmental Resources Seminar

Presentation and discussion of recent research, literature, and policy problems in the natural and social sciences influencing resource use. 1 cr. Cr/F.

996. Natural Resource Education

Responsibilities include set-up, teaching, and grading of one lab section per week or equivalent lecture experience. Required of all M.S. degree students in the department. 1 cr. Cr/F.

998. Directed Research

Student designs and conducts original research that culminates in a paper of publishable quality. Alternative to NR 899 for those choosing nonthesis degree option. 4 cr. Cr/F. IA.

899. Master's Thesis

Usually 6 credits, but up to 10 credits when the problem warrants. 6–10 cr. Cr/F.

Environmental Conservation (EC)

802. Ecological Values and Ethics

Deeper more fundamental philosophical questions, including spiritual values questions, are being asked concerning the ecological/environmental challenge of our time; its causes and resolution. Aspects of this challenge—environmental education, energy, food, agriculture, and natural resources—analyzed with ethics and values approaches. Students develop ways of responding to problems identification and resolution. Prereq: permission. 4 cr.

803. Applied Environmental Philosophy

Applying the philosophical theory underlying environmental studies and approaches to environmental conservation. Students conduct critiques of extensive readings and write papers, creatively analyzing aspects of selected philosophical works. Major research manuscript required. 4 cr.

810. Environmental History

History of ideas, beliefs, values, and actions regarding the environment and the socioeconomic matrix within which they lie, with special reference to the American experience. 4 cr. (Not offered every year.)

818. 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, land-use economics, or equivalent. 3 cr.

820. International Environmental Politics and Policies for the 21st Century

Examines policies for managing human activities to sustain the health of regional ecosystems and planetary life-support systems. Focus on selected problems of the international commons (e.g., oceans, marine resources, atmosphere, migratory species); global and regional carrying capacity (e.g., population, resource consumption), internationally shared ecosystems (e.g., transboundary watersheds and waterbodies, tropical forests); and the relevant international institutions and politics for policy formation, conflict resolution, and implementation. Using a policy-analytic framework, students develop case studies to assess international policies and institutional arrangements to achieve the objectives of Agenda 21—The Earth Summit Strategy to Save the Planet. Prereq: permission. 4 cr.

824. Resolving Environmental Conflicts

Theories and practices of environmental dispute settlement. Roles of public, nongovernmental organizations and government assessed. Effectiveness of public participation initiatives in influencing public policy decisions and/or resolving environmental conflicts examined. Alternative approaches to consensus (policy dialogues, joint problem solving; strategic planning; negotiation; mediation) as well as litigation examined. Specific cases critiqued and evaluated; conflict resolution skills developed. Prereq: permission. 3 cr.

884. Sustainable Living

Concepts of living within ecosystem limits explored in a learning-community format. The importance of human communication, sense of place and time, and the health and longevity of our human species and natural systems emphasized.

Examination of governance, education, economic, agricultural, and ethical systems while asking, "What makes one system more or less sustainable than another?" to lead to directions for sustainable society. Two field trips and small research projects conducted. 2 cr.

885. Systems Thinking for Sustainable Living
Introduction to systems thinking from a sustainable living perspective. The course is a collaborative inquiry using a problem-solving approach. After studying different types of systems and learning a variety of tools useful in systems analysis, we ask, "In what ways can systems thinking be employed to understand and begin to resolve the complex problems that face us as we move toward living within the limits of natural systems?" Prereq: sustainable living or permission. 3 cr.

895. Investigations in Environmental Conservation

Seminar and independent study format give students the opportunity to identify and explore specific research issues. Topics may include policy, principles of sustainable living, leadership and advocacy, legislative and judiciary processes, public agencies, or issues relating to environmental science. Seminar format. Prereq: permission. 1–4 cr.

995. Investigations/Environmental Conservation

Topics may include environmental and natural resource policy; environmental diplomacy; the application of ethics, values, and philosophy to environmental conservation; agriculture; or teaching experience in these or related areas. Seminar format. Prereq: permission. Special fee for some topics. 1–4 cr.

Forestry (FOR)

822. Advanced Silviculture

Intensive silviculture of forest stands. Regeneration (e.g., alternative regeneration methods and site preparation); stand management (e.g., thinning schedules and fertilization). Prereq: silviculture or equivalent; permission. Special fee. 3 cr. (Not offered every year.)

825. Ecology and Management of Tropical Forests

Investigations of tropical environments; structure, composition of the archeological record of human impacts on tropical forests; tropical deforestation; tropical soils and agroforestry systems. Analysis of tropical timber and nontimber forest products. Prereq: forest ecology or equivalent; environmental and resource economics perspectives or equivalent. 4 cr.

834. Forest Protection Seminar

Discussion and special problems based on principles and techniques of forest protection. Prereq: permission. 3 cr. (Not offered every year.)

845. Forest Management

Forest land ownership; management objectives; forest inventory regulation and policy; forest administration; professional responsibilities and opportunities. Special fee. Lab. 4 cr.

854. Wood Products Manufacture and Marketing

Wood products from harvesting and procurement of raw material to finished product processes; management decisions, marketing, and promotion problems. Case-study approach backed up by all-day field trips to wood product manufacturing plants in the region. Prereq: wood science and technology or permission. Special fee. Lab. 4 cr.

855. Regional Silviculture and Forest Management

Extended field trip to another forest region. Prereq: forest management or permission. Limited enrollment. May be repeated. 2 cr. Cr/F. (Not offered every year.)

#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: permission. 4 cr. (Not offered every year.)

#901. Forest Management Seminar

Seminar discussions of current literature, plans, principles, and new developments in the general field of forest management. Prereq: permission. Special fee. 2 cr. (Not offered every year.)

#906. Forestry Economics Seminar

Discussion and reports on current economic and policy issues affecting forest resources and their management. Prereq: permission. 1–4 cr. (Not offered every year.)

910. Forest Stand Dynamics

Discussion and presentations on forest dynamics to include soil-site quality evaluation, individual tree growth, stand growth and yield, stand and forest management, and related resource politics. 4 cr. (Not offered every year.)

#916. 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. Seminar is 2 credits; an additional 2 credits available for an in-depth study of a particular topic. 2–4 cr. (Not offered every year.)

918. Advanced Forest Biology

Topical orientation following a workshop-type format. Presentations by faculty, students, and outside speakers. Emphasis placed on management impacts on biological systems. Sessions on theory and current literature are followed by data analysis and practical sessions, as appropriate. Subject areas include conservation biology, conservation genetics, climate change, old-growth forests, and the impact of management on natural forest ecosystems. Prereq: permission. 3 cr. (Not offered every year.)

930. Modeling of Forest Ecosystems

Computer modeling of energy, water, and nutrient dynamics of forest ecosystems; review of existing ecosystem models, modification of an existing model. Original programming of new model required as course project. Prereq: NR 830 or permission. 3 cr.

995. Investigations in Forestry

Topics may include forest ecology, remote sensing, wood products, mensuration, forest economics, forest management, decision science, watershed management, natural resource education, or teaching experience. Prereq: permission. May be repeated. 1–4 cr.

Soil Science (SOIL)

802. Chemistry of Soils

Chemical composition of soil; colloidal phenomena and the 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. 3 cr.

804. Soil Genesis and Classification

Processes involved in formation of soils and soil properties as reflectors of genetic processes. Classification systems of soils related to soil genesis and soil landscapes. Lab sessions illustrate concepts by examining soils in the field. Prereq: soils and the environment or equivalent. Special fee. Lab. 4 cr.

805. Forest Soils

Basic ecological and management perspectives; soil-site quality evaluation; forest land classification and interpretation; forest soil management techniques. Prereq: introduction to soil science; forest ecology; or permission. Special fee. Lab. 4 cr. (Not offered every year.)

#808. Soil Physics

Physical properties of soils and how they relate to the movement of water, solutes, and contaminants in saturated and unsaturated soils. Methods of measuring and characterizing soil physical properties. Applications to environmental problems, including land-based disposal systems, hazardous waste site investigation and remediation, and soil-water management. Prereq: basic courses in mathematics, chemistry, and physics; or permission. 3 cr. (Not offered every year.)

902. Special Topics in Soil Science

Topics may include soil mineralogy, advanced soil chemistry, soil physical chemistry, or others as the need arises. Seminar or lecture format as appropriate to the topic. Prereq: permission. 1–3 cr. Cr/F. (Offered only with sufficient demand.)

949. Pedology

Extensive readings and discussion of recent literature dealing with soils from a process-oriented perspective. Topics include mineral weathering, soil-geomorphic relationships, quantification of soil-forming functions, and paleopedology. 4 cr.

995. Independent Work in Soil Science

Topics may include soil-plant relationships, physics of soils, chemistry of soils, soil classification, forest soils, soil microbiology, or teaching experience. Elective only after consultation with instructor in charge. Prereq: permission. 1–4 cr.

Water Resources (WARM)

800. Critical Analysis of Water Resources Literature

Detailed consideration of current issues in water resource management in a seminar format. Emphasis on critical analysis of primary literature in environmental science relevant to water resources management. Prereq: watershed water quality management. Special fee. 2 cr.

811. Wetland Resource Management

Analysis of the natural resources of coastal and inland wetlands and environmental problems caused by human use and misuse of these ecosystems. Prereq: general ecology; watershed water quality management;/or permission. Special fee. 3 cr.

813. Field Wetland Ecology

Field investigation of coastal and inland wetland types. First half of course consists of field trips to visit and sample regional wetlands. Second half of course consists of methods used to analyze field samples from wetlands. Enrollment is limited. Prereq: present or past enrollment in WARM 811 and permission. Special fee. Lab/field trips. 3 cr.

816. Wetland Delineation

Examination of the soils, vegetation, and hydraulic functions of coastal and central New England wetlands. Students are responsible for the collection and identification of aquatic plant species, the description of wetland soils, and the delineation of wetland boundaries. Lectures and fieldwork. For graduate students and professionals. Prereq: permission. Special fee. Lab. 4 cr. (Offered summer session only.)

#818. Wetland Evaluation

Lectures and field trips covering the theory and practice of wetland evaluation techniques with emphasis on the method for the comparative evaluation of nontidal wetlands in New Hampshire. For graduate students and working professionals. Field trips. Special fee. 2 cr. (Not offered every year.)

819. Wetlands Mitigation and Restoration

Assessing the problems of wetland loss. Asks: what steps can be taken; does restoration work; can habitat value be replaced, and what constitutes equivalent mitigation? First half of course involves field trips to visit and sample mitigation and restoration sites. Second half focuses on student projects using the scientific method to address wetlands issues. Prereq: WARM 811 or permission. Special fee. Lab/field trips. 3 cr. (Not offered every year.)

821. Ecology of Polluted Waters

Impact of various water quality problems (e.g., excessive nutrient loading, organic matter loading, contamination by trace organic compounds) on the ecology of fresh waters, including microorganisms, aquatic invertebrates, algae, and fish. Design of impact assessment studies and data interpretation. Prereq: applied statistics, watershed water quality management, or permission. Special fee. Lab/field trips. 4 cr.

995. Independent Work in Water Resources Management

Projects arranged according to student need. May include watershed management, wetland ecology and management, biogeochemistry, risk assess-

ment, ecosystem restoration, or teaching experience. Prereq: permission. 1-4 cr.

Wildlife (WILD)

810. Endangered Species Seminar

Seminar provides students with an interactive class of student presentations and guest lectures by endangered species biologists. Emphasis placed on biological, sociological, economic, and political factors that influence endangered species policy. The text provides case studies with emphasis on nonbiological factors influencing policy. Students research the biological factors affecting endangered species and provide group presentations that explore the fundamentals of endangered species management. Prereq: basic ecology/biology. Special fee. 2 cr.

837. Wildlife Population Dynamics

Mechanisms that influence and characteristics of terrestrial wildlife populations. Prereq: one course in general ecology and statistics. 3 cr.

838. Wildlife Policy and Management

Wildlife administration and policy. Local, regional, and national wildlife management strategies. Contemporary management issues of fragmentation, commercialization of wildlife, and wildlife professionalism. Prereq: permission. Lab. 4 cr.

839. Methods in Wildlife Demography

Introduction to census methods, mortality estimators, and viability assessment. Prereq: concurrent or previous enrollment in a course on the concepts of population dynamics and one course in statistics. Special fee. Lab. 2 cr.

872. Wildlife Energetics

Energy requirements of wildlife species and the manner in which these needs are met in their natural environment. Thermodynamics in ecological systems, factors influencing metabolic rate, food habits, food-use efficiency, food availability. Prereq: permission. Special fee. 2 cr.

995. Investigations in Wildlife Management

Topics may include wildlife energetics and physiology, habitat management, population dynamics, waterfowl management, fire ecology, wildlife management, captive wildlife care, landscapes and wildlife habitat, or teaching experience. Prereq: permission. 1-4 cr.

Natural Resources Ph.D. Program (NRP)

Chairperson: John D. Aber

Professors: John D. Aber, Paul T. Brockelman, John E. Carroll, Garrett E. Crow, Richard W. England, Robert D. Harter, Paul J. Ossenbruggen

Associate Professors: Drew Christie, Russell G. Congalton, Robert T. Eckert, John M. Halstead, Theodore E. Howard, John A. Litvaitis, William H. McDowell, Berrien Moore III, Peter I. Pekins, Barrett N. Rock

Research Associate Professors: Janet W. Campbell, Patrick M. Crill, Frederick T. Short

Assistant Professors: Eleanor D. Abrams, Mimi Larsen Becker, Robert A. Robertson, Daniel J. Zarin

Graduate Program Coordinator: John D. Aber

Degree Offered

The natural resources program is an interdepartmental program offering only the Ph.D. degree for interdisciplinary work in areas related to the understanding and management of natural resources in the broadest context. Areas of study include ecosystem science, biogeochemical cycling from local to global scales, social science, ethical and policy issues, and multidisciplinary natural resources management.

Admission Requirements

Applicants to the natural resources program come from a wide range of undergraduate majors. Individuals are judged as to the quality of their work and its relevance to the particular area of study they propose to pursue. Certain applicants may be admitted with deficiencies identified by their adviser and by the executive committee. These deficiencies must be corrected through coursework in the first year in the program.

In addition, applicants must identify an adviser before being admitted, and this adviser must agree to take on the new student.

Applicants with master's degrees are judged on the basis of both undergraduate and graduate records. Coursework done at the master's level is, with appropriate approvals, counted against credit hour requirements for the degree.

Ph.D. Degree Requirements

The total coursework requirement is 48 credits, of which only 12 may be in project and seminar courses. This total may be reduced to 36 with the approval of the program's executive committee and the Graduate School. Graduate-level coursework in master's degree programs and from other universities may be applied to this requirement. All students in the program take courses in five core areas: concepts of natural resource management, problems in natural resource man-

agement, ethics, experimental design, and seminar. Additional course requirements will be determined by the doctoral committee and the program.

Each student must take three written/oral examinations: (1) a comprehensive exam, which covers the basic concepts and factual material deemed essential for the student by the doctoral committee; (2) a proposal exam, which covers the student's proposed dissertation research topic; and (3) a defense, which covers the results of the student's dissertation research (eligibility to take this exam is dependent on the student's completion of a dissertation acceptable to the doctoral committee).

Students are advanced to candidacy after successfully completing the comprehensive and proposal exams, and the foreign or computer programming language requirement. Language proficiency *may* be required at the discretion of the student's adviser/committee. If so required, a student would need to show proficiency in one foreign language or one computer language.

995. Independent Study
1-4 cr.

999. Doctoral Research

Nursing (NURS)

Chairperson: Ann Kelley

Professor: Judith A. Sullivan

Associate Professors: Gene E.

Harkless, Ann Kelley, Karol A.

LaCroix, Margaret A. Lamb, Juliette D.

Petillo, Dorothy D. Rentschler, Raelene

Shippee-Rice, Rosemary Y. Wang,

Carol L. Williams-Barnard

Assistant Professors: Diana M.

Crowell, Judith A. Evans, Susan J.

Fetzer, Liza Little, Joan S. Reeves

Graduate Program Coordinator:

Juliette D. Petillo

Degree Offered

The Department of Nursing offers the master of science degree in nursing. Two specialty areas are offered: advanced practice (clinical) and nursing administration. The advanced practice area currently offers two specialty foci: adult nurse practitioner/clinical nurse specialist and family nurse practitioner.

Individualized opportunities for role development in teaching and other nursing specialties can be pursued with permission of the graduate program director.

Admission Requirements

Registered nurses who hold a baccalaureate degree in either nursing or another field are considered for admission. Applicants are required to have a good academic record, satisfactory scores on either the Graduate Record Examination general test or the Miller Analogies Test, and completion of coursework in statistics and research. In addition, a minimum of one year of experience as a professional nurse is preferred. Applicants whose baccalaureate degree is in a discipline other than nursing are considered. The program of study is individualized based on evaluation of competency statements submitted with the application form. Applicants should contact the Graduate Nursing Office for a copy of the competency statement form.

M.S. Degree Requirements

The program for the master of science degree includes a total of 42 credits for the adult nurse practitioner/clinical nurse specialist, 39 credits for the nursing administration specialty, and 45 credit hours for the family nurse practitioner specialty. It is designed to be completed within two academic years of full-time study. Individualized plans of study are available for those wishing to pursue part-time study. The program of study is designed as follows:

Core courses (9 credits): Courses required of all students include: 900, The Discipline of Nursing; 901, Nursing and Change in Health Care Services; and 905, Research in Nursing.

Specialty courses (21-27 credits): Courses required for each area of specialization include for *adult nurse practitioner/clinical nurse specialist*: 907, Pharmacology; 908, Clinical Application of Human Physiology; 909, Health and Illness Appraisal; 935, Primary Care of the Adult; 936, Practicum in Primary Care of Adults; 941, Population-Focused Practicum; 945, Clinical Decision Making in Health Care; 946, Practicum in Adult Health Care. *For nursing administration*: 920, Administrative Theories of Nursing;

921, Administrative Context for Quality Nursing Care Delivery; 922, Resource and Financial Management in Nursing; 929, Practicum and Seminar in Nursing Administration; HMP 810, Financial Management for Clinicians; and HMP 903, Health Care Planning. *For family nurse practitioner*: 907, Pharmacology; 908, Clinical Application of Human Physiology; 909, Health and Illness Appraisal; 935, Primary Care of the Adult; 936, Practicum in Primary Care of Adults; 937, Primary Care of Children; 938, Practicum in Primary Care of Children; 939, Seminar and Practicum in Primary Care of Families. One elective must be a family cognate course.

Elective courses (0, 3, or 6 credits): Based upon the student's area of specialty and choice of master's thesis or project option, 0, 3, or 6 credits of elective coursework are required. If the project option is taken, the student will select a 3-credit elective related to the student's program of study.

Master's thesis (6 credits) or master's project (3 credits): A student may elect either a thesis or nonthesis option. A formal presentation of the completed project or thesis is required.

810. Families in Health and Illness

Seminar focusing on the family environment as a context for the experience of health and illness. Current middle-range theories and research from nursing and other disciplines analyzed for their application to family health. Public policy initiatives related to family health will be explored. 3 cr.

836. Cardiac Arrhythmias

Covers the theory and practice of single-lead and 12-lead electrocardiography for the purpose of identification of disturbances of the cardiac rhythm; designed to provide a firm foundation for the assessment and treatment of persons experiencing disturbances of the cardiac rhythm; includes field experiences. 4 cr.

900. The Discipline of Nursing

Nursing as a discipline with a focus on paradigms for nursing science, patterns of knowing, concept analysis, and nursing theory. Emphasis on concepts fundamental to nursing practice, including advocacy, caring, power, and collaboration; analysis of nursing theories in relation to practice and research. Prereq: permission. 3 cr.

901. Nursing and Change in Health Care Services

Emphasizes identifying emerging issues that have an impact on the health care system and determining nursing's role in adapting to address these issues. Students analyze problems and proposed solutions from a nursing perspective with reasoned approach to their resolutions. Prereq: permission. 3 cr.

905. Research in Nursing

Provides overview of current state-of-the-art research in nursing. Emphasis on critique of research findings and application of research to clinical practice. Prepares student to work collaboratively with expert researchers in either academic or clinical settings. Discusses types of research designs and qualitative and quantitative methods. Critique process focuses on individual components of research study, including the theory, purpose, sample, data collection procedures, and analysis. Includes ethical issues of scientific fraud and misconduct and issues of human subjects. Prereq: permission. 3 cr.

907. Pharmacology

Principles of pharmacodynamics and pharmacokinetics relevant to primary care practice. Focuses on major classes of drugs with an emphasis on knowledge necessary for prescriptive authority. Prereq: permission. 3 cr.

908. Clinical Application of Human Physiology

Examines human physiologic function and interaction of selected body systems in maintaining health. Clinical correlation strategies used to examine implications of recent advances in selected areas of human physiology to better understand the human body and its functioning in health and illness. Stresses application of course materials to advanced nursing practice in a variety of settings. Prereq: permission. 3 cr.

909. Health and Illness Appraisal

Advanced health assessment including communication strategies, functional health pattern assessment, advanced physical assessment, screening diagnostic tests, developmental evaluation, and clinical decision making. Lab and clinical component. Pre- or coreq: NURS 900; 905; 907; 908. Special fee. 3 cr.

920. Administrative Theories in Nursing

Application of administrative theories and organizational behavior concepts to the practice of nursing administration in current and emerging health care settings. Examines organizational structure, motivation, leadership/management, decision making, creativity, and change. Prereq: permission. 3 cr.

921. Administrative Context for Quality Nursing Care Delivery

Identification of strategies to create an organizational context to enhance effective and efficient quality nursing practice in a variety of health care settings. Intra- and interdepartmental effectiveness, care delivery models, governance models, patient/client focused redesign, operations improvement programs, and human resource management are studied within an open systems focus. Prereq: permission. 3 cr.

922. Resource and Financial Management in Nursing

Strategies for the effective use of human and financial resources in health care systems. Explores budget development and control, business plan development, skill mix, costing of nursing services, computer uses, classification of systems and activity determination of staffing/skill mix, and marketing of nursing service strategies in relation to fiscal responsibilities of the nurse and administrator. Prereq: HMP 810. 3 cr.

929. Practicum and Seminar in Nursing Administration

Individualized practicum experience arranged to

assist student in applying theoretical knowledge in the practice setting and to achieve personal goals related to development as a nurse administrator. Seminar topics selected to reflect issues arising from practicum experiences but will include ethical administrative considerations and nursing administration in future health care delivery systems. Prereq: permission. Special fee. 6 cr.

935. Primary Care of the Adult

Lecture/discussion course covering the primary care management of healthy adults through the lifespan with a focus on health maintenance and disease prevention. Focuses on evaluation and management of common acute and chronic adult health care problems. Major causes of adult morbidity are covered. Prereq: NURS 909. 3 cr.

936. Practicum in Primary Care of Adults

Supervised clinical experience in the primary care management of adults through the lifespan, including assessment and management of common acute and chronic clinical problems. Focuses on the clinical application of knowledge of health maintenance, disease prevention, and the evaluation and management of major causes of adult morbidity and mortality. Prereq: NURS 908; 909. Pre- or coreq: NURS 907; 935. Special fee. 3 cr.

937. Primary Care of Children

Lecture/discussion course covering the primary care management of children across the health-illness continuum, including assessment and management of common acute and chronic clinical problems. A developmental perspective is taken to examine child-health evaluation and maintenance from infancy through adolescence. Prereq: NURS 909. 3 cr.

938. Practicum in Primary Care of Children

Supervised clinical experience in the primary care management of the child and adolescent, including assessment and management of common acute and chronic clinical problems. A family-centered developmental perspective is taken to provide child-health services from infancy through adolescence. Nursing care, family, and rehabilitation issues related to various health problems are investigated in practice. Prereq: NURS 908; 909. Pre- or coreq: NURS 907; 937. Special fee. 3 cr.

939. Seminar and Practicum in Primary Care of Families

Final integrative clinical course that allows for intensive application of primary care knowledge and skills in practice. Seminar allows for in-depth analysis of various clinical problems and role issues. Students are actively involved in a primary care setting appropriate to their area of study. Extensive clinical experience under the guidance of a preceptor. Prereq: NURS 935; 936; 937; 938. Special fee. 6 cr.

941. Population-Focused Practicum

In this practicum students acquire the specialty knowledge and skills that are required in the care of a particular adult population. Students propose clinical performance competencies, learning activities, settings, and resource persons for the supervised practicum and complete a minimum of 112 precepted clinical hours. May be repeated to a maximum of 6 credits. Prereq: NURS 935; 936. Coreq: NURS 945. Special fee. 3 cr.

945. Clinical Decision Making in Health Care
Clinical decision making is analyzed and applied with a focus on integrating the humanistic, func-

tional, and medical frameworks of health care. An approach to identifying and analyzing ethical conflicts is developed, and culture-appropriate care examined. Students consider the range of management modalities that might benefit their populations of interest, and are assisted in expanding their repertoire of interventions. Pre- or coreq: NURS 935; 936. 3 cr.

946. Practicum in Adult Health Care

Seven seminars and 336 hours of precepted clinical experience. Students design the precepted clinical experience to refine, expand, and/or refocus existing clinical competencies with the objective of developing the ability to assess and manage complex client cases, and/or manage cases across clinical settings. Seminars involve presentation-discussions of case management situations, and discussion of role issues relevant to advanced practice roles. Pre- or coreq: NURS 945. Special fee. 6 cr.

994. Special Topics

Formal courses given on selected topics or special interest subjects. Several topics may be taught in one year or semester. Prereq: permission. May be repeated. 1-3 cr.

996. Independent Study

Opportunity for study and/or practice in an area of choice. Objectives are developed by students and must be approved by faculty. May be repeated. Prereq: permission. 1-3 cr.

998. Master's Project

Opportunity to develop, implement, and evaluate a project relevant to the practice setting. Prereq: permission. Variable 1-6 cr. (Total must equal 3 or 6 cr.) Cr/F. 1A.

999. Master's Thesis

Prereq: permission. 6 cr. Cr/F.

Occupational Education (AOE)

Chairperson: Bruce E. Lindsay

Professors: David L. Howell, Bruce E. Lindsay

Associate Professors: Patricia D. Bedker, Lewis Roberts, Jr.

Graduate Program Coordinator: David L. Howell

Degree Offered

The program in adult and occupational education offers the master of occupational education degree. Graduate students can select one of two areas of concentration: (a) vocational/technical education; or (b) adult education.

Admission Requirements

Applicants should consult with a faculty member before seeking admission, because an applicant's scholastic achievement, experience, references, and professional goals

are all relevant in the admission process. Applicants must also submit scores achieved on either the Graduate Record Examination general test or the Miller Analogies Test, in addition to the materials required by the Graduate School.

Master of Occupational Education Degree Requirements

All students are required to take AOE 912, Introduction to Social Sciences Research; AOE 998, Adult and Occupational Education Seminar (1–2 cr.); and AOE 802, Concepts of Adult and Occupational Education. Students concentrating in the area of vocational/technical education must also complete AOE 901, Advanced Methods and Materials of Instruction. Students concentrating in adult education are required to take AOE 990, Programming in Adult Education.

A graduate guidance committee consisting of a minimum of two faculty members from occupational education plus one other graduate faculty member is appointed for each student. Prior to the completion of 12 credit hours, the individual's graduate program is approved by the student's graduate committee. A minimum of 18 credit hours within the program is required. The committee, working with the candidate, makes every effort to provide a total program that reflects the goals of the individual.

Students must select a thesis or nonthesis option. Students completing a thesis are required to defend it orally. Students following the nonthesis option are required to complete written and oral examinations plus a professional paper.

Students may obtain initial certification in vocational agriculture and trade and industrial education through this program.

800. Workshops in Adult and Occupational Education

Modularized instruction of in-service education. Focus varies with the needs of the student. May be repeated up to 8 credits. Special fee. 1–4 cr.

802. Concepts of Adult and Occupational Education

Development of occupational education in the U.S.; socioeconomic influences responsible for its establishment; federal and state requirements for secondary and postsecondary schools. Coordination of programs with general education and vocational fields. Focus on selected concepts relevant to adult education. Special attention on the adult as a learner, volunteer management, evaluation and accountability, experiential learning, adult education. Required of all degree candidates in AOE concentrations. 4 cr.

852. Youth Organizations

Organizational Development: advising youth organizations; teaching parliamentary procedure; developing programs and activities; leadership organizations.

FFA/SOEP (Future Farmers of America/Supervised Occupational Experience Programs for high school youth).

VICA (Vocational Industrial Clubs of America).

4-H (Cooperative Extension Youth Program). 4 cr.

883. Conducting and Supervising Adult Education Programs

Analysis of traditional and nontraditional adult education programs; development of strategies of program planning, instruction, evaluation, and supervision. 4 cr.

884. Experiential Adult Learning

Theory, development, and applications of experientially based educational programming especially in relation to adult learning styles. Major emphasis placed on student-directed simulations, journals, facilitation, experiential reflection, and group activities. 4 cr.

891. Planning for Teaching

Organization of materials of instruction to meet group and individual needs. Techniques of instruction, planning for teaching, function of consulting committees, working with youth groups, program evaluation. Course scheduled concurrently with Educ. Supervised Teaching. Prereq: microcommunications or permission. 4 cr.

896. Investigations in Adult and Occupational Education

Topics may include career education, secondary education, postsecondary education, adult education, extension education, exemplary education, cooperative education, disadvantaged and handicapped education, international agriculture, or teaching experience. Student-selected problems in one of the areas listed. Elective after consultation with instructor. Hours to be arranged. May be repeated. 1–4 cr.

900. College Teaching

An analysis of teaching strategies at the collegiate level. The planning, execution, and evaluation of instruction for meeting the needs of the young adult learner. Recommended for all who wish to teach in a collegiate setting. Discussion of lectures of selected, distinguished UNH lecturers. Prereq: permission. 2 cr.

901. Advanced Methods and Materials of Instruction

Organization and delivery of performance-based instruction. Provides opportunities for exploration in instructional planning, execution, evaluation, management, and guidance. Open to teachers of vocational/technical education and others by permission. Required of master's degree candidates concentrating in vocational/technical education. 4 cr.

903. Administration and Supervision of Vocational/Technical Education

Students identify and develop competencies required of vocational administrators, using a vocational administrator task analysis, which includes fair hiring and firing practices, staff development, long-range planning, federal administration for

vocational programs, and evaluation of program effectiveness. Philosophy of, and federal regulations governing, vocational education. 4 cr.

904. Planning Strategies in Vocational/Technical Education

A systematic approach to the development of course materials for vocational/technical 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. 4 cr.

905. The Development of Cooperative Education Programs

Organization and development of cooperative training programs. Designed for teachers, cooperative-education coordinators, work-study coordinators, school administrators, industrialists, and others in charge of external training programs. Focus on planning, implementation, and evaluation of cooperative training programs as they relate to the role and function of the organization. 4 cr.

909. 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.

911. Internship

Internship in a field of vocational/technical and adult education either in methodology of teaching or in technical subject matter. Students may elect internship only after completing the qualifying examinations for the master's degree, with permission of their major adviser. May be repeated up to 8 cr. 0–8 cr.

912. Introduction to Social Sciences Research

The course is designed to develop a knowledge and understanding of the principles and techniques of scientific research in the social sciences. The research process is examined in terms of selection and formulation of research problems, design, techniques of data collection, analysis, and interrelation of data and reporting. 4 cr.

920. 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.

941. Population-Focused Practicum

In this practicum students acquire the specialty knowledge and skills that are required in the care of a particular adult population. Students propose clinical performance competencies, learning activities, settings and resource persons for the supervised practicum and complete a minimum of 112 precepted clinical hours. Prereq: NURS 935; 936. Coreq: NURS 945. May be repeated for a maximum of 6 credit. Special fee. 3 cr.

990. Programming in Adult Education

Focus on the program development process with particular attention to the design and implementation of educational programs that respond to adult needs. Special attention given to the involvement of the adult learners in the programming process and to educational programs in both the Coopera-

tive Extension Service and continuing education. Required for master's degree candidates concentrating in adult education. 4 cr.

995. Independent Study

Individual study problems in various phases of vocational/technical and adult education. Prereq: permission. May be repeated. 2-6 cr.

998. Adult and Occupational Education Seminar

Discussion of current issues, problems, and research and development in vocational/technical and adult education. Students, faculty, and other personnel serve as discussion leaders. Required of departmental graduate students. 1-2 cr. (Fall semester only.)

899. Master's Thesis

6-10 cr. Cr/F.

Occupational Therapy (OT)

Chairperson: Alice C. Seidel

Associate Professors: Elizabeth L. Crepeau, Lou Ann Griswold, Maureen E. Neistadt, Alice C. Seidel, Barbara Sussenberger, Ann D. Ury, Judith D. Ward

Assistant Professor: Shelley E. Mulligan

Graduate Program Coordinator: Lou Ann Griswold

Degree Offered

The Department of Occupational Therapy offers the master of science degree in occupational therapy. The program advances occupational therapists' skills in areas of clinical practice, administration, and clinical education. Students are prepared to engage in advanced level professional practice and to assert leadership in their chosen area of clinical specialization, education, and research.

Admission Requirements

Applicants for admission must demonstrate the following requirements: (1) a minimum of a baccalaureate degree; (2) current NBCOT or WFOT certification as an OTR; (3) a minimum of one year of working experience as a professional occupational therapist; and (4) successful completion of an undergraduate statistics course. All applicants must complete the Graduate School application, furnish recommendations from three individuals, and provide a recent score on the Gradu-

ate Record Examination. Applications are accepted for fall term only, and completed applications are reviewed on a regular basis commencing on February 1. Applications are reviewed until available spaces are filled.

M.S. Degree Requirements

The master of science degree in occupational therapy requires the completion of 34 graduate-level credits. Students complete four core courses (16 credits), three courses (12 credits) in a concentration area that reflects the student's professional goals, and a thesis or graduate project (6 credits). Students must earn a minimum of B- in all courses.

Courses: 901, Theoretical Practice of Occupational Therapy; 902, Statistics for Occupational Therapists; 903, Research Methods for Occupational Therapists; 904, Health Care Trends and Occupational Therapy; 911, Clinical Reasoning; 912, Clinical Education and Supervision; 913, Occupational Therapy Administration and System Analysis; 921, Occupational Therapy Service Delivery in Long Term Care Settings; 922, Occupational Therapy Service Delivery in Pediatric Practice; 923, Changing Patterns in Mental Health Practice; 924, Perceptual and Cognitive Dysfunction in Adults: Evaluation and Treatment; 893, Special Topics; 895, Readings and Research in Occupational Therapy; 897, Graduate Project; 898, Capstone Course; and 899, Thesis.

Curriculum design: Courses meet all day Saturday at the University of New Hampshire's Durham campus. A 4-credit course meets for one full day, four times during a semester.

Two-year degree sequence: Students may complete the degree in two years by taking two courses each fall and spring semester and two courses during the summer term. Students complete 24 credits the first year and 10 credits the second year.

Three-year degree sequence: Students may complete the degree in three years by taking one course each fall and spring semester and one course during the summer term. Students complete 12 credits in each of the first two years and 10 credits the third year.

893. Special Topics

Formal courses given on selected topics or special interest subjects. Work may be directed in one of the following areas: A) Administration; B) Clinical Education; C) Pediatrics; D) Physical Disabilities; E) Mental Health; F) Gerontology/Geriatrics; G) School-based Practice; and others. Prereq: permission. May be repeated to a maximum of 12 credits. 4 cr.

895. Reading and Research in Occupational Therapy

Independent work under the guidance of an instructor. Work may be directed in one of the following areas: A) Administration; B) Clinical Education; C) Pediatrics; D) Physical Disabilities; E) Mental Health; F) Gerontology/Geriatrics; G) School-based Practice; and others. Prereq: permission. May be repeated to a maximum of 8 credits. 2-4 cr.

901. Theoretical Practice of Occupational Therapy

The therapist's patterns of daily clinical practice reflect underlying theoretical assumptions that can be made self-evident through an informed process of practice-inventory. Students increase their knowledge of the contributions and constraints of theoretical developments in occupational therapy which enhance daily clinical/administrative practice and support research. Open only to students in the master's OT program. 4 cr.

902. Statistics for Occupational Therapists

Exploration of the parametric and nonparametric statistical methods used in the health services professions with a focus on applying and interpreting current statistical procedures in occupational therapy research. Open only to students in the master's OT program. Prereq: OT 901. 4 cr.

903. Research Methods for Occupational Therapists

Exploration of the components of health-related research. Students guided through the research proposal process. Issues addressed include developing and implementing research questions, literature review, appropriate research design, qualitative and quantitative methods, data analysis, publication collaboration, peer review, and research ethics. Class meetings structured to help students choose a research topic and develop a grant proposal. Lecture and discussion used as teaching methodologies. Open only to students in the master's OT program. Prereq: OT 902. 4 cr.

904. Health Care Trends and Occupational Therapy

Students examine the dynamics of health policy formulation, the political economy of health care, and the roles and potential for occupational therapy within the changing system. Open only to students in the master's OT program. Prereq: OT 901. 4 cr.

911. Clinical Reasoning

Clinical reasoning in health care and occupational therapy, phenomenology and interpretative sociology, and qualitative research analyzed as applied to the practice of occupational therapy. Students function as a research team which explicates the clinical reasoning used by team members. Narratives, journals, and videotaped treatment sessions used as part of this exploration. Open to students in the master's OT program. Prereq: OT 901 or permission. 4 cr.

912. Clinical Education and Supervision

Prepares students to serve as clinical educators and supervisors in health-care delivery systems. Philosophy of education provides a base for the development of a clinical educational program and selection of teaching methods. Issues of supervision and management of clinical education programs in various settings addressed. Ongoing program evaluation issues discussed. Open to students in the master's OT program. Prereq: OT 901 or permission. 4 cr.

913. OT Administration and Systems Analysis

Provides a framework to analyze systems of occupational therapy service delivery; to identify system influences on clinical practice and program administration; and to identify strategies for change. Open to students in the master's OT program. Prereq: OT 901 or permission. 4 cr.

922. Occupational Therapy Service Delivery in Pediatric Practice

Application of occupational therapy in pediatrics to the educational and family systems. Focuses on analysis of these systems and their essential components to guide effective service delivery. Open to students in the master's OT program. Prereq: OT 901 or permission. 4 cr.

924. Perceptual and Cognitive Dysfunction in Adults: Evaluation and Treatment

Explores the neurophysiology, evaluation, and treatment of common perceptual and cognitive dysfunctions associated with adult neurological diagnoses such as head trauma and stroke. Dysfunctions covered include unilateral neglect, apraxias, visuospatial and visuoconstructive disorders, attention, memory, and executive function deficits. Open to students in the master's OT program. Prereq: OT 901 or permission. 4 cr.

925. Changing Patterns in Mental Health Practice

Occupational therapy practice in mental health is in a state of constant change and readaptation in response to the larger environmental constraints of legislation and reimbursement. This course takes a two-pronged approach to tackling some of today's issues. The first is the role of clinical research. The second is in the area of new role development. Open to students in the master's OT program. Prereq: OT 901 or permission. 4 cr.

897. Graduate Project

Application of graduate education addressing an issue related to occupational therapy and a change in occupational therapy practice, education, or administration. The project includes a literature review, a plan for change based on the literature, a plan of implementation, and a plan for evaluation. Prereq: permission. 4 cr. IA.

898. Capstone

Designed as a seminar with a culminating project that requires students to integrate previous coursework and readings about their chosen area of specialization. Project includes an oral presentation and a written paper. As part of the oral presentation, students lead a discussion exploring the theoretical and practical aspects of their topic. Prereq: permission. 2 cr. IA. Cr/F.

899. Master's Thesis

Prereq: permission. 6 cr. Cr/F.

Ocean Engineering (OE)

Chairperson: Kenneth C. Baldwin
Professors: Jean Benoit, Wendell S. Brown, Barbaros Celikkol, Pedro A. de Alba, David L. Gress, Godfrey H. Savage, Kondagunta Sivaprasad, M. Robinson Swift

Associate Professors: Kenneth C. Baldwin, Thomas P. Ballestero, Allen D. Drake, Nancy E. Kinner

Graduate Program Coordinator: Kenneth C. Baldwin

Degree Offered

The interdisciplinary ocean engineering program offers graduate work leading to the degree of master of science in ocean engineering. The general purpose of this program is to prepare engineering students for professional careers in ocean-related fields.

Admission Requirements

Applicants to the program should have completed a baccalaureate degree in either chemical, civil, electrical, or mechanical engineering or have an equivalent background.

M.S. Degree Requirements

Each student in the program is required to take an oceanography course: ESCI 852, Chemical Oceanography, or ESCI 858, Introductory Physical Oceanography, or ESCI 859, Geological Oceanography, or ZOO 850, Biological Oceanography, and OE 990, 991, Ocean Engineering Seminar I, II. In addition, each student must select three of the following six courses: OE 881, Physical Instrumentation; OE 810, Ocean Measurements Laboratory; OE 853, Ocean Hydrodynamics; OE 854, Ocean Waves and Tides; OE 885, Underwater Acoustics; and ESCI 959, Data Analysis Methods in Ocean and Earth Sciences. Students are also required to take a minimum of 12 credits of additional coursework and complete a master's thesis for 6 credits. Normally the additional courses are in the student's field of engineering.

810. Ocean Measurements Laboratory

Measurements of fundamental ocean processes and parameters. Emphasis on understanding typical offshore measurements, their applications, and the use of the acquired data. The latter is in terms of the effects on structures and processes in the ocean. 4 cr.

844. Corrosion

The course is split into three parts: (1) reviews and develops basic concepts of electrochemistry, kinetics, and measurement methods; (2) covers the details of specific corrosion mechanisms and phenomena including passivity, galvanic corrosion, concentration cell corrosion, pitting and crevice corrosion, and environmentally induced cracking; and (3) focuses on the effects of metallurgical structure on corrosion, corrosion in selected environments, corrosion prevention methods, and materials selection and design. Prereq: general chemistry, introduction to materials science or permission. (Also offered as ME 844.) Lab. 4 cr.

853. Ocean Hydrodynamics

Fundamental concepts of fluid mechanics as applied to the ocean; continuity; Euler and Navier-Stokes equations; Bernoulli equation; stream function, potential function; momentum theorem; turbulence and boundary layers are developed with ocean applications. Prereq: permission. 3 cr.

854. Ocean Waves and Tides

Introduction to waves: small-amplitude, linear wave theory, standing and propagating waves, transformation in shallow water, energy and forces on structures, generation by wind and specification of a random sea, long waves with rotation, and internal waves. Introduction to tides: description of tides in ocean tidal generation forces, equilibrium tide, and tidal analysis. Lab/project: field and lab measurements with computer analysis. Prereq: general physics; differential equations;/or permission. (Also offered as EOS 854.) Lab. 4 cr.

856. Principles of Natural Architecture and Model Testing

Fundamentals of naval architecture presented including hydrostatics, basics of resistance and propulsion, sea keeping and scaling. Concepts applied in experiments utilizing the tow/wave tank and associated instrumentation. Prereq: fluid dynamics, mechanics III, or equivalent. Lab. 4 cr.

#857. Coastal Engineering and Processes

Introduction to small-amplitude and finite-amplitude wave theories. Wave forecasting by significant wave method and wave spectrum method. Coastal processes and shoreline protection. Wave forces and wave structure interaction. Introduction to mathematical and physical modeling. Prereq: fluid dynamics or permission. (Also offered as CIE 857 and ME 857.) 3 cr.

#861. Materials in the Ocean

Introduction to mechanical properties of materials; ferrous metals; nonferrous metals; concrete, plastic, wood, etc.; corrosion of metals; corrosion control; durability of cementitious materials; degradation of plastics, wood, etc., in marine environment; proper materials selection for a marine environment. Prereq: permission. 3 cr.

#881. Physical Instrumentation

Analysis and design of instrumentation systems. Sensors, circuits, and devices for measurement and control. Elements of probability and statistics as applied to instrument design and data analysis. Transmission, display, storage, and processing of information. The design, implementation, testing, and evaluation of an instrument system is an integral part of the course. Prereq: permission. (Also offered as EE 881.) 4 cr.

885. 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. (Also offered as EE 885.) 4 cr.

895. Special Topics in Ocean Engineering

New or specialized courses and/or independent study. May be repeated for credit. 2–4 cr.

#937. Advanced Hydrodynamics

Continuum approach to the analysis of ocean circulation problems. Shallow and deep water modeling to include temperature, salinity, and species distributions in time and space. Air-sea interaction, energy transport phenomena, internal currents, and the effect of coastal geometry on wave reflection and resonant phenomena. Fundamental data acquisition and analysis techniques. Prereq: permission. 4 cr.

954. Ocean Waves and Tides II

Continuation of ocean waves and tides. Topics include nonlinear wave theory, long wave (tidal) equations with Coriolis acceleration and friction, turbulence, Reynold's stress, and estuarine fronts. Random seas studied with consideration of wave spectra, generation of random seas for numerical and physical modeling, and the response of marine vehicles and structures to wave loading. Prereq: OE 854. 4 cr.

956. Dynamics of Moored Systems

Dynamic response of floating and submerged moored systems to currents and wave spectra studied. Examples include buoys, moored platforms, and ocean net pens. Prereq: OE 856 or permission. 4 cr.

990, 991. Ocean Seminars I, II

Various topics, including marine systems design, marine vehicle operation, data collecting and processing, and marine law. 2 cr.

995. Graduate Special Topics

Investigation of graduate-level problems or topics in ocean engineering. May be repeated for a maximum of 16 cr. 24 cr.

998. Independent Study

Independent theoretical and/or experimental investigation of an ocean engineering problem under the guidance of a faculty member. 1–4 cr.

899. Master's Thesis

6 cr. Cr/F.

Physics (PHYS)

Chairperson: L. Christian Balling

Professors: Roger L. Arnoldy, L. Christian Balling, John R. Calarco, Edward L. Chupp, John F. Dawson, Jochen Heisenberg, F. William Hersman, Joseph Hollweg, Richard L. Kaufmann, Robert H. Lambert, Martin A. Lee, Eberhard Möbius, James M. Ryan, Harvey K. Shepard, Robert E.

Simpson, Roy B. Torbert, John J. Wright

Research Professors: Terry Forbes, W. T. Vestrand

Associate Professors: Olof Echt, Dawn C. Meredith

Research Associate Professors: David J. Forrest, Philip A. Isenberg, Lynn M. Kistler, Mark L. McConnell

Assistant Professor: Robert E. Leuchtner

Research Assistant Professor: Mark B. Leuschner

Graduate Program Recruiter: James M. Ryan

Graduate Student Adviser: John R. Calarco

Degrees Offered

The Department of Physics offers the degrees of master of science and the doctor of philosophy. Areas of specialization are space physics and astrophysics, nuclear physics, solid-state physics, and nonlinear dynamical systems.

Admission Requirements

Applicants to the master of science and doctor of philosophy programs are expected to have a bachelor's degree in science, with at least 24 credits in physics and closely allied fields.

M.S. Degree Requirements

The courses required for the master of science in physics include 805, 931, 939, 941, and 943. Students in the M.S. program are not required to take the Ph.D. qualifying examination. Students may select one of the following plans:

- 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.

Ph.D. Degree Requirements

The courses required for a doctor of philosophy degree in physics are (1) 805, 931–932, 935, 939, 941–942, 943–944, either 940, 953 or 955; and (2) any additional four courses at the 900 level, excluding 969, 978,

979, 989, and 999. With appropriate additional work, a student may petition to receive credit for one of the following courses: PHYS 810, 812, 818, 820, or 851.

For students doing Ph.D. research in astrophysics or space physics, one of the four elective courses must be PHYS 951; 952 is also highly recommended. These students must also take either 810 or 812 and three semesters of EOS 901 seminar.

Admission to candidacy for the degree is based primarily on demonstrated ability in formal coursework; experience in teaching, equivalent to at least half time for one year; and passing a written qualifying examination. This examination is normally taken during the second year and must be passed by the end of the third year. Upon completion of a dissertation, doctoral candidates will take an oral examination based on the area of their research.

Interdisciplinary Research

The department encourages research in areas related to physics or applied physics. Should students desire to do research in a field related to physics, special provisions may be made. A cooperative program with the Department of Electrical and Computer Engineering is available to master's students in physics. Physics students specializing in space science may complete M.S. or Ph.D. theses under the guidance of professors or research professors in the Institute for the Study of Earth, Oceans, and Space (EOS). (See the listing for EOS in this catalog.) Contact the department chairperson or graduate adviser for details.

805. Experimental Physics

Experiments in nuclear, solid-state, and surface physics. Includes discussion of laboratory techniques, data analysis, and data presentation. Special projects assigned to individual students. 4 cr.

810. Introduction to Astrophysics

Review of the sun, stars, Milky Way, external galaxies, and expansion of the universe. Recent discoveries of radio galaxies, quasi-stellar objects, cosmic black-body radiation, x rays, and gamma rays precede a discussion of Newtonian and general relativistic cosmological models, steady-state/big-bang theories, and matter-antimatter models. (Also offered as EOS 810.) 4 cr. (Alternate years only.)

#811. Topics in Modern Physics

Discussions, lectures, and laboratory work on topics of current interest in physics. An introductory course for secondary school teachers and others with some science background. 1–4 cr. (Not offered every year.)

812. Physics of the Ionosphere

Introduces basic plasma physics using a case study of the Earth's ionosphere and its connection both to the upper atmosphere and to the Earth's magnetosphere. Topics include single-particle motion, fluid and kinetic descriptions of ionospheric plasma, wave propagation, and instabilities. Prereq: electricity and magnetism I or equivalent; calculus II. (Also offered as EOS 812.) 4 cr.

818. Introduction to Solid-State Physics

Crystal structure, diffraction, lattice vibrations, electronic and optical properties of metals and semiconductors; selected topics in modern condensed matter physics. Prereq: introduction to quantum mechanics I, electricity and magnetism I or equivalent. 4 cr. (Normally offered every other year.)

820. Nuclear Physics

Nuclear phenomenology, reactions, models, radiation, interaction of radiation with matter; accelerators; properties and interactions of elementary particles; symmetries and symmetry breaking standard model. Prereq: introduction to quantum mechanics I and II; electricity and magnetism I and II; or permission or instructor. 4 cr.

854. Introduction to Scientific Computing

Introduction to the tools and methodology of scientific computing via the examination of interdisciplinary case studies from science and engineering. Emphasis on numerical approaches to solving linear systems, eigenvalue-eigenvector problems, and differential equations. Problems are solved on various hardware platforms using a combination of software and data visualization packages. Prereq: linear algebra; differential equations; introduction to programming;/or permission. (Also offered as MATH 854; CS 854.) Lab. 3 cr.

895. Independent Study

Individual project under direction of a faculty adviser. 1–8 cr.

901. Physics Teaching Seminar

Course for new graduate students providing an introduction to their role as teaching assistants. Designed to raise awareness of professional responsibilities, to provide instruction on theory-based teaching and learning, and to provide opportunities for reflective practice. 1 cr. Cr/F.

931–932. Mathematical Physics

Complex variables, differential equations, asymptotic methods, integral transforms, special functions, linear vector spaces and matrices, Green's functions, and additional topics selected from integral equations, variational methods, numerical methods, tensor analysis, and group theory. (Also offered as MATH 931–932.) 3 cr.

935. Statistical Physics

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 and applications of statistical mechanics to selected physical problems. Prereq: PHYS 931; 939; 943. 3 cr.

939–940. Theoretical Mechanics I and II

Newtonian, Lagrangian, and Hamiltonian formulation of the classical mechanics of particles and rigid bodies; continuum mechanics. Topics that serve as background for the study of modern physical theories are emphasized. 3 cr.

941–942. Electromagnetic Theory

The formulation and detailed application of electromagnetic theory to physical problems. The material covered is at the level of the text by J. D. Jackson, *Classical Electrodynamics*. 3 cr.

943–944. Quantum Mechanics

Introduces nonrelativistic quantum theory, covering wave mechanics, Dirac notation, angular momentum, the use of perturbation theory to calculate atomic energy levels, the interaction of atoms with radiation, and various approaches to calculating the differential scattering cross-section. 3 cr.

951–952. Plasma Physics I and II

Kinetic theory of plasmas; plasma waves, instabilities, turbulence, diffusion, adiabatic motion of charged particles, nonlinear plasma phenomena. Prereq: PHYS 935; 941; 942. 3 cr. (Normally offered every other year.)

953. Solar Magnetohydrodynamics

Introduction to solar physics, with emphasis on gas dynamics and magnetic fields. Interior structure, the theory of convection, wave motions in the presence of magnetism and gravity, coronal heating theories, steady and nonsteady flows, dynamo theory, and the theory of solar flares and other transient phenomena. Salient observational data are reviewed. 3 cr. (Normally offered every other year.)

954. Solar Wind and Cosmic Rays

The solar wind and its effects on cosmic rays. The basic equations of the solar wind: mass, momentum, angular momentum, and energy balance. Transport processes. Waves, shocks, and instabilities in the solar wind. The basic equations of energetic particle transport. Solar modulation of solar and galactic cosmic rays. Interaction of energetic particles with shock waves. Salient data are reviewed. 3 cr. (Normally offered every other year.)

955. Geophysical and Astrophysical Fluid Dynamics

Applies principles of fluid dynamics and magnetohydrodynamics to the Earth's atmosphere and oceans and to space plasmas. Emphasizes common problems and techniques. Topics include mass, momentum, energy conservation; static equilibria; quasigeostrophic flow; waves (acoustic-gravity, planetary, magnetoacoustic); surface waves in the ocean and in space; instabilities (convective, baroclinic Rayleigh-Taylor, Kelvin Helmholtz); boundary layer problems (Ekman layers, Stewartson layers, tearing modes; resonance absorption); supersonic flows (the solar wind, shock waves). Prereq: MATH 845 and 846, or PHYS 931. (Also offered as EOS 955.) 3 cr. (Normally offered every other year.)

961–962. 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 939; 944. 3 cr. (Normally offered every other year.)

963–964. 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 944. 3 cr. (Normally offered every other year.)

965. Advanced Solid-State Physics

Theory of crystalline metals, semiconductors, and insulators. Selected topics from the following: surfaces, films, quantum dots, clusters, solid-state devices. Prereq: PHYS 935; 941; 943. 3 cr. (Normally offered every other year.)

#969. Nuclear Physics Seminar

Lectures and discussion of current topics in nuclear and particle physics. 1–3 cr. (Not offered every year.)

978. Condensed Matter Physics Seminar

Lectures and discussion of current topics in condensed matter physics. May be repeated. 1–3 cr.

979. Nonlinear Studies Seminar

Lectures and discussion of current topics in the interdisciplinary field of nonlinear dynamics. 1–3 cr.

987. Magnetospheres

Introduces plasma physics of the interaction of solar and stellar winds with planets having internal magnetic fields, most predominantly, the Earth. Both MHD and kinetic descriptions of internal and boundary processes of magnetospheres as well as treatment of the interaction with collisional ionospheres. Flow of mass, momentum, and energy through such systems. Prereq: PHYS 951; 952;/or permission. (Also offered as EOS 987.) 3 cr. (Normally offered every other year.)

988. High Energy Astrophysics

One-semester course on the physical principles underpinning the field of high energy astrophysics. Subjects covered include production, detection, and transport processes of neutral and charged high energy particles and photons. Emphasizes the applications of these processes to the detection and measurement problem and theory of telescope design. Uses astrophysical examples to illustrate the subject matter. First part serves as a basis for discussing the astrophysics of the heliosphere, including solar flares, galactic and solar cosmic rays, and the influence of the Earth's magnetic field on the cosmic rays. Prereq: PHYS 941; 942; 944. (Also offered as EOS 988.) 3 cr. (Normally offered every other year.)

#989. Space Physics Seminar

Lectures and discussions of current research in the physics of fields and particles in space. May be repeated to 6 credits. 1–3 cr. (Not offered every year.)

995. 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; general relativity and cosmology; group theory; atomic physics; quantum theory of light, nonlinear equations, and chaos. May be taken more than once. 1–3 cr. (Not offered every year.)

899. Master's Thesis

6 cr. Cr/F.

999. Doctoral Research

Plant Biology (PBIO)

Chairperson: Robert O. Blanchard
Professors: Robert O. Blanchard, A. Linn Bogle, Garrett E. Crow, George O. Estes, Curtis V. Givan, J. Brent Loy, William E. MacHardy, Arthur C. Mathieson, Subhash C. Minocha, Otho S. Wells

Associate Professors: Alan L. Baker, Thomas M. Davis, Wayne R. Fagerberg, Leland S. Jahnke, Anita S. Klein, Thomas D. Lee, James R. Mitchell, James E. Pollard, John M. Roberts

Adjunct Associate Professor: Kevin T. Smith

Assistant Professors: Paul R. Fisher, Estelle M. Hrabak

Graduate Program Coordinator: J. Brent Loy

Degrees Offered

The Department of Plant Biology offers the master of science and the doctor of philosophy degrees. Research opportunities are available in both basic and applied areas of plant biology, including breeding and genetics, cell biology, cell and tissue culture, crop management, ecology, plant molecular biology, genetic engineering, marine and freshwater biology, morphology and anatomy, mycology, pathology, phycology, physiology, and systematic botany.

Admission Requirements

Applicants are expected to have adequate preparation in plant biology and in the physical sciences; they must also submit general and subject biology scores from the Graduate Record Examination.

M.S. Degree Requirements

Students will meet the Graduate School's requirements for the degree (minimum of 30 credits). Students will be required to write and defend a thesis (6–10 credits) based on field or laboratory research.

Ph.D. Degree Requirements

Students will complete a program of study as determined by their guidance committee. Students will be advanced to candidacy after successfully completing comprehensive written and oral qualifying examinations. Candidates must suc-

cessfully defend a dissertation based on original research in plant biology. For some program areas, a foreign language may be required at the discretion of the student's guidance committee.

Teaching Requirements

Teaching experience is required of all M.S. and Ph.D. degree students. The requirement may be fulfilled by enrolling in a supervised teaching course, by serving as a teaching assistant, or by having previous professional teaching experience.

806. Weed Ecology

Ecology and reproductive biology of weed species. Dormancy and germination, dispersal, and patterns of weed establishment. Physiology and biochemistry of herbicides. Genetic engineering and environmental issues. Discussions emphasize developments in current literature. Prereq: introductory botany and general chemistry. Special fee. 2 cr.

808. Weed Ecology Laboratory

Application of weed identification and weed control practices, considering various types of crops (including ornamental), cultural control, herbicide equipment, application, and safety. Environmental concerns. Field trips. Special fee. Pre- or coreq: PBIO 806. 2 cr.

809. Plant Stress Physiology

Examines the physiological and biochemical mechanisms of plant response to abiotic stresses including drought, salt, high and low temperature, visible and ultraviolet radiation, heavy metals, and air pollutants. Discusses current hypotheses, agricultural and ecological implications. Prereq: plant physiology; biochemistry;/or permission. 3 cr.

811. Plant Cell Biochemistry

Photosynthetic and nonphotosynthetic metabolism of plant cells: nitrogen and carbon metabolism, lipid biosynthesis and degradation, nitrogen fixation, respiration, integration and regulation of cell functions. Prereq: basic biochemistry; plant physiology;/or permission. 3 cr.

813. Photosynthesis

The physiology and biochemistry of photosynthesis in higher plants and microorganisms: light reactions, electron transport, membrane structure and function, carbon assimilation pathways, energy conservation, and metabolic regulation. Agronomic and ecological aspects of photosynthesis are examined. Prereq: plant physiology or biochemistry. 4 cr. (Not offered every year.)

814. Electron Microscopy

Theory and principles involved in preparing plant and animal tissue for observation with the transmission (TEM) and scanning (SEM) electron microscopes; x-ray analysis (EDAX); freeze-fracture, including shadow casting and photographic techniques; and presentation of micrographs for publication. Prereq: permission. Coreq: PBIO 815. 2 cr.

815. Electron Microscopy Lab

Practical application of theoretical principles and

practices utilized in preparing and observing plant and animal tissues with the transmission and scanning electron microscopes. Student project assigned. Prereq: permission. Coreq: PBIO 814. Special fee. 3 cr.

817. 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. (Also offered as ZOOL 817.) 4 cr.

818. Quantitative Aquatic Ecology

Aquatic ecosystems studied through field and laboratory exercises. Emphasis on the application of statistical methods from sampling design to statistical and ecological interpretation of results. Field trip data analyzed in both biology and statistics laboratories. Understanding how the principles underlying statistical concepts can be applied to biological systems will be emphasized. Field trips, designed to collect data for rigorous statistical analysis, include remote pristine lakes in the White Mountains National Forest as well as lakes in southern New Hampshire. Prereq: general ecology or equivalent. (Also offered as ZOOL 818.) 6 cr. (Fall semester only. Alternate years.)

819. Field Limnology

Ecology of inland waters examined through field studies of lakes, streams and other freshwater habitats. Emphasizes methods for studying lakes, analysis and interpretation of data, and writing of scientific reports. Includes seminars on research papers and field trips to a variety of lakes from coastal plain to White Mountains. Prereq: concurrent or prior enrollment in general limnology, zooplankton ecology, or equivalent; permission. (Also offered as ZOOL 819.) Special fee. Lab. 4 cr.

821. The Microscopic Algae

Survey of phytoplankton and periphyton in local marine and freshwater habitats. Identification, systematics, and evolution. Class and individual collection trips. Prereq: principles of biology II, or introductory botany, or evolution of plants. Lab. 4 cr. (Not offered every year.)

822. Marine Phycology

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: principles of biology or elementary botany or survey of the plant kingdom. Lab. 4 cr. (Not offered every year.)

824. Freshwater Algal Ecology

Survey of freshwater algal habitats; physiological explanation of population models. Individual experimental projects. Prereq: general limnology or permission. 4 cr.

825. Marine Ecology

Marine environment and its biota, emphasizing intertidal and estuarine habitats. Includes field, laboratory, and independent research project. Prereq: general ecology; permission. Marine invertebrate zoology, oceanography, and statistics are desirable. (Also offered as ZOOL 825.) 4 cr. (Not offered every year.)

826. Integrated Pest Management

Integration of pest management techniques involv-

ing biological, culture, and chemical control with principles of insect ecology into management approach for insect pests. Prereq: permission. 4 cr.

827. Algal Physiology

Survey of major topics in the physiology and biochemistry of marine and freshwater algae including nutrition, metabolic pathways, reproductive physiology, storage and extracellular products, cell inclusion, growth, and development. Prereq: introduction to biochemistry or permission. 3 cr. (Not offered every year.)

829. Algal Physiology Laboratory

Laboratory techniques useful in studying the physiology of freshwater and marine algae. Experiments in nutrition, metabolism, and pigment and enzyme analysis. Small research project required. Prereq: permission. Coreq: P BIO 827. 2 cr. (Not offered every year.)

842. Physiological Ecology

Physiological responses of plants to the physical environment; energy exchange, light and photosynthesis, water relations, and mineral nutrition. Prereq: plant physiology or permission. Lab. 4 cr. (Not offered every year.)

844. Vegetation Sampling and Analysis

Methods for sampling plant populations and communities especially estimation of abundance. Analysis of pattern, measurement of species diversity, and relation of abundance to environmental factors. Ordination and classification of communities. Modeling of succession. Prereq: statistics and general ecology or equivalent;/or permission. Lab. 4 cr.

845. Community Ecology

Theoretical and empirical exploration of the nature of natural communities; the factors that influence community properties such as species composition, species diversity, and trophic structure; and community stability and dynamics, including succession. Prereq: statistics; general ecology;/or permission. 4 cr.

#847. Aquatic Higher Plants

Flowering plants and fern relatives found in and about bodies of water in the northeastern United States; extensive field and herbarium work, preparation techniques, and collections. Prereq: plant taxonomy or permission. Lab. 4 cr. (Not offered every year.)

851. Cell Culture

Theory and principles fundamental to the culture of cells in vitro. Introduction to techniques of preparation and maintenance of animal, plant, insect, and fish cell cultures. Application of cell culture to contemporary research in biological sciences. Prereq: general micro.; permission. (Also offered as MICR 851 and ANSC 851.) Special fee. Lab. 5 cr.

852. Mycology

Classification, identification, culturing, life histories, and ecology of fungi, from slime molds to hallucinogenic mushrooms; the significance of fungi in human history, from their contribution to the art of bread making and alcoholic fermentation to their destructiveness as agents of deadly diseases of plants and animals. Prereq: principles of biology I, II or introduction to botany, or equivalent. Special fee. Lab. 4 cr.

853. Cytogenetics

Chromosome structure, function, and evolution. Eukaryotic genome organization. Theory of, and laboratory techniques for, cytogenetic analysis in plants and animals. Prereq: principles of genetics. (Also offered as GEN 853.) Special fee. Lab. 4 cr. (Not offered every year.)

854. Laboratory in Biochemistry and Molecular Biology of Nucleic Acids

Application of modern techniques to the analysis of biomolecules, with an emphasis on nucleic acids; includes DNA isolation and analysis, cloning and sequencing and analysis of gene products. No credit for students who have completed MICR 704 (microbial genetics). Prereq: general biochemistry; principles of biochemistry;/or permission. Lab. 5 cr.

858. Plant Anatomy

Anatomy of vascular plants; structure and development of basic cell and tissue types and the major organs of woody plants. Prereq: introduction botany or survey of the plant kingdom or principles of biology; permission. 5 cr. (Not offered every year.)

861. Plant Geography

Distribution of plants, a consideration of world vegetation types and floras, with emphasis on North America. Major influential factors such as geologic, climatic, edaphic, and biotic. Includes such topics as island biogeography, continental drift, and the historical development of floras from the Tertiary through the Pleistocene to major floras of today. Prereq: plant taxonomy or permission. 4 cr. (Not offered every year.)

864. Microtechnique

Methods of preserving cell and tissue structure, paraffin embedding, sectioning, and staining plant tissues, and an introduction to microscopy. Prereq: permission. Lab. 4 cr. (Not offered every year.)

865. Molecular Biology and Biochemistry of Plants

Molecular mechanisms and regulation of plant metabolic functions. Structure and function of cellular constituents of plants; role of secondary metabolites. Emphasis on developments in current literature. Prereq: general biochemistry or principles of biochemistry or permission. Complements P BIO 874/875. (Also offered as BCHM 865.) 3 cr.

873. Breeding Improved Varieties

Techniques for creating new varieties of crop and ornamental plants. Discussion and assigned readings in crop breeding. Prereq: genetics. 4 cr. (Not offered every year.)

874. Plant Cell Culture and Genetic Engineering

Theory and techniques of cell/tissue culture and genetic manipulation in plants, transformation vectors, somatic cell genetics, regulation of foreign gene expression, molecular basis of agriculturally important traits, environmental and social implications of genetic engineering in plants. Prereq: genetics or permission. (Also offered as GEN 874.) 3 cr. (Not offered every year.)

875. Plant Cell Culture and Genetic Engineering Lab

Techniques of plant cell and tissue culture, protoplast fusion, genetic transformation. Mutant cell selection, analysis of foreign gene expression. Special fee. (Also offered as GEN 875.) 2 cr. (Not offered every year.)

985. Advanced Topics in Plant Biology

Discussions of current topics in selected areas of plant biology. A) Systematic Botany; B) Physiology; C) Pathology; D) Anatomy; E) Morphology; F) Ecology; G) Mycology; H) Phycology; I) Cell Biology; J) Genetics; K) Evolution; L) Plant Utilization; M) Cell Physiology; N) Developmental Plant Biology; O) Cell and Tissue Culture; P) Physiological Ecology; Q) Plant Disease Control; R) Plant Hormones. Prereq: permission. 1-6 cr.

995. Investigations in Plant Biology

Supervised projects in selected areas of plant biology. A) Systematic Botany; B) Physiology; C) Pathology; D) Anatomy; E) Morphology; F) Ecology; G) Phycology; H) Mycology; I) Cell Biology; J) Cell Physiology; K) Microtechnique; L) Cell and Tissue Culture; M) Genetics; N) Crop Management; O) Developmental Plant Biology; P) Scientific Writing; Q) History of Botany; R) Teaching in Plant Biology. Prereq: permission. 1-6 cr.

997. Graduate Seminar

Library research and discussion of current topics of plant biology. Required of all graduate students majoring in plant biology. 1 cr. Cr/F.

899. Master's Thesis

6-10 cr. Cr/F.

999. Doctoral Research

Political Science (POLT)

Chairperson: B. Thomas Trout

Professors: Bernard K. Gordon, Marilyn Hoskin, B. Thomas Trout, Susan O. White

Associate Professors: Warren R. Brown, John R. Kayser, Aline M. Kuntz, Lawrence W. O'Connell, Susan J. Siggelakis, Clifford J. Wirth

Assistant Professors: Marla A. Brettschneider, John F. Camobreco, Janine Clark, Clark R. Hubbard, John P. McCormick, Lawrence C. Reardon

Graduate Program Coordinator: Lawrence W. O'Connell

Degrees Offered

The Department of Political Science offers the master of arts in political science and the master of public administration. Areas of specialization for the master of arts are political thought, American politics, comparative politics, and international politics.

Admission Requirements

Applicants are expected to have majored either in political science or in a related field. Where undergraduate preparation

has been insufficient, applicants may be admitted provided that they follow, without credit, a program of study approved by the chairperson. The Graduate Record Examination general test is required for the M.A.; either the Graduate Record Examination general test or the Graduate Management Admission Test is required for the M.P.A.

M.A. Degree Requirements

The M.A. in political science is available to full- and part-time students. The program has three goals: to assure familiarity with the breadth of the discipline; to provide training in research techniques; and to allow each candidate an opportunity to develop special familiarity with a particular field. Accordingly, the M.A. program includes a master's thesis and the following course-related requirements: one advanced course or seminar in each of the four fields offered by the department; two additional advanced courses or seminars offered by the department or in a related discipline; one advanced course in research techniques and methods (POLT 907 or equivalent); and the master's thesis in the selected field of concentration. Each candidate must complete seven courses or seminars (26–28 credits) and the thesis (8 credits) for a total of 34–36 credits.

Master of Public Administration Degree Requirements

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 countries. Students will be required to complete eight full courses (30–32 credits) and a 4-credit internship program (POLT 970, Administrative Internship) for a total of 34–36 credits.

Of the eight courses, three are required core courses (POLT 905, 906, 907), two are elective courses in public administration and political science, and three may be selected from other departments in related fields, including administration, health management and policy, leisure management and tourism, resource economics, community development, and others.

Students who have had appropriate responsibility in public administration may be exempted from the internship

upon petition for such exemption. Such students will be required to undertake independent research on an approved topic related to public administration (POLT 995 or 996, 4 credits).

A student may concentrate all three electives in one department or choose from separate departments. A student who concentrates three courses in one department may also take the internship under the direction of faculty in that department.

The program is offered for full- and part-time students. The full-time program can be completed during one academic year (four courses each semester) plus one summer (internship). The part-time program, designed for working professionals, can be completed during late afternoon or evenings.

American Politics and Public Administration

801. Courts and Public Policy

Impact of judicial decisions on public policy at federal, state, local, and regional levels. 4 cr.

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.

803. Urban and Metropolitan Politics

An eclectic approach to the study of urban and metropolitan politics. Topics include: urban politics, forms of local government; migrations, urban development, intergovernmental relations; community power structure, urban policy making, urban service delivery, crime and law enforcement, urban bureaucracy, urban decay, and revitalization. 4 cr.

804. Policy and Program Evaluation

Policy and program evaluation of federal, state, and local governmental enterprise; focuses on the politics, practices, and methods of evaluative investigation. Evaluation as a technique for providing rational information for budgetary and policy-making decisions. 4 cr.

897, 898. Section B: Seminar in American Politics

Advanced analysis and individual research. 4 cr.

897, #898. Section F: Seminar in Public Administration

Advanced analysis and individual research, including opportunities for direct observation of governmental administration. 4 cr.

905. Methods of Policy Analysis

Research design, survey methods, experimental techniques, and aggregate data analysis applied to public policy settings. 4 cr.

906. 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.

907. Cases in Public Management

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

#820. Perspectives on Political Science

Different views on the study and meaning of politics. Perspectives of political scientists, political philosophers, and political activists. 4 cr.

897, 898. Section I: Seminar in Political Thought

Advanced treatment and individual research. 4 cr.

Comparative Politics

843. Comparative Political Economy

Exploration of the origins, development, and functions of the modern state in the West, its links with markets and capitalism, and its role in contemporary political economy. Examples from various advanced industrial societies. 4 cr.

844. Wealth, Poverty, and Politics in the Middle East

Examination of the role of the West in the development of the economies of agriculture, oil, manufacturing and information technology in the Middle East, and of the political responses of Middle Eastern states to gain control over their economies and address the needs of their populations. 4 cr.

847. Women and Politics in the Middle East

Examination of women as agents of social and political change in the Middle East. Focus on the diversity of rural, urban, secular, and religious womens' groups, their differing goals and activities, reasons for their successes and failures. 4 cr.

897, 898. Section C: Seminar in Comparative Politics

Advanced analysis and individual research on foreign nations or regions, focusing on governmental institutions, foreign policy, political parties, or bureaucracy. 4 cr.

International Politics

860. Theories of International Relations

Theoretical approaches of international politics, international organization, and international political economy with particular emphasis on systems theories, domestic determinants of foreign policy, and theories of decision making. 4 cr.

861. International Law

Formalized processes for regularizing state behavior; development of norms based on custom, pre-

cedent, and formal institutions, as in treaties and cases. Arms reduction and limitation arrangements; inspection and other formal procedures designed to preserve peace. Special fee. 4 cr.

862. Politics of International Trade and Development

Explores the postwar global trade system against the background of calls for increased protectionism. Emphasis given to both domestic and international political considerations. 4 cr.

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.

897, 898. Section E: Seminar in International Politics

Advanced analysis and individual research; emphasis on developments in theory. 4 cr.

General Courses

970. Administrative Internship

Practical administrative experience in an area of professional interest. Prereq: M.P.A. candidate. 4 cr.

995, 996. Reading and Research in Political Science

A) American Politics; B) Comparative Politics; C) International Politics; D) Political Thought; E) Public Administration; F) Public Policy. The graduate student engages in independent study under the direction of one of the members of the department. Requires approval of the graduate committee. 1–4 cr.

899. Master's Thesis

Each student carries out original research that culminates in a master's thesis. Must be taken 4 cr. per semester in each of two semesters or 8 credits in one semester. 8 cr. required. Cr/F.

Psychology (PSYC)

Chairperson: Victor A. Benassi

Professors: William M. Baum, Victor A. Benassi, Ellen S. Cohn, Peter S. Fernald, Kenneth Fuld, Robert G. Mair, Kathleen McCartney, Edward J. O'Brien, Rebecca M. Warner

Associate Professors: John E. Limber, John D. Mayer, Carolyn J. Mebert, William Wren Stine, Elizabeth A. L. Stine-Morrow, Daniel C. Williams, William R. Woodward

Research Associate Professor: Daniel G. Morrow

Assistant Professors: Victoria L. Banyard, Deborah J. Coon, Robert C. Drugan, Suzanne Mitchell

Graduate Program Coordinator: Robert G. Mair

Degree Offered

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 have a broad knowledge of psychology, who can teach and communicate effectively, and who can carry out sound research in an area of specialization. Although some students seek employment outside academia, the program is oriented toward developing the skills required by the research psychologist who intends to become a college or university teacher.

Areas in which the student may specialize are cognition and psycholinguistics, developmental psychology, the history and theory of psychology, behavior analysis, physiological psychology, sensation and perception, and social/personality psychology. The department *does not* offer training in clinical or counseling psychology.

Admission Requirements

In addition to meeting the requirements for admission to the Graduate School, applicants must intend to be full-time students working toward the doctoral degree (not just the master's degree), and they must submit Graduate Record Examination general test scores and the score on the subject test in psychology along with other standard application forms, which can be obtained from the department. Before beginning graduate work, the applicant must have completed a minimum of 15 undergraduate credits in psychology, including courses in elementary statistics and experimental psychology.

Ph.D. Degree Requirements

Required courses include two semesters of the graduate proseminar (PSYC 901–902), three semesters of research methodology and statistics (PSYC 905–906; 907 or 908), eight graduate seminars, and two semesters of the practicum and seminar in the teaching of psychology (PSYC 991–992). Work outside the department is also included in each student's program. Depth in a particular area is obtained through participation in advanced seminars and by independent reading and research conducted under the supervision of a faculty member. Because topics generally differ each time an advanced seminar is offered, advanced seminars may be repeated for credit.

Prior to the doctoral dissertation, the

student carries out original research that culminates in either a master's thesis or a paper of publishable quality. A master's degree is awarded upon the successful completion of a program approved by the department and dean of the Graduate School. This typically takes place by the end of the second year.

The third year of the program is dedicated to the practicum and seminar on the teaching of psychology in conjunction with the teaching of introductory psychology.

Advancement to candidacy for the Ph.D. degree depends on receiving the master's degree, passing a specialist examination in one of the department's areas of specialization, and identifying a topic for doctoral research. Advancement to candidacy is usually accomplished by the end of a student's fourth year in the program. During the fourth year, students typically begin dissertation research and teach an introductory course in their specialty area. Most students complete the Ph.D. degree in the fifth year.

For more details about the graduate program, for application forms, and for a schedule of course offerings, contact the department. Approval of the instructor is required before registering for any graduate course.

901–902. Graduate Proseminar

Students and graduate faculty in psychology meet periodically for a mutual exchange on current issues in psychology. 0 cr. Cr/F.

905–906. 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 non-parametric 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. 4 cr.

907. Research Methods and Statistics III

The application of multivariate methods of data analysis in psychological research: multiple regression, analysis of covariance, Hotelling's T2 multivariate analysis of variance, path analysis, discriminant functions, canonical correlation, factor analysis. 4 cr.

#908. Mathematical Methods and Behavioral Models

Equations, transformations, and graphs; fundamentals of differential equations; stochastic processes and probability distributions other than

Gaussian; applications to selected models of behavior. Prereq: PSYC 906 or permission. 4 cr.

909. Advanced Seminar in Quantitative and Analytic Methods

Advanced treatment of methodological topics of current interest. Content varies: representative topics include field research, surveys, time series, causal analyses, log-linear models, formal and mathematical models, and computer simulation. May be repeated for credit. 4 cr.

914. Advanced Seminar in Cognition

An in-depth examination of one or more specific topics in cognition including issues in memory, attention, the use and development of language, and cognitive science. May be repeated for credit. 4 cr.

917. Advanced Seminar in Sensory and Perceptual Processes

Comprehensive examination of a specific topic in sensory and perceptual processes. May be repeated for credit. 4 cr.

933. Advanced Seminar in Physiological Psychology

In-depth examination of a specific topic in the neurosciences. Topics vary depending on interests of instructor and students. Prereq: PSYC 831 or permission. May be repeated for credit. 4 cr.

945. Advanced Seminar in Behavior Analysis

Current empirical and theoretical issues in the analysis of behavior. May be repeated for credit. 4 cr.

954. Advanced Seminar in Social Psychology

Intensive coverage of the experimental and theoretical literature in a selected area of basic or applied social psychology. Students 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. Prereq: PSYC 852. May be repeated for credit. 4 cr.

973. Methods and Theories in Historical Research on the Behavioral Sciences

Major methods and theories used in historical research applied to the study of the behavioral sciences. Prereq: PSYC 870 or 871 or permission. 4 cr.

974. Advanced Seminar in the History and Theory of Psychology

In-depth examination of a specific topic in the history and/or theory of psychology. Topics vary each time the seminar is offered. Prereq: PSYC 870 or 871 or permission. May be repeated for credit. 4 cr.

982. Advanced Seminar in Developmental Psychology

In-depth analysis of one or several specific topics or issues in developmental psychology. May be repeated for credit. 4 cr.

991–992. 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. 6 cr.

995. Reading and Research in Psychology

A) Cognition/Psycholinguistics; B) Developmental Psychology; C) History and Theory of Psychology; D) Learning and Behavior Analysis; E) Personality/Psychopathology; F) Physiological Psychology; G) Sensation/Perception; H) Social Psychology; I) Statistics/Methodology. 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 faculty member directing project. May be repeated for credit. 1–4 cr.

998. Problems and Issues in Psychology

Seminar on a problem that has been the subject of specialized research and study by a member of the faculty. Topic and instructor vary. May be repeated for credit. 4 cr.

894. Advanced Research in Psychology

Student designs and conducts original research that culminates in a paper of publishable quality. Completion of either this course or PSYC 899 satisfies the department's research requirement for the master's degree. May be taken for 4 credits per semester in each of two semesters or 8 credits in one semester. Maximum 8 cr. Cr/F.

899. Master's Thesis

Four credits per semester in each of two semesters or 8 credits in one semester. Maximum 8 cr. Cr/F.

999. Doctoral Research

Resource Administration and Management (RAM)

Chairperson: Bruce E. Lindsay

Professors: John E. Carroll, Richard W. England, Lawrence C. Hamilton, Edmund F. Jansen, Jr., Bruce E. Lindsay
Adjunct Professor: George E. Frick
Associate Professors: Russell G. Congalton, Robert T. Eckert, John M. Halstead, Theodore E. Howard, Alberto B. Manalo, Richard L. Mills, Douglas E. Morris, Gus C. Zaso

Assistant Professors: Mimi Larsen Becker, Robert A. Robertson, Debra L. Straussfogel

Graduate Program Coordinator: John M. Halstead

Degree Offered

The Department of Resource Economics and Development coordinates the interdisciplinary master of science degree program in resource administration and management. Students may specialize in

management of publicly and privately owned natural resources or in administration of natural resource laws and policies.

Admission Requirements

Applicants 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. A minimum of three courses in the areas of ecology or natural resources, intermediate microeconomics, and introductory statistics is required. Persons having professional experience in resource administration, management, or related areas receive priority for admittance to the program. An applicant is required to submit an essay of up to 2,000 words describing his or her background and goals.

Applicants 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 general test is required of all applicants.

M.S. Degree Requirements

The master of science degree in resource administration and management is conferred upon successful completion of the following:

- 1) A program amounting to not less than 34 credits including the following course requirements or equivalent: RAM 993, Seminar, 1 cr.; RAM 903, Approach to Research, 2 cr.; quantitative methods or analytical techniques, 3–4 cr.; RAM 911, Natural and Environmental Resource Management, 4 cr.; RAM 912, Administration of Resource Laws and Policies, 4 cr.; and RAM 898, Directed Research, 4–6 cr., or RAM 899, Thesis, 6–10 cr.
- 2) A final oral and/or written examination.

805. Ecotourism: Managing for the Environment

Ecotourism by definition embraces both the environment and economics. A comprehensive framework for planning and managing ecotourism in order to both maximize the potential benefits and minimize the potential costs for people and the environment. Conducted in a seminar format, case studies used to assess the role of ecotourism in the sustainable development of natural resources. Prereq: introduction to tourism. (Also offered as TOUR 705.) 4 cr.

841. Critical Issues in Solid Waste Management

Overview of the basic issues in managing society's waste, focusing on municipal solid waste and sewage sludge or "biosolids." Issues such as recycling, source reduction, composting, incineration, land spreading, and land filling examined in detail from the perspectives of different disciplines. Five basic modules: agronomy, economics, engineering and hydrology, planning and policy, and social/cultural/ethical issues. Guest speakers from state government and legislature, private sector firms, and nonprofit and environmental groups. Field trips to waste management sites, e.g., landfills, recycling centers, and composting operations. Prereq: environmental and resource economics perspectives or equivalent, principles of biology I or equivalent or permission. (Also offered as CD 741.) 2 cr.

867. Social Impact Assessment

A cross-disciplinary perspective on the issues, problems, and methods of Social Impact Assessment (SIA). The analytic approach and theoretical framework provided applied to the assessment of very diverse events—changes in the natural environment, local economy, or dominant technology. SIA is required of most U.S. and Canadian federal and state sponsored projects that come under the National Environmental Protection Act, to include tourism, park and recreation development, highways, reservoirs, timber production, hazardous waste disposal, as well as policy issues. SIA is also required for all projects funded by international donor agencies such as USIA, the World Bank, and private international development agencies. 4 cr.

896. Investigations in Resource Management and Administration

A) Resource Administration; B) Resource Management; C) Resource Policy; D) Public Laws and Resources. Prereq: permission. May be repeated. 2–4 cr.

898. Directed Research

Hours and credits to be arranged. Not available if credit obtained for RAM 899. A year-long course; an IA grade (continuous course) given at the end of the first semester. Prereq: permission. 2–6 cr. Cr/F. IA.

900. Resource Administration and Management Internship

Practical administrative and management experience in an area of professional interest. Open only to graduate students in the RAM program. 4 cr. Cr/F.

903. 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. Prereq: permission. (Also offered as RECO 903.) 2 cr.

911. Natural and Environmental Resource Management

Fundamental economic, aesthetic, and ethical principles involved in the management of natural resources. Ways to apply these principles in the formulation and evaluation of resource-management policies, including the management of specific renewable resources, soils, water, forests, and wildlife. Prereq: permission. (Also offered as RECO 911.) 4 cr. (Offered every other year.)

912. Administrative Principles and Practices for Resource Systems

An overview of the traditional concepts of administrative philosophy and theory, including emerging concepts in chaos theory and other administrative approaches. Demonstrates how administrators in resource agencies can apply these concepts to create a new vision of organizational change. Traditional and innovative management techniques are presented relative to shaping organizational cultures, flattening hierarchies, and reengineering work and evaluates their capacity to allow organizational systems to respond to change in agencies responsible for natural resource policy implementation. Prereq: permission. 4 cr.

993. Natural and Environmental Resources Seminar

Presentation and discussion of recent research, literature, and policy problems in the natural and social sciences influencing resource use. (Also offered as RECO 993.) 1 cr. Cr/F.

899. Master's Thesis

6–10 cr. Cr/F.

Resource Economics (RECO)

Chairperson: Bruce E. Lindsay

Professors: Edmund F. Jansen, Jr.,
Bruce E. Lindsay

Adjunct Professor: George E. Frick

Associate Professors: John M. Halstead, Alberto B. Manalo, Douglas E. Morris

Graduate Program Coordinator:
Douglas E. Morris

Degree Offered

The Department of Resource Economics and Development offers the master of science degree in resource economics with specializations in agricultural economics; community and regional economics; land economics; water economics; and environmental economics.

Admission Requirements

Applicants 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. Four or more undergraduate courses in economics or resource economics, including intermediate microeconomics and intermediate macroeconomics, are required, as well as calculus and statistics.

Applicants with good undergraduate records who lack background in a particular field may be admitted to a program, provided they are prepared to cor-

rect the deficiencies. The Graduate Record Examination general test is required of all applicants.

M.S. Degree Requirements

The master of science degree in resource economics is conferred on successful completion of the following:

- 1) A program amounting to not less than 30 credits including the following course requirements or equivalent: RECO 993, Seminar, 1 cr.; RECO 903, Approach to Research; ECON 926, Econometrics I, or ECON 927, Econometrics II; RECO 808, Environmental Economics, or RECO 856, Rural and Regional Economic Development; RECO 815, Linear Programming and Quantitative Models; ECON 976, Microeconomics I, or equivalent; and RECO 898, Directed Research, 4–6 cr., or RECO 899, Thesis, 6–10 cr.
- 2) A final oral and/or written examination.

804. Economics of Policy Issues in Food and Natural Resource Use

Economic analysis of current issues affecting food and natural resource use, such as food, safety, air and water pollution, land use and conservation, and waste management. Economic, political, and social consequences of alternative policies and programs are evaluated. Prereq: intermediate microeconomics or permission. 4 cr. (Not offered every year.)

808. Environmental Economics

Environmental pollution, the market economy, and optimal resource allocation; alternative control procedures; levels of environmental protection and public policy; property right issues. Prereq: intermediate microeconomic theory; permission. 4 cr. (Not offered every year.)

#810. Resource Economics Seminar

Seminars arranged to students' needs and offered as demand warrants. A) Rural Development; B) Marine Economics; C) Community Economics; D) Land and Water Economics; E) Quantitative Methods; F) Recreation Economics; G) Small Business Economic and Managerial Issues. In-depth treatment of area, including classic works. May be repeated. 2–4 cr.

815. Linear Programming and Quantitative Models

Solving applied economic problems using linear and nonlinear techniques with emphasis on problem specification and interpretation of model results. The unit of analysis includes individuals, firms, or communities as they address contemporary problems in resource allocation, product distribution, and whole-firm organization. Computer applications on both mainframe and personal computers used for managerial decision making. Prereq: permission. 4 cr. (Offered every other year.)

817. 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. 4 cr.

856. Rural and Regional Economic Development

Concepts and methods of delineating regional economies, methods of measuring activity, regional development, and public policies. Emphasis on empirical research studies. Prereq: intermediate economic theory or permission. 4 cr. (Offered every other year.)

895. Investigations in Resource Economics

A) Agricultural Marketing; B) Agricultural Production and Farm Management; C) Community Development; D) Economics of Human Resources; E) Economics of Population and Food; F) Land Economics; G) Marine Economics; H) Rural Economic Development; I) Regional Economics; J) Water Economics. Special assignments in readings, investigations, or field problems. Prereq: permission. May be repeated. 2-4 cr.

898. Directed Research

Hours and credits to be arranged. Not available if credit obtained for RECO 899. A year-long course; an IA grade (continuous course) given at the end of the first semester. Prereq: permission. 2-6 cr. Cr/F. IA.

903. 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. Prereq: permission. (Also offered as RAM 903.) 2 cr.

911. Natural and Environmental Resource Management

Fundamental economic, aesthetic, and ethical principles involved in the management of natural resources and ways to apply these principles in the formulation and evaluation of resource-management policies including the management of specific renewable resources, soils, water, forests, and wildlife. (Also offered as RAM 911.) Prereq: permission. 4 cr. (Offered every other year.)

993. Natural and Environmental Resources Seminar

Presentation and discussion of recent research, literature, and policy problems in the natural and social sciences influencing resource use. (Also offered as RAM 993.) 1 cr. Cr/F.

899. Master's Thesis

6-10 cr. Cr/F.

Social Work (SW)

Chairperson: Robert E. Jolley

Associate Professors: Jerry Finn,
Robert E. Jolley

Assistant Professors: Mary Banach,
Linda Rene Bergeron, Walter Ellis,
Mary Essley, Jerry D. Marx, Suzanne
McMurphy, Angie H. Rice, Sharyn J.
Zunz

Graduate Program Coordinator:

Jerry D. Marx

Degree Offered

The Department of Social Work offers a master of social work (M.S.W.) degree. This program develops advanced professional knowledge and skill for persons interested in pursuing careers in the field of social work.

All students complete a foundation-year course of study, then elect a second-year concentration either in direct/clinical practice or in macro/administrative practice. Both concentrations require classroom work and two, year-long field internships in social work settings. The M.S.W. requires two years of full-time study or four years of part-time study. The full- and part-time programs are available only in Durham. Advanced standing is a possibility for students who have graduated within the past five years from an accredited B.S.W. program. The M.S.W. program at UNH is currently in candidacy toward Council on Social Work Education (C.S.W.E.) accreditation.

Admission Requirements

The department encourages applications from persons who (1) hold a baccalaureate degree from an accredited college or university; (2) have attained an overall grade-point average of "B" or better in undergraduate coursework; (3) have completed courses in a broad range of liberal arts and science disciplines; (4) have acceptable recommendations from three individuals, one of whom must be a member of an academic faculty; and (5) have completed satisfactorily a personal statement of interest in pursuing graduate education in the field. Though not required, significant volunteer and/or work experience in the field is strongly recommended. Students who do not meet the liberal arts and science expectations may be asked to complete additional coursework in one or more areas prior to or during the first year of their enrollment in the program. Standardized graduate examinations are not required, but results of such tests may be submitted to supplement other admission materials.

Students applying for advanced standing must hold a degree from an accredited B.A. in S.W./B.S.W. program with a minimum grade-point average of 3.2 (4.00 point scale) in social work major requirements.

Advanced-standing applicants must also submit a reference from a B.S.W. faculty member and the undergraduate field supervisor or field coordinator.

In order to insure that each student entering the second-year field placement and practice courses is appropriately prepared, the department expects students accepted for advanced standing to complete a ten-week summer practicum and seminar prior to enrollment in the advanced practice and field courses. Full-time, advanced-standing students enroll during the summer of their matriculation into the program. Extended-time students (those completing the advanced standing coursework in two years) are expected to complete courses other than advanced practice and field courses during the first year; then enroll in the summer practicum and seminar before entering the advanced practice and field courses. Including the summer coursework, advanced-standing students complete a minimum of 35 credits to graduate from the M.S.W. program. Additional information may be obtained by contacting the coordinator of graduate admissions in the department office.

M.S.W. Degree Requirements

An M.S.W. candidate must complete 62 credit hours of 800- or 900-level courses including two, two-semester field internships, comprising a total of 1,100 hours in the field. Although a significant portion of the curriculum is required, students will be able to complete three elective courses. At least one of these must be taken from among Department of Social Work course offerings. Students select a second-year concentration in direct/clinical practice or macro/administrative practice. Each concentration requires that three courses and the second-year field internship be completed in the student's area of concentration. Students may choose a graduate-level elective outside the department. In each case, the course must be relevant to the M.S.W. student's course of study and must be approved in advance by the student's adviser and the Graduate School. Successful completion of all course- and fieldwork is required in order to graduate.

801. Women and Aging

An overview of women as they age in the American culture, with a brief international overview. Ethnic and cross-cultural perspectives explored. Areas to be studied include biological aging, focus-

ing on menopause; economics and women, including retirement issues; women in the media; lesbian relationships; and late marriages. 3 cr.

805. Child Welfare: Policies, Programs, and Practice

Major social work policy and program questions in the field of child welfare introduced. The relationship between child welfare and the rest of the social work profession analyzed. Various types of child welfare services, some aspects of social and child welfare policy studied, as well as current research and practice issues in child welfare services. 3 cr.

810. Computer Utilization in Social Work

Provides students with a basic understanding of computerization and its application in social work. Computer literacy is seen as a requirement for the effective practice of social work for the 1990s and beyond. 3 cr.

811. Social Work and Mental Illness

An overview of the public mental health system focusing on people affected by severe and persistent mental illness. Reviews the current service system and its history; major mental illness, psychosocial rehabilitation, and treatment; and community support systems. 3 cr.

812. Social Work and Developmental Disabilities

Analysis of the complex social contexts of people with developmental disabilities. Explores and questions traditional approaches and the current service system. Examines family and community services and resources. 3 cr.

814. Introduction to Addiction: Assessment and Intervention

Information and skills necessary to address issues of substance abuse with individuals, families, and communities. Overview of the dynamics of addiction; the treatment and recovery process; and the role of social work professionals in identification and treatment of addiction. Special populations (women, adolescents, elderly, gay/lesbian/bisexual/transgendered, ethnic/racial groups) discussed. Treatment approaches explored. 3 cr.

820. Social Welfare Policy I

The history and development of social welfare systems in the United States. Origins and development of significant policies, values, attitudes, and other issues related to the social welfare system and the delivery of service. Basic social welfare concepts studied and economic inequality in the U.S. examined along with policy responses to this social issue. 3 cr.

830. Social Work Practice I

Basic concepts, theories, and skills of social work practice. Lectures and discussions, readings and written exercises, and laboratory and practice sessions. Students use the experiential parts of the course (laboratory and interview simulations) to apply the conceptual and theoretical knowledge. 3 cr.

831. Social Work Practice II: Practice in Small Groups and Community Organizations

Continuation of Social Work Practice I with the further aim of introducing students to social work with groups and communities as models of social work practice. 3 cr.

840. Implications of Race, Culture, and Oppression for Social Work Practice

Concepts of race and oppression, integrating content from all foundation areas. Examines and explores the social, psychological, and social structural implications of racism, culture, and oppression as a dynamic force influencing social work practice. Analyzes and evaluates the social, cultural, political, economic, and intrapersonal contexts of racism that bear on our current policies and institutions. This course is designed to: (1) describe and analyze the life experiences of culturally different populations; (2) sensitize students to the issue of racism and oppression on both cognitive and affective levels; and (3) enhance their effectiveness as social work practitioners and change agents. Required for all students in the master's degree program. 3 cr.

850. Human Behavior and the Social Environment I

Human growth and development through the life span using systems theory and person-in-environment as a conceptual framework. Theoretical perspectives from biology, sociology, and social systems theory explored as influences on developmental processes. 3 cr.

851. Human Behavior and the Social Environment II

Continuation of the exploration of human growth and development begun in SW 850. The key organizing concept of this sequence of courses is the biopsychosocial and interactive processes evidenced by social work's focus on the person-in-environment. Information about small and large systems including families, ethnic and cultural groups, social groups, organizations, and communities. 3 cr.

860. Research Methods in Social Work

Designed to acquaint first-year master's degree students with the concepts and skills necessary for carrying out research in social work practice. Particular emphasis placed on methodological issues related to research in a variety of practice contexts. Although the skills necessary to review research critically are examined, the primary emphasis is on preparing the student to carry out research related to practice. Familiarity with basic statistical methods in social science research is useful for this class. 3 cr.

873. Intervention with Groups

Principles in social work practice with groups. Focus on helping the individual within the framework of a group setting. The purpose and usefulness of group work as a preventive method and as an intervention tool outlined. History, underlying theory, techniques of group facilitation and typology of treatment and task groups examined. Students actively participate in a group simulation. 3 cr.

880, 881. Field Internship I, II

This two-semester requirement provides supervised learning and practice within social work programs in a wide range of program settings. Students spend 16 hours per week in the field. Individual field placements will be arranged with each student by the field coordinator. In order to receive credit, students must satisfactorily complete both field experience semesters. A concurrent integrative seminar is also required. In this weekly seminar, attention is given to the development of basic social work skills and techniques, legal and ethical issues, and the development of appropriate professional relationships. A primary goal is to

integrate classroom learning with the field experiences. Special fee. 3 cr. per semester. Cr/F. IA.

897. Special Topics in Social Work and Social Welfare

Seminar for graduate students. Topics may include: A) Alcohol and Alcoholism; B) Drugs and Chemical Dependency; C) Income Maintenance; D) Health Care; E) Child Welfare; F) Aging; G) Mental Health; H) Developmental Disabilities. May be repeated for different topics. 3 cr.

900. Advanced Standing Practice and Field Seminar

Weekly seminar held concurrently with field placement designed to orient and adequately prepare advanced standing students for advanced practice and field courses. Bridges the undergraduate and graduate curriculum and reviews foundation year concepts, theories, and skills of social work practice and field. Review includes a reexamination of the dynamics of the change process, the strengths perspective, and the skills essential to practice such as assessment, contracting, intervention, and termination with systems of all sizes. Exploration of social work identity and of professional relationships with supervisors, colleagues, and agencies. Primary focus on social work values and ethics and the development of ethical decision-making skills including the importance of culturally competent practice. Only offered to advanced standing masters of social work students. Special fee. 3 cr.

926. Social Welfare Policy II

A continuation of the exploration of social policy issues begun in SW 820. Students review various methods of social policy analysis and apply these to issues of concern at the state, local, and agency levels. The course's key organizing concept is the integration of social policy concerns with social work practice and the promotion of client well-being. This course is required. Prereq: SW 820. 3 cr.

932. Direct Practice III: Clinical Assessment and Intervention

Builds on the academic and direct practice foundations from Practice I and II and the first-year field placement. Deepens the process of differential assessment and intervention with individuals, dyads, and families. Students learn to assess clients' functioning using a variety of theoretical frameworks and constructs which explore the person/environment fit. Prereq: SW 831. 3 cr.

933. Direct Practice IV: Advanced Clinical Assessment and Intervention

The major objective of the direct practice curriculum is to educate practitioners to work toward restoration and enhancement of functioning and prevention of maladaptive functioning. Direct clinical practice reflects the mutuality and reciprocity between individuals and systems and links present, past, and future. Advanced assessment using cognitive, psychodynamic, and systemic frameworks are presented. Course emphasizes conscious, purposeful, and differential use of self as a therapeutic or change agent. Prereq: SW 932. 3 cr.

934. Macro Practice III: Management of Human Service Organizations

Preparation of students for informed participation in public and private human service settings. Focuses on the concepts, principles, values, and strategies that inform administrative practice, including policy formulation and program planning. Empha-

sis on the integration of knowledge of organizational dynamics and managerial roles. Prereq: completion of foundation-year practice courses, SW 830, 831. 3 cr.

935. Macro Practice IV: Community Organization and Political Strategies

Continuation of the exploration of macro practice issues begun in SW 934. Provides students with the knowledge base and skills necessary to engage in community planning and organizing activities. Students learn to use political strategies to mobilize support for human service endeavors that enhance the well-being of underserved constituent groups. Course is required of students in the macro practice concentration, but is also open as an elective to any M.S.W. student who has completed first-year practice courses. Prereq: SW 934. 3 cr.

952. HB/SE III: Adaptive and Maladaptive Functioning

Designed to acquaint master's degree students with the epidemiology, classification, etiology, and treatment of the major forms of mental illness. A primary objective is to develop the student's diagnostic skills in the field of psychopathology and to apply the competence acquired in direct practice settings. At course conclusion, students have an effective working knowledge of: the biological and psychosocial bases of the major mental disorders; the behavioral symptomatology that characterizes them; the major modalities of treatment currently available for each of them; and their classification according to the DSM IV system of classification. Prereq: SW 850; 851. 3 cr.

955. Strengths-Based Social Work Practice with Families

Strengths-based social work principles for working with families. Emphasis placed on developing knowledge and skills in approaches that effectively preserve and restore family functioning. Students develop an understanding of the theoretical and practice concepts used in identifying strengths in family life as well as areas of concern and stress. Students learn about the values and ethics that strengthen families in care giving roles and develop skill in the use of formal and informal community resources. 3 cr.

957. Program and Resource Development in the Social Service Arena

Introduction to program and resource development in the social services. Teaches students the knowledge and techniques to mobilize critical resources and supports for social service programs. Emphasis placed on the roles and functions of needs assessment, service and market research, and strategic planning for program development. Principles and techniques for resource mobilization and the development of organizational and community support considered. Provides students with knowledge and skills required for program development and planning and managing in social work and other human service settings. 3 cr.

962. Research II: Statistics

Social science statistics is a set of methods used to organize and analyze data for the purpose of either answering research questions or testing social science theories with data. Course provides practical, data-oriented introduction to the methods of modern statistical analysis with a focus on understanding and interpretation rather than the details of calculation. 3 cr.

965. Research III: Program and Practice Evaluation

A one-semester, basic introduction to evaluation methods in the context of social work practice and social welfare. Students develop and conduct evaluations of practice, programs, and policies. Course provides skills required for practice and program evaluation. Prereq: SW 860; 962. 3 cr.

974. Social Work Supervision

Prepares students for a supervisory role in any social agency or field of social work practice. Basic principles and techniques of supervision reviewed and related to the student's own experiences in supervision or as a supervisor. 3 cr.

975. Theory and Practice of Family Therapy

Designed to provide an advanced specialist overview of evolving viewpoints, perspectives, values, intervention techniques, and goals of family therapy. Views the family as a unit of attention and target of intervention. Emphases on the development and enhancement of knowledge, skills, theory, and values specific to family therapy and social work practice. 3 cr.

976. Practice with Gay, Lesbian, and Bisexual Clients

Sexual minorities constitute the minority group a counselor most consistently encounters wherever he or she works. Addresses the task of counseling gay, lesbian, and bisexual people on both personal and professional levels for the counselor. Readings include theoretical, experimental, clinical, counseling, and personal perspectives, as well as providing an introduction to the gay/lesbian/bisexual subculture. Students explore and examine their own attitudes and assumptions regarding gays, lesbians, and bisexuals. 3 cr.

977. Ego Psychology I

Development of ego psychology from Freud's early writings to contemporary theorists. Examines the historical changes since Freud. Differences between early ego psychology and current psychology views examined by focusing on ego functions. Emphasis on the relationship between theory and its application to practice with many clinical examples given to demonstrate the impact that changing theory has on clinical practice. Prereq: SW 851. 3 cr.

978. Brief Treatment in Social Work

Examination of the theory and practice of short-term treatment approaches used in social work practice with individuals, families and small groups. Particular attention is given to the principles and techniques of assessment as the basis for treatment design critical to effective practice and differential use of modes and techniques of brief service. Prereq: graduate students in M.S.W. program or permission. 3 cr.

979. Social Work and the Law

Social work practitioners routinely encounter and interact with the legal system in their work. The course provides knowledge of, and learning about, the differences between the legal and social service networks, the realities of work involving the law, and legal issues, as well as an understanding of those aspects of the legal system most likely to impact clients and their families. 3 cr.

982, 983. Field Internship III, IV

This two-semester requirement provides advanced

practice experience in a wide range of social work settings. Students spend 24 hours per week in the field. Individual field placements are arranged with each student by the field coordinator. In order to receive course credit, students must satisfactorily complete both semesters. A concurrent integrative seminar is also required. The goal of the weekly seminar is to assist students in conceptualizing and integrating the multiple theoretical issues and practice concepts of coursework with the practicum. Students are expected to take major responsibility for the seminar, using the instructor as a resource. Special fee. 4 cr. per semester. Cr/F. IA.

985. Object Relations: Theory and Practice

Builds on content from Ego Psychology I. Explores concepts of object relations theory and practice. Emphasis placed on the centrality of relationships in developmental theory and on the relationship between theory and clinical practice. Prereq: SW 977; second-year M.S.W. students;/or permission. 3 cr.

992. Special Projects and Independent Study

Projects, research, and reading programs in areas of concentration. Sixty days advance approval of the student's plan of study by adviser and proposed instructor required. Prereq: 24 cr. in M.S.W. coursework. May be repeated to a maximum of 6 credits. 1-3 cr. per semester.

Sociology (SOC)

Chairperson: Michael J. Donnelly
Professors: Melvin T. Bobick, Michael J. Donnelly, Lawrence C. Hamilton, Bud B. Khleif, Arnold S. Linsky, Murray A. Straus, Sally Ward
Research Professor: David Finkelhor
Associate Professors: Cynthia M. Duncan, Heather A. Turner
Assistant Professors: Linda M. Blum, Benjamin C. Brown, Anita I. Garey, James Tucker
Graduate Program Coordinator: Sally Ward

Degrees Offered

The Department of Sociology and Anthropology offers M.A. and Ph.D. degrees in sociology. The master's degree program emphasizes theory and methodology. Students in the doctoral program are expected to select from the areas of departmental specialization one major area and one minor area for intensive study and examination. There are six major substantive areas for possible specialization: deviance, conflict, and control; social psychology; family; social stratification; social policy and applied sociology; and medical sociology. Students may pursue specialties within or across the major areas of specialization or

propose to the Graduate Committee other major areas of specialization that fall within the faculty's competence.

Admission Requirements

Applicants must present, in addition to meeting the general Graduate School requirements, Graduate Record Examination scores on the general test (verbal, analytical, and quantitative reasoning sections).

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, in addition to the requirements outlined above.

All students entering the program must complete the M.A. before admission to the Ph.D. program. The department welcomes both applicants who plan to continue for the Ph.D. as well as students planning for the M.A. only.

M.A. Degree Requirements

Students must fulfill the following requirements:

- 1) Complete satisfactorily at least 26 credit hours of graduate-level coursework in sociology including the Proseminar in Sociology (900, 2 credits); Sociological Methods I (901); and either SOC 902, 903, or 904; and Sociological Theory I (911); two elective graduate seminars.
- 2) Register for 1 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.
- 3) Submit for approval a report of a research endeavor to the thesis committee.
- 4) Register for a total of 6–10 thesis credits.

Ph.D. Degree Requirements

As part of fulfilling the residence requirement of three years' work after the bachelor's degree, students must:

- 1) Take a minimum of thirteen courses in sociology (at least eight as seminars) other than thesis or dissertation research, including the Proseminar in Sociology (900, 2 credits); Sociological Theory I and

II (911 and 912), Sociological Methods I and II (901 and 902), and one other course in methods or statistics (SOC 903 or 904), three courses in a major area, and two in a minor area of sociology;

2) Complete a second minor consisting of three related courses whether or not sociological in content (these three courses are in addition to the thirteen required courses in sociology); no preliminary examination is required;

3) Pass written examinations in the major and minor areas of sociological specialization and in advanced theory and methodology;

4) Demonstrate reading-level proficiency in a foreign language or a research tool appropriate to the overall program of the student (The research tool option must not be part of the other degree requirement for graduate students in sociology; examples of appropriate research tools include computer programming, historical methods, 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.);

5) Write and defend the doctoral dissertation.

815. Criminological Theory

Critically examines the major schools of criminological thought. Traditional perspectives—learning, control, strain, and labeling theories—covered as are more contemporary approaches, including Marxian, feminist, rational-choice, routine-activities, and structural theories. 4 cr.

820. Current Developments in Sociology of the Family

A current topic is 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 usually will be carried out. Prereq: 8 credits of sociology; a family course recommended. 4 cr.

830. Political Sociology

Contemporary issues in political sociology with emphasis on the relationship between social class structure and political power. Seminar explores various perspectives on the nature and distribution of power, theories of the state, class structure and political participation, and the politics of policy making. 4 cr.

#835. 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; effect of complex, formal organizations on persons and societies. Prereq: permission. 4 cr.

841. 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. 4 cr.

850. The Middle East: Issues of Ethnicity, Work, and Identity

Community studies approach to such topics as ethnicity and identity in the interrelationship of language, religion, and corporate membership in a community; ethnic division of labor; work, pluralism, and family networks; mobility and immobility; estates vs. classes. 4 cr.

860. Aging and Late Life Family

Using a life-course perspective, this course focuses on family relationships and social role transitions in later life. Addresses impact of the empty nest stage, grandparenthood, retirement, care giving, and widowhood on the well-being and relationships of older people. 4 cr.

#861. Population Studies

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.

#870. Culture, Personality, and Society

A cross-cultural view of the development of personality as emergent from genetic, situational, and sociocultural determinants; analysis of the dynamic interplay of sociocultural and psychological behavior systems. Prereq: prior courses in sociology, anthropology, or psychology. 4 cr.

880. Social Conflict

Nature of social conflict, especially war. Setting and initiation of conflict, its dynamics, and factors affecting its course and outcomes. Prereq: permission. 4 cr.

885. 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. 4 cr.

890. 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 focuses on a social problem and writes a paper covering the above issues. Applied projects where possible. Prereq: methods of social research. 4 cr.

894. Evaluation of Social Programs

Evaluation research defined: purposes of evaluation; design of evaluation studies; setting of programs; utilization of evaluation results. Examination of case studies of evaluations of social programs. Students are responsible for designing an evaluation study in their chosen substantive area. Prereq: methods of social research. 4 cr.

897. Special Topics in Sociology

Occasional or experimental offerings. Prereq: permission. May be repeated for different topics. 4 cr.

900. Proseminar in Sociology

An introduction to the discipline of sociology and to the graduate program. Topics include writing for professional audiences, publishing, applying for support, TA workshop, writing a thesis or dissertation. Meetings with faculty members throughout the semester. Meets bi-weekly. 2 cr.

901. Sociology Methods I: Intermediate Social Statistics

Application of statistical methods to the analysis of social data, with particular emphasis on multiple regression and related topics. 4 cr.

902. 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 are pursued. Prereq: methods of social research; social statistics;/or their equivalents or permission. 4 cr.

903. Sociological Methods III: Special Problems in Methods and Statistics

Course alternates among special problems, such as measurement and advanced statistics. 4 cr.

904. Sociological Methods IV: Field Work

Training for participant observation in the manner of an anthropologist or Chicago-school sociologist. Students write and discuss field notes and become familiar with case studies, content analysis, and relevant issues. Field notes, basis for a term paper. 4 cr.

911. Sociological Theory I

The content, presuppositions, and implications of the body of sociological theory, exemplifying the full range of sociological inquiry. Prereq: history of social theory; contemporary social theory;/or equivalents. 4 cr.

912. Sociological Theory II

The content, presuppositions, and implications of contemporary sociological theory. Students engage in theory construction and analysis and in this endeavor are encouraged to develop their particular interests in substantive areas. Prereq: SOC 911. 4 cr.

913. 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: history of social theory; contemporary social theory;/or equivalents. 4 cr.

918. Historical Methods in Sociology

Introduction to major varieties of historical sociology. Focus on problems of method in defining research agendas, selecting historical evidence, and using historically bounded models and concepts. 4 cr.

921. Deviant Behavior

Relationships among cultural, subcultural, and personality variables and deviant behavior; forms of deviant behavior: invention, crime, alcoholism, and emotional illness. Prereq: permission. 4 cr.

#930. The Small Group

Sociological and social psychological perspectives on interaction within small groups. Prereq: courses in sociology and social psychology, or permission. 4 cr. (Not offered every year.)

934. Sociology of Mental Health and Illness

This seminar reviews major sociological theories of mental illness including social isolation, labeling, stressful life events, role conflicts, social class, and economic factors and family dynamics. Family and community processes involved in becoming a mental patient and the problems of leaving the role of the mentally ill are examined. The politics of mental illness are considered, including decarceration, issues surrounding sex roles and mental illness, patients' rights, and the prediction of dangerousness. Other topics covered include cross-cultural comparisons in diagnosis and treatment, training of clinicians, and mental health as a social movement. 4 cr.

938. Sociology of Education: Social Organization of Schools and Community

Schools in their sociocultural 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.

942. Sociology and Social Policy

Social policy and public policy defined: description of the policy-making process. The political sociology of the policy-making process; who makes policy and who influences policy, under what conditions, and with what effect. Definition of social policy research and the various roles social scientists can adopt for policy-relevant work. Students are responsible for critiquing the readings and for preparing a substantial research paper. 4 cr.

#950. Methods of Social Psychological Analysis

The logic, inferential strength, and potential bias of the various methodologies for studying social behavior. 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. 4 cr.

951. Seminar in Social Psychology

Some of the major themes in social-psychological theory, including social structure and personality, socialization, small-group processes, and interaction analysis. Students are expected to read and evaluate selected empirical research. 4 cr.

#954. Sociology of Religion

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.

970. Social Stress and Health

Focuses on social stress processes and their relation to physical and mental health. Sources, moderators, and outcomes of stress examined within various social-structural contexts. Specific topics include the measurement and conceptualization of stress, social support and coping processes, self concept, and the role of gender, race, and social class in the stress process. 4 cr.

975. Sociology of the Family

Major approaches in the sociological study of families. Individuals in families, family relationships, and families as groups, and the interrelationships among these levels. Interactional and systemic

properties of marriage, parent-child relations, and extended family relations. 4 cr.

976. Violence in the Family

Analysis of abusive relationships within the family, especially physical and sexual abuse of children and spouses. The primary focus is on the design of research to test theories purporting to explain intrafamily violence, consequences of violence for family members and society, and research on prevention. 4 cr.

980. Social Stratification

Introduces students to the core of theoretical, methodological, and substantive issues in social stratification. Readings include classical and contemporary theories of stratification and work exploring the sources and consequences of stratification. Inequalities based on class, race, and gender examined. 4 cr.

985. 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.

988. Medical Sociology: Health, Healing, and Society

Social context of wellness, illness, and healing; stratification and health; mortality and morbidity in relation to class, race, ethnicity, religion, gender, and age; social control functions of medicine: medicalization and de-medicalization; interaction of physicians and patients; medical occupations; mental health and mental illness; stress and illness; medical care systems in various countries. 4 cr.

#989. 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. 4 cr.

990. Teaching Practicum in Sociology

Helps graduate students deal with teaching issues, explore teaching techniques, and improve their teaching skills. Topics include: setting course goals, designing lectures, evaluating student work, leading discussion, and experimenting with innovative teaching techniques. 4 cr.

995, 996. Reading and Research in Sociology and Anthropology

A) Communications; B) Criminology; C) Culture Change; D) Culture and Personality; E) Deviant Behavior; F) Family; G) Population; H) Rural-Urban; I) Social Control; J) Social Differentiation; K) Social Movements; L) Social Psychology; M) Social Research; N) Social Theory; O) Applied Sociology; P) Medical Sociology. A student prepared by training and experience to do independent work under the guidance of an instructor may register for one or more of these sections. Prereq: 16 graduate hours of sociology and permission. Hours and credit to be arranged. 2-8 cr.

997. Advanced Special Topics in Sociology

Occasional or experimental offerings. 24 cr. Cr/F.

999. Master's Thesis

Usually 6 cr. but up to 10 cr. when the problem warrants. Cr/F.

999. Doctoral Research

Spanish (SPAN)

Chairperson: F. William Forbes

Professor: F. William Forbes

Associate Professors: John M. Chaston, Bernadette Komonchak, William Mejías-López

Assistant Professors: Janet Gold, Lori Hopkins, Lina Lee, Dionisio L. Viscarri, Alicia Quiroz Woodruff

Graduate Program Coordinator: Janet Gold

Degree Offered

The Department of Spanish and Classics offers a master of arts degree in Spanish with courses in Hispanic literature, Hispanic linguistics, foreign language methodology, and interdisciplinary Hispanic studies.

Admission Requirements

Applicants 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. The Graduate Record Examination general test is required.

M.A. Degree Requirements

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 (1) successfully complete ten graduate courses (of which eight should be from the Spanish offerings); or (2) successfully complete at least eight courses in Spanish and submit a thesis (6 credits, thus completing the minimum of 30 credits required by the Graduate School). All advanced literature courses are conducted in Spanish.

In addition, all students are required to take SPAN 901. Teaching assistants must also take SPAN 903. No student may register for a graduate course if he or she has already taken the corresponding undergraduate course here or its equivalent elsewhere.

A comprehensive examination based on a master's degree reading list is given four times a year. If the thesis option is selected, it must embody the results of independent investigation and be written in Spanish in a form acceptable to the Spanish faculty and the Graduate School.

#833. History of the Spanish Language

The evolution of the Spanish language from the period of origins to the present. Special fee. 3 cr. (Not offered every year.)

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. Special fee. 3 cr. (Not offered every year.)

854. The Age of Cervantes

Study of the major works of Cervantes and his contemporaries in the context of the historical, literary, and social currents of the time. Special fee. 3 cr. (Not offered every year.)

855. Literature of the 19th Century

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

856. Modern Spanish Poetry

Study of selected Spanish poets of the 18th, 19th, and 20th centuries in the context of the historical, literary, and social currents of the times. Special fee. 3 cr. (Not offered every year.)

857. Spanish Drama of the 20th Century

Study of selected Spanish dramatic works of the 20th century in the context of the historical, literary, and social currents of the times. Special fee. 3 cr. (Not offered every year.)

858. Spanish Prose of the 20th Century

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

860. Unamuno and Ortega y Gasset

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

871. Latin American Drama

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

#872. Latin American Novel

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

873. Latin American Short Story

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

874. Major Latin American Authors

Special fee. 3 cr. (Not offered every year.)

890. Grammatical Structure of Spanish

An overview of the grammatical structure of Spanish through an in-depth analysis of both morphology and syntax, with emphasis given to the meaningful contrasts that exist within the Spanish language and to grammatical contrasts between Spanish and English. Special fee. 3 cr.

891. Methods of Foreign Language Teaching—Spanish

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

897. Special Studies in Spanish Language and Literature

A) The History of the Spanish Language; B) Medieval Spanish Literature; C) Spanish Literature of the Renaissance; D) Spanish Literature of the Golden Age; E) Spanish Literature of the 18th and 19th Centuries; F) Spanish Literature of the 20th Century; G) Contemporary Spanish Literature; I) Latin American Literature of the 16th and 17th Centuries; J) Latin American Literature of the 18th and 19th Centuries; K) Latin American Literature of the 20th Century; M) Contemporary Latin American Literature; N) Structural and Applied Linguistics; O) Spanish Literary Criticism; P) Latin American Essay; Q) Latin America; S) Spanish Theatre; T) Spanish Poetry; U) Latin American Poetry; V) Galdos; W) Archetype Latin American Literature; X) Special Teaching Problems; Y) Spanish Civilization and Culture; Z) Latin American Civilization and Culture. Specialized courses covering topics not normally presented in regular course offerings. Prereq: permission of major supervisor. Special fee. 3 cr.

898. Special Studies in Spanish Language and Literature

A) Hispanic Minorities of the United States; B) Portuguese; C) Hispanic Film; D) Introduction to Hispanic Linguistics; F) Other. Specialized courses covering topics not normally presented in regular course offerings. Barring duplication of content, Topic F may be repeated for credit. Prereq: permission of major supervisor. Special fee. 3 cr.

901. 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.

903. 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. May be repeated for a total of 3 cr. 1 cr.

995. Independent Study

Guided individual study with training in bibliography and organization of materials. Topics selected by instructor and student in conference. Barring duplication of content, may be repeated for credit. Prereq: permission of major supervisor. 1–3 cr.

997. Graduate Seminar

Presents and discusses selected topics in Spanish language and literature. See SPAN 897 for list of topics. Prereq: permission of major supervisor. Special fee. 3 cr.

998. Graduate Seminar

Presents and discusses selected topics in Spanish language and literature. See SPAN 898 for list of topics. Barring duplication of content, Topic F may be repeated for credit. Prereq: permission of major supervisor. Special fee. 3 cr.

#899. Master's Thesis

6 cr. Cr/F.

Zoology (ZOOL)

Chairperson: James T. Taylor

Professors: John F. Burger, Donald S. Chandler, James F. Haney, Larry G. Harris, W. Hunting Howell, John J. Sasner, James T. Taylor, Edward K. Tillinghast, Charles W. Walker, Winsor H. Watson III

Adjunct Professors: Miyoshi Ikawa, Philip J. Sawyer

Associate Professors: Thomas D. Kocher, Michelle P. Scott

Research Associate Professors: Ann C. Bucklin, Michael P. Lesser

Assistant Professors: Jessica A. Bolker, Edwin D. Grosholz, Marianne Klauser Litvaitis

Research Assistant Professor: Karen L. Carleton

Adjunct Assistant Professors: David T. Bernstein, C. Sarah Cohen, Richard Langan, Barry J. Wicklow

Graduate Program Coordinator: James F. Haney

Degrees Offered

The Department of Zoology offers the master of science and the doctor of philosophy degrees. Students can specialize in behavior, development, ecology (freshwater, marine, and terrestrial), fisheries, genetics, invertebrate zoology, systematics, entomology, neurobiology, and physiology.

Admission Requirements

Applicants 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, organic chemistry and a semester each of calculus and physics are necessary. Applicants who are deficient in any of these requirements may be admitted to graduate status but may be re-

quired to remedy their deficiencies by taking courses that do not give graduate credit. Applicants must submit general and subject biology scores from the Graduate Record Examination.

M.S. Degree Requirements

Students plan a program of study (minimum of 30 credits) in conjunction with a faculty advisory committee. Students complete a thesis of 6 to 10 credits that is acceptable to the guidance committee. Prior to the receipt of the master's degree, all candidates must pass a thesis defense, which will include questions covering general knowledge in zoology in addition to specific questions relevant to the student's research at the University of New Hampshire.

Ph.D. Degree Requirements

Students plan a program of study in conjunction with a faculty guidance committee. All doctoral students must pass a written examination to certify their proficiency in one foreign language.

After the successful completion of the language requirement and of all required courses, students who wish to be admitted to doctoral candidacy must demonstrate a broad basic knowledge of their major and minor fields and their ability to carry out basic research in zoology in an oral qualifying examination. Prior to the qualifying examination, the student will present 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. All students must complete an original dissertation project, present the results at a public seminar, and pass an oral defense consisting of questions put forth by members of the dissertation committee.

Teaching Requirement

All graduate students are encouraged to obtain appropriate teaching experience, preferably as a teaching assistant.

801. Conservation Biology

A critical and quantitative investigation of current issues in the conservation of biological systems. Issues addressed include habitat restoration, nonindigenous species, harvest strategies, conserving genetic diversity, population viability analysis, global climate change, endangered species recov-

ery, habitat fragmentation, and reserve design. Case studies include examples drawn from terrestrial, aquatic, and marine systems. Weekly laboratories include trips to local habitats of concern. A statistics course or familiarity with computers is highly recommended. Prereq: general ecology or permission. Special fee. Lab. 4 cr. (Not offered every year.)

805. Population Genetics

An exploration of the forces affecting the frequency and distribution of allelic variation in natural populations. Emphasis on the relative roles of mutation, selection, random drift and inbreeding in structuring genetic variation, and on the quantification of the genetic structure of populations. Prereq: principles of genetics; applied biostatistics I recommended. (Also offered as GEN 805) Special fee. Lab 4 cr. (Not offered every year.)

808. Stream Ecology

Ecological relationships of organisms in flowing water; streams as ecosystems. Lectures on physical and chemical features of streams, floral and faunal communities, and factors controlling populations of benthic invertebrates. Laboratory exercises employ both field and laboratory experimental techniques. Weekly seminars on original research papers. Special fee. 4 cr. (Not offered every year.)

809. Environmental Physiology of Animals

Animal responses to natural changes or extremes of the physical environment. Emphasis on adaptation of animals to environmental parameters such as nutrient levels, light, temperature, and ionic environment, as well as temporal (seasonal, daily) changes in these major environmental factors. Examples from several levels of organization including biofeedback mechanisms. Prereq: general ecology; principles of animal physiology;/or equivalent. 4 cr. (Not offered every year.)

810. Ichthyology

An introduction to the evolution, systematics, anatomy, physiology, and ecology of fishes, with an emphasis on New England species. Prereq: principles of biology or equivalent. Lab. 4 cr. (Offered alternate years.)

811. Zooplankton Ecology

Methods of sampling populations; factors regulating temporal and spatial 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/PBIO 817, or equivalent; permission. 4 cr. (Not offered every year.)

812. Mammalogy

Evolution, ecology, behavior, physiology, and diversity of mammals. Focuses on conceptual issues such as the relations of structure, function, physiology, and ecology of species; reproductive physiology and life history strategies; and the evolution of mating systems and social structure. Requires familiarity with mammalian groups to the family level and identification of local fauna to species. Prereq: principles of biology or equivalent. Lab. 4 cr. (Not offered every year.)

813. Animal Behavior

Introduces the naturalistic study of animal behavior. Emphasizes the evolution, development, physiology, and ecology of behavior. Topics

include the genetic and acquired bases of behavior; neuroethology and behavioral endocrinology; communication; orientation; foraging strategies; reproductive ecology; and the evolution of altruistic behavior. Prereq: principles of biology I and II or equivalent. Lab. 4 cr.

815. Molecular Evolution

Rates and patterns of evolutionary change in biomolecules; forces affecting the size and structure of genomes; molecular mechanisms of organismal evolution. Emphasis on integrating evidence from biochemistry, molecular genetics and organismal studies; as well as on methods for reconstructing phylogeny from molecular sequences. Some knowledge of statistics and familiarity with personal computers recommended. Prereq: principles of genetics. (Also offered as GEN 815.) Special fee. Lab. 4 cr. (Not offered every year.)

816. Multivariate Statistics for Ecology

Methods of observation and inference in ecology; data reduction and exploratory analysis; detection of association, difference, and similarity using linear models and other multivariate approaches. Critiques of design and analysis of published studies. Prereq: formal coursework in statistics and ecology; permission. 4 cr.

817. 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. (Also offered as PBIO 817.) 4 cr.

818. Quantitative Aquatic Ecology

Aquatic ecosystems studied through field and laboratory exercises. Emphasis on the application of statistical methods from sampling design to statistical and ecological interpretation of results. Field trip data analyzed in both biology and statistics laboratories. Understanding how the principles underlying statistical concepts can be applied to biological systems will be emphasized. Field trips, designed to collect data for rigorous statistical analysis, include remote pristine lakes in the White Mountains National Forest as well as lakes in southern New Hampshire. Prereq: general ecology or equivalent. (Also offered as PBIO 818.) 6 cr. (Fall semester only, alternate years.)

819. Field Limnology

Ecology of inland waters examined through field studies of lakes, streams, and other freshwater habitats. Emphasizes methods for studying lakes, analysis and interpretation of data, and writing of scientific reports. Includes seminars on research papers and field trips to a variety of lakes from coastal plain to White Mountains. Prereq: concurrent or prior enrollment in general limnology, zooplankton ecology, or equivalent; permission. (Also offered as PBIO 819.) Special fee. Lab. 4 cr.

823. Quantitative Genetics

Analysis of continuous variation in populations simultaneously segregating at multiple loci. Genetic and nongenetic factors and the complex interactions between them; models and methods of analysis, for both theoretical and practical applications. Prereq: principles of genetics; applied biostatistics I is strongly suggested. (Also offered as GEN 823.) Special Fee. Lab. 4 cr. (Not offered every year.)

825. Marine Ecology

Marine environment and its biota, emphasizing intertidal and estuarine habitats. Includes field work, laboratory work, and an independent research project. Prereq: general ecology; permission. Marine invertebrate zoology, oceanography, and statistics are desirable. (Also offered as PBIO 825.) 4 cr. (Not offered every year.)

826. Comparative Physiology

Laboratory modules designed to enable students to investigate nutrition, metabolism, neural function, reproduction, and homeostatic mechanisms, of animals, especially invertebrates. Emphasis on conducting effective physiological studies. Prereq: principles of animal physiology or equivalent; permission. Special fee. Lab. 1–4 cr. (Not offered every year.)

827. Field Ecology of Amphibians and Reptiles

Origins, evolution, ecology, and conservation of amphibians and reptiles. Emphasis on overnight field trips conducted throughout the state, using photographic and other nondestructive sampling methods. Prereq: principles of biology I and II or equivalent. Special fee. Field trips. 4 cr. (Summer only)

828. Comparative Systematics and Evolution of Invertebrates

A synthetic approach to invertebrate phylogenies based on critical examinations of morphological, embryological and molecular characters. Considers methods of phylogenetic reconstruction, theories of metazoan origin and phylogeny of major groups. Prereq: marine invertebrate evolution and ecology or equivalent. Lab. 4 cr. (Fall semester, alternate years.)

850. Biological Oceanography

Biological processes of the oceans including primary and secondary production, trophodynamics, plankton diversity, zooplankton feeding ecology, microbial ecology, and global ocean dynamics. Emphasis on experimental approaches. Term project involves either development of an ecosystem model or performance of a field experiment. Field trips on research vessels and to the Jackson Estuarine Laboratory. Prereq: one year of biology or permission of instructor. (Also offered as ESCI 850.) Lab. 4 cr.

872. Fisheries Biology

Principles of fisheries science, with emphasis on techniques used to assess the biological characteristics of exploited fish populations and the use of such information for fisheries management. Prereq: ichthyology or equivalent; permission. Lab. 4 cr. (Not offered every year.)

877. Neurobiology and Behavior

Survey of fundamental concepts and recent discoveries in neurobiology. Topics include structure and function of neurons, development, cellular basis of behavior (sensory and motor systems), neuropharmacology, and neural plasticity (learning). Prereq: principles of biology I and II or permission. Physiology also desirable. 4 cr.

878. Neuroscience Techniques

A techniques- and laboratory-oriented course designed for students of the behavioral and physiological sciences who wish to understand the basic electrophysiological properties of neurons and how

they interact. Uses both invertebrate and vertebrate systems to illustrate principles of synaptic transmission, integration, sensory information processing, and the control of movement. Prereq: ZOOL 877 or equivalent. Lab. 4 cr. (Not offered every year.)

895, 896. Special Problems in Zoology

Independent study in various areas, including but not limited to: animal behavior; developmental biology; ecology; electron microscopy; endocrinology; evolution; genetics; histology; history of biology; invertebrate biology; neurobiology and behavior; physiology; protozoology; teaching practices; underwater research; vertebrate biology; biological techniques. 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. 1–4 cr.

901. Research Methods in Zoology

Introduction to the range of research approaches in zoology and to the skills needed for success in graduate school and beyond. Topics include scientific writing, graphical methods, library techniques, scientific method and experimental design, research techniques available, and seminar presentation. 2 cr. Cr/F. (Offered every fall.)

#915. Population Ecology

Dynamics of population growth; effects of age, structure, predation, and competition; measures of community interaction. Prereq: permission. Lab. 4 cr. (Not offered every year.)

921. Advanced Invertebrate Zoology

Morphology, phylogeny, and natural history of the major invertebrate phyla. Prereq: introduction to invertebrate zoology or equivalent. 4 cr. (Not offered every year.)

997, 998. Zoology Seminar

Reports on recent zoological literature. Subject fields are those listed under ZOOL 895, 896; not all areas available every semester. Required of graduate students in zoology. 1–2 cr. Cr/F.

899. Master's Thesis

Prereq: permission of department chairperson and prospective supervisor. 6–10 cr. Cr/F.

999. Doctoral Research

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Concord, N.H. (1992–2000)

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Dean of the College of Life Sciences and Agriculture

William W. Mautz, Ph.D.

Dean of the Whittemore School of Business and Economics

Lyndon Goodridge, Ph.D.

Interim Dean of the University of New Hampshire at Manchester

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Dean of the Division of Continuing Education and Summer Session

William F. Murphy, Ed.D.

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Claudia J. Morner, Ph.D.



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Professor of Organizational Behavior

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Associate Professor of Geology

Thomas D. Lee, Ph.D. (1997–2000)
Associate Professor of Plant Biology

Rochelle Lieber, Ph.D. (1995–1998)
Professor of English

Rebecca S. New, Ed.D. (1995–1998)
Associate Professor of Education

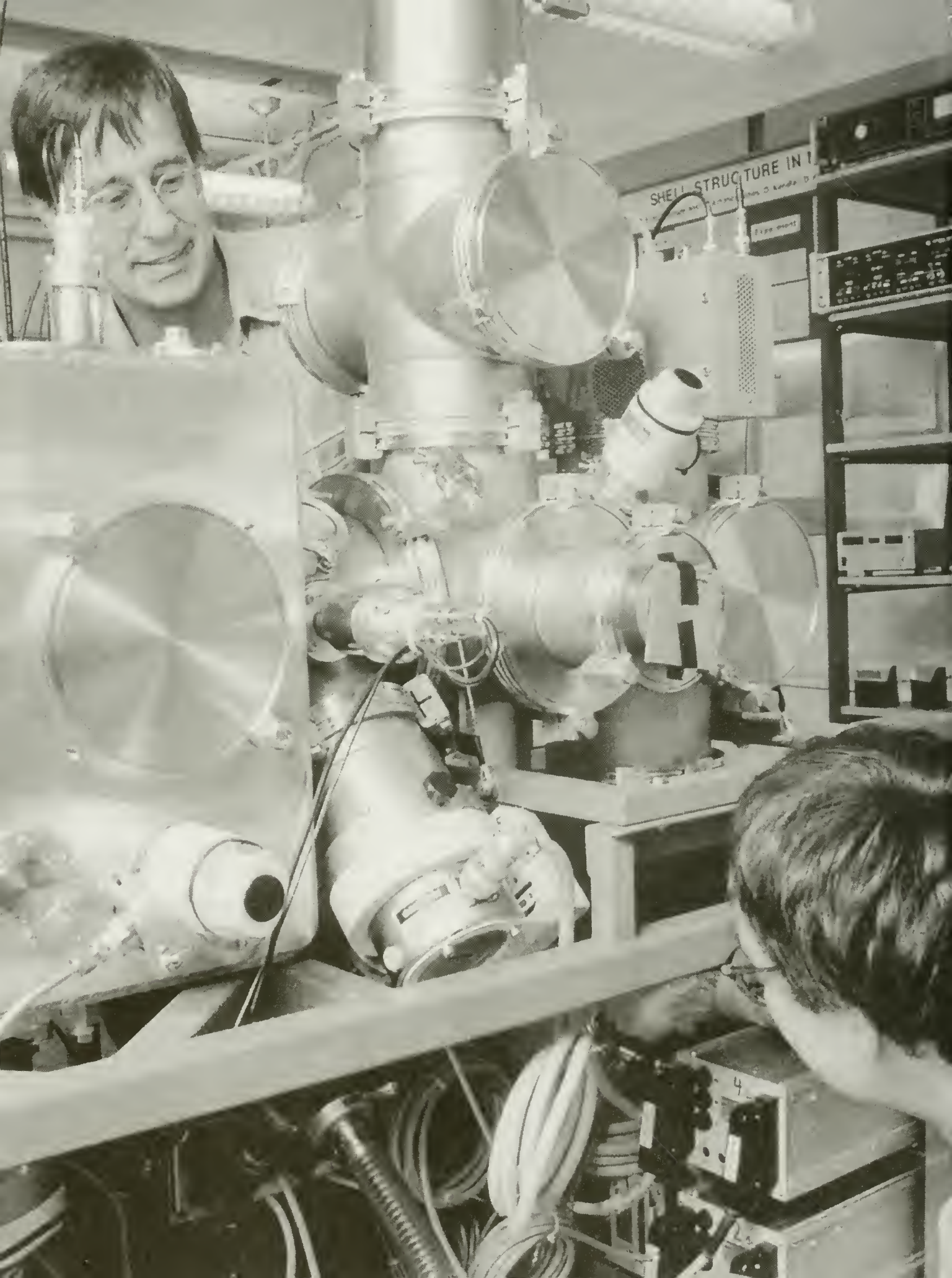
Lee F. Seidel, Ph.D. (1996–1999)
Professor of Health Management and
Policy

Harvey K. Shepard, Ph.D. (1996–1999)
Professor of Physics

James T. Taylor, Ph.D. (1997–2000)
Professor of Zoology

David W. Watt, Ph.D. (1995–1998)
Associate Professor of Mechanical
Engineering

(Three graduate students are appointed
to this council each year.)



FACULTY OF THE GRADUATE SCHOOL

(This list is current as of July 1, 1997. The date of appointment appears in parentheses following the faculty member's name.)

*Currently less than 100 percent status.

- Aber, John D.** (1987)
Director of the Complex Systems Research Center and Professor of Natural Resources and Earth, Oceans and Space; Ph.D., Yale University, 1976.
- Abrams, Eleanor D.** (1994)
Assistant Professor of Education; Ph.D., Louisiana State University, 1993.
- Afolayan, Funso** (1996)
Assistant Professor of History; Ph.D., Obafemi Awolowo University, Nigeria, 1991.
- Aikins, Janet** (1979)
Professor of English; Ph.D., University of Chicago, 1980.
- Amato-wierda, Carmela C.** (1995)
Assistant Professor of Chemistry; Ph.D., Rensselaer Polytechnic Institute, 1993.
- Anderson, Franz E.** (1967)
Professor of Geology; Ph.D., University of Washington, 1967.
- Andrew, David S.** (1976)
Professor of Art History and the Humanities; Ph.D., Washington University, 1977.
- Andrew, Michael D.** (1966)
Professor of Education; Ed.D., Harvard University, 1969.
- Annicchiarico, Michael J.** (1991)
Assistant Professor of Music; Ph.D., Brandeis University, 1993.
- Appel, Kenneth I.** (1993)
Professor of Mathematics; Ph.D., University of Michigan at Ann Arbor, 1959.
- Archer, John M.** (1996)
Associate Professor of English; Ph.D., Princeton University, 1988.
- Arnoldy, Roger L.** (1967)
Director, Space Science Center and Professor of Physics and Earth, Oceans, and Space; Ph.D., University of Minnesota, 1962.
- Ashley, Charles H.** (1969)
Associate Professor of Education; Ed.D., Boston University, 1969.
- Babbitt, Kimberly J.** (1996)
Assistant Professor of Wildlife Ecology; Ph.D., University of Florida, 1996.
- Baber, Kristine M.** (1984)
Associate Professor of Family Studies; Ph.D., University of Connecticut, 1983.
- Bailey, Brigitte Gabcke** (1987)
Associate Professor of English; Ph.D., Harvard University, 1985.
- Baker, Alan L.** (1972)
Associate Professor of Plant Biology; Ph.D., University of Minnesota, 1973.
- Baldwin, Kenneth C.** (1982)
Director, Center for Ocean Engineering and Associate Professor of Mechanical Engineering and Ocean Engineering; Ph.D., University of Rhode Island, 1982.
- Ballesterio, Thomas P.** (1983)
Director, Water Resources Research Center and Associate Professor of Civil Engineering; Ph.D., Colorado State University, 1981.
- Balling, L. Christian** (1967)
Professor of Physics; Ph.D., Harvard University, 1965.
- Banach, Mary** (1995)
Assistant Professor of Social Work; D.S.W., Columbia University, 1995.
- Banyard, Victoria L.** (1995)
Assistant Professor of Psychology; Ph.D., University of Michigan at Ann Arbor, 1994.
- Barber, Heather** (1993)
Assistant Professor of Kinesiology; Ph.D., University of Oregon, 1992.
- Barkey, Dale P.** (1987)
Associate Professor of Chemical Engineering; Ph.D., University of California at Berkeley, 1987.
- Barnett, Carole K.** (1994)
Assistant Professor of Management; Ph.D., University of Michigan at Ann Arbor, 1994.
- Barrett, James P.** (1962)
Professor of Forest Biometrics and Management; Ph.D., Duke University, 1962.
- Barton, Richard M.** (1991)
Assistant Professor of Education; Ph.D., University of Georgia, 1991.
- Bartos, Radim** (1997)
Assistant Professor of Computer Sciences; Ph.D., University of Denver, 1997.
- Bauer, Christopher F.** (1981)
Professor of Chemistry; Ph.D., Colorado State University, 1979.
- Baum, William M.** (1977)
Professor of Psychology; Ph.D., Harvard University, 1966.
- Becker, Mimi Larsen** (1993)
Assistant Professor of Natural Resources and Environmental Policy; Ph.D., Duke University, 1993.
- Bedker, Patricia D.** (1985)
Associate Dean of the College of Life Sciences and Agriculture and Associate Professor of Animal Science and Adult Education; Ph.D., Cornell University, 1985.
- Bellamy, Elizabeth Jane** (1993)
Associate Professor of English; Ph.D., Duke University, 1982.
- Benassi, Victor A.** (1982)
Professor of Psychology; Ph.D., City College of New York, 1974.
- Bennett, Albert B., Jr.** (1967)
Professor of Mathematics; Ed.D., University of Michigan at Ann Arbor, 1966.
- Benoit, Jean** (1983)
Professor of Civil Engineering; Ph.D., Stanford University, 1983.
- Bergeron, Linda Rene** (1997)
Assistant Professor of Social Work; M.S.W., University of Connecticut, 1981.
- Bergeron, R. Daniel** (1974)
Professor of Computer Science; Ph.D., Brown University, 1973.
- Berndtson, William E.** (1979)
Professor of Animal Science; Ph.D., Cornell University, 1971.
- Bernhard, Jennifer T.** (1995)
Assistant Professor of Electrical Engineering; Ph.D., Duke University, 1994.
- Bernstein, David T.** (1989)
Adjunct Assistant Professor of Zoology; Ph.D., University of New Hampshire, 1979.
- Birch, Francis S.** (1972)
Professor of Earth Sciences; Ph.D., Princeton University, 1969.
- Black, Kelly J.** (1994)
Assistant Professor of Mathematics; Ph.D., Brown University, 1992.
- Blakemore, Richard P.** (1977)
Professor of Microbiology; Ph.D., University of Massachusetts at Amherst, 1975.
- Blanchard, Robert O.** (1972)
Professor of Plant Biology; Ph.D., University of Georgia, 1971.
- Blum, Linda M.** (1996)
Assistant Professor of Sociology and Women's Studies; Ph.D., University of California at Berkeley, 1987.
- Bobick, Melvin T.** (1958)
Professor of Sociology; Ph.D., University of Illinois at Urbana-Champaign, 1958.
- Bobilya, Dennis J.** (1991)
Associate Professor of Nutritional Sciences; Ph.D., University of Missouri, 1989.
- Bocciarelli, Gene** (1983)
Associate Professor of Organizational Behavior; Ph.D., Case Western Reserve University, 1982.
- Bogle, A. Linn** (1970)
Professor of Plant Biology; Ph.D., University of Minnesota, 1968.
- Bolker, Jessica A.** (1997)
Assistant Professor of Zoology; Ph.D., University of California at Berkeley, 1993.
- Bolster, W. Jeffrey** (1991)
Associate Professor of History; Ph.D., Johns Hopkins University, 1991.
- Bonnice, William E.** (1962)
Associate Professor of Mathematics; Ph.D., University of Washington, 1962.
- Bornstein, Steven P.** (1989)
Director of Audiology Clinic and Associate Professor of Communication Disorders; Ph.D., University of Connecticut, 1981.
- Bothner, Wallace A.** (1967)
Professor of Geology; Ph.D., University of Wyoming, 1967.
- Boudette, Eugene L.** (1985)
New Hampshire State Geologist and Adjunct Professor of Geology; Ph.D., Dartmouth College, 1969.
- Boulton, Elizabeth P.** (1988)
Station Veterinarian and Associate Professor of Animal Science; D.V.M., University of Georgia, 1980.
- Bowden, William B.** (1987)
Associate Professor of Water Resources Management; Ph.D., North Carolina State University, 1982.
- Boy, Angelo V.** (1965)
Professor of Education; Ed.D., Boston University, 1960.
- Bradford, William D., III** (1991)
Associate Professor of Economics; Ph.D., Louisiana State University, 1991.
- Brannaka, Larry K.** (1994)
Research Assistant Professor of Civil Engineering; Ph.D., Pennsylvania State University, 1993.
- Brettschneider, Marla A.** (1996)
Assistant Professor of Political Science and Women's Studies; Ph.D., New York University, 1993.
- Brockelman, Paul T.** (1963)
Professor of Philosophy; Ph.D., Northwestern University, 1968.
- Brown, Benjamin C.** (1996)
Assistant Professor of Sociology; Ph.D., Emory University, 1996.

- Brown, Warren R.** (1972)
Associate Professor of Political Science and Humanities; Ph.D., Claremont Graduate School and University Center, 1976.
- Brown, Wendell S.** (1974)
Director of the Ocean Process Analysis Laboratory and Professor of Earth Sciences and Earth, Oceans, and Space; Ph.D., Massachusetts Institute of Technology, 1971.
- Bruce, Toni** (1993)
Assistant Professor of Kinesiology; Ph.D., University of Illinois at Urbana-Champaign, 1995.
- Bucklin, Ann C.** (1992)
Director of UNH Sea Grant College Program and Research Professor of Zoology and Earth, Oceans, and Space and Genetics; Ph.D., University of California at Berkeley, 1980.
- Burger, John F.** (1977)
Professor of Zoology; Ph.D., University of Arizona, 1971.
- Caccavo, Frank** (1997)
Assistant Professor of Microbiology; Ph.D., University of Oklahoma, 1995.
- Calarco, John R.** (1981)
Professor of Physics; Ph.D., University of Illinois at Urbana-Champaign, 1969.
- Calculator, Stephen N.** (1983)
Professor of Communication Disorders; Ph.D., University of Wisconsin at Madison, 1980.
- Camobreco, John F.** (1995)
Assistant Professor of Political Science; Ph.D., State University of New York at Binghamton, 1996.
- Campbell, Janet W.** (1993)
Research Associate Professor of Earth Sciences and Earth, Oceans, and Space; Ph.D., Virginia Polytechnic Institute and State University, 1973.
- Carey, Gale B.** (1989)
Associate Professor of Nutritional Sciences; Ph.D., University of California at Davis, 1981.
- Carleton, Karen L.** (1997)
Research Assistant Professor of Zoology; Ph.D., University of Colorado at Boulder, 1987.
- Carney, John J.** (1973)
Associate Professor of Education; Ph.D., Syracuse University, 1973.
- Carnicelli, Thomas A.** (1967)
Professor of English and the Humanities; Ph.D., Harvard University, 1966.
- Carr, Russell T.** (1984)
Associate Professor of Chemical Engineering; Ph.D., University of Rochester, 1984.
- Carroll, John E.** (1974)
Professor of Environmental Conservation; Ph.D., Michigan State University, 1974.
- Carter, Michael J.** (1987)
Associate Professor of Electrical Engineering; Ph.D., University of Michigan at Ann Arbor, 1984.
- Celikkol, Barbaros** (1969)
Professor of Mechanical Engineering and Ocean Engineering; Ph.D., University of New Hampshire, 1972.
- Chamberlin, Kent** (1985)
Professor of Electrical Engineering; Ph.D., Ohio University, 1982.
- Chandler, Donald S.** (1981)
Curator and Professor of Zoology; Ph.D., Ohio State University, 1976.
- Chasteen, N. Dennis** (1972)
Professor of Chemistry; Ph.D., University of Illinois at Urbana-Champaign, 1969.
- Chaston, John M.** (1989)
Associate Professor of Spanish; Ph.D., University of Texas at Austin, 1987.
- Christie, Drew** (1981)
Associate Professor of Philosophy; Ph.D., Massachusetts Institute of Technology, 1983.
- Chupp, Edward L.** (1962)
Professor of Physics and Earth, Oceans, and Space; Ph.D., University of California at Berkeley, 1954.
- Cielinski, Kerry** (1995)
Assistant Professor of Family Studies; Ph.D., Auburn University, 1995.
- Cioffi, Grant L.** (1980)
Associate Professor of Education; Ph.D., University of Minnesota, 1980.
- Clark, Charles E.** (1967)
Professor of History and the Humanities; Ph.D., Brown University, 1966.
- Clark, Janine** (1995)
Assistant Professor of Political Science; Ph.D., University of Toronto, Canada, 1994.
- Clark, Mary Morris** (1978)
Professor of English; Ph.D., University of Massachusetts at Amherst, 1978.
- Clark, Ronald R.** (1957)
Professor of Electrical Engineering; Ph.D., Syracuse University, 1963.
- Cohen, C. Sarah** (1997)
Adjunct Assistant Professor of Zoology; Ph.D., University of Washington, 1992.
- Cohn, Ellen S.** (1978)
Professor of Psychology; Ph.D., Temple University, 1978.
- Collins, John J.** (1988)
Associate Professor of Biochemistry and Molecular Biology and Genetics; Ph.D., University of Wisconsin at Madison, 1984.
- Collins, Michael R.** (1985)
Professor of Civil Engineering; Ph.D., University of Arizona, 1985.
- Condon, William A.** (1976)
Professor of Animal Science; Ph.D., University of Massachusetts at Amherst, 1975.
- Congalton, Russell G.** (1991)
Associate Professor of Remote Sensing & Geographic Information Systems; Ph.D., Virginia Polytechnic Institute and State University, 1984.
- Connors, Robert J.** (1984)
Professor of English; Ph.D., Ohio State University, 1980.
- Conway, Karen Smith** (1987)
Associate Professor of Economics; Ph.D., University of North Carolina at Chapel Hill, 1987.
- Cook, Raymond A.** (1992)
Assistant Professor of Civil Engineering; Ph.D., Cornell University, 1992.
- Coon, Deborah J.** (1995)
Assistant Professor of Psychology and Adjunct Assistant Professor of History; Ph.D., Harvard University, 1988.
- Cooper, Barbara T.** (1978)
Professor of French; Ph.D., University of Wisconsin at Madison, 1974.
- Copeland, Arthur H., Jr.** (1968)
Professor of Mathematics; Ph.D., Massachusetts Institute of Technology, 1954.
- Corcoran, Ellen P.** (1972)
Associate Professor of Education; Ph.D., New York University, 1972.
- Cote, Rick H.** (1988)
Associate Professor of Biochemistry and Molecular Biology; Ph.D., University of Wisconsin at Madison, 1980.
- Craycraft, Catherine A.** (1991)
Associate Professor of Accounting; Ph.D., Ohio State University, 1991; C.P.A.
- Crepeau, Elizabeth L.** (1981)
Associate Professor of Occupational Therapy; Ph.D., University of New Hampshire, 1994.
- Crill, Patrick M.** (1988)
Research Associate Professor of Earth Sciences and Earth, Oceans, and Space; Ph.D., University of North Carolina at Chapel Hill, 1984.
- Croce, Ronald V.** (1986)
Professor of Kinesiology; Ph.D., University of New Mexico, 1983.
- Crow, Garrett E.** (1975)
Professor of Plant Biology; Ph.D., Michigan State University, 1974.
- Crowell, Diana M.** (1997)
Assistant Professor of Nursing; Ph.D., The Union Institute, 1997.
- Curran-Celentano, Joanne** (1982)
Associate Professor of Nutritional Sciences; Ph.D., University of Illinois at Urbana-Champaign, 1982.
- Darlington, Sidney W.** (1971)
Adjunct Professor of Electrical Engineering; Ph.D., Columbia University, 1940.
- Davis, John Matthew** (1993)
Assistant Professor of Hydrogeology; Ph.D., New Mexico Institute of Mining and Technology, 1994.
- Davis, Thomas M.** (1984)
Associate Professor of Plant Biology and Genetics; Ph.D., University of California at Davis, 1985.
- Dawson, John F.** (1968)
Professor of Physics; Ph.D., Stanford University, 1963.
- de Alba, Pedro A.** (1977)
Professor of Civil Engineering; Ph.D., University of California at Berkeley, 1975.
- de la Torre, Pilar** (1989)
Associate Professor of Computer Science; Ph.D., University of Maryland, 1987.
- Degenova, Mary Kay** (1996)
Assistant Professor; Ph.D., Purdue University, 1992.
- DeMitchell, Todd A.** (1990)
Associate Professor of Education; Ed.D., University of Southern California, 1979.
- Denis, Clyde L.** (1982)
Professor of Biochemistry and Molecular Biology and Genetics; Ph.D., University of Washington, 1982.
- Denman, Margaret-Love G.** (1992)
Associate Professor of English; M.A., University of Mississippi, 1967.
- DePorte, Michael V.** (1972)
Professor of English; Ph.D., Stanford University, 1966.
- DeTurk, Mark S.** (1988)
Associate Professor of Music; Ph.D., University of Wisconsin at Madison, 1988.
- Dibb, Jack E.** (1991)
Research Associate Professor of Earth Sciences and Earth, Oceans, and Space; Ph.D., State University of New York at Binghamton, 1988.

- Diefendorf, Jeffrey M.** (1976)
Professor of History; Ph.D., University of California at Berkeley, 1975.
- Diller, Ann L.** (1973)
Professor of Education; Ed.D., Harvard University, 1971.
- Diller, Karl C.** (1972)
Professor of English; Ph.D., Harvard University, 1967.
- Dingman, S. Lawrence** (1975)
Professor of Hydrology and Water Resources; Ph.D., Harvard University, 1970.
- Dolan, Elizabeth M.** (1980)
Associate Professor of Family Studies; Ph.D., Virginia Polytechnic Institute and State University, 1980.
- Donnelly, Michael J.** (1991)
Professor of Sociology and Adjunct Professor of History; Ph.D., University of London, England, 1977.
- Dorsey, Kurk** (1994)
Assistant Professor of History; Ph.D., Yale University, 1994.
- Drake, Allen D.** (1983)
Associate Professor of Electrical Engineering; Ph.D., Tufts University, 1978.
- Drugan, Robert C.** (1995)
Assistant Professor of Psychology; Ph.D., University of Colorado at Boulder, 1984.
- Duncan, Cynthia M.** (1989)
Associate Professor of Sociology; Ph.D., University of Kentucky, 1985.
- Dyson, Benedict P.** (1996)
Assistant Professor of Kinesiology; Ph.D., Ohio State University, 1994.
- Echt, Olof** (1990)
Associate Professor of Physics; Ph.D., University of Konstanz, Germany, 1979.
- Eckert, Robert T.** (1978)
Professor of Natural Resources; Ph.D., Ohio State University, 1978.
- Eggers, Walter F.** (1989)
Provost and Vice President for Academic Affairs and Professor of English; Ph.D., University of North Carolina at Chapel Hill, 1971.
- Eighmy, T. Taylor** (1987)
Director, Environmental Research Group and Research Associate Professor of Civil Engineering; Ph.D., University of New Hampshire, 1986.
- Ellis, Walter** (1996)
Assistant Professor of Social Work; Ph.D., Ohio State University, 1989.
- Elmslie, Bruce T.** (1989)
Associate Professor of Economics; Ph.D., University of Utah, 1988.
- England, Richard W.** (1976)
Professor of Economics and Natural Resources; Ph.D., University of Michigan at Ann Arbor, 1974.
- Ernest, John Richard** (1993)
Associate Professor of English; Ph.D., University of Virginia, 1989.
- Eshbach, Robert W.** (1987)
Associate Professor of Music; M.M., New England Conservatory of Music, 1976.
- Essley, Mary** (1997)
Assistant Professor of Social Work; D.S.W., Catholic University of America, 1996.
- Estes, George O.** (1969)
Professor of Plant Biology; Ph.D., Oregon State University, 1969.
- Etebari, Ahmad** (1980)
Professor of Business Administration; Ph.D., North Texas State University, 1979.
- Evans, Christine V.** (1987)
Associate Professor of Pedology; Ph.D., University of Wyoming, 1987.
- Evans, Judith A.** (1996)
Assistant Professor of Nursing; Ed.D., Teachers College, Columbia University, 1992.
- Fagerberg, Wayne R.** (1984)
Associate Professor of Plant Biology (Cell Biology); Ph.D., University of South Florida, 1975.
- Fairchild, Thomas P.** (1969)
Professor of Animal Science and Genetics; Ph.D., University of Wisconsin at Madison, 1964.
- Falvey, Janet Elizabeth** (1984)
Associate Professor of Education; Ph.D., Pennsylvania State University, 1983.
- Fan, Stephen S.T.** (1962)
Professor of Chemical Engineering; Ph.D., Stanford University, 1962.
- Fant, L. Franklin, Jr.** (1994)
Assistant Professor of Finance; Ph.D., Florida State University, 1994.
- Farag, Ihab H.** (1976)
Professor of Chemical Engineering; Sc.D., Massachusetts Institute of Technology, 1976.
- Federer, C. Anthony** (1970)
Adjunct Professor of Micrometeorology; Ph.D., University of Wisconsin at Madison, 1964.
- Feintuch, Burt H.** (1988)
Director of Center for the Humanities and Professor of English; Ph.D., University of Pennsylvania, 1975.
- Feldman, David V.** (1987)
Associate Professor of Mathematics; Ph.D., Wesleyan University, 1987.
- Ferber, Michael K.** (1987)
Professor of English and the Humanities; Ph.D., Harvard University, 1975.
- Fernald, Peter S.** (1966)
Professor of Psychology; Ph.D., Purdue University, 1963.
- Ferrini-Mundy, Joan** (1983)
Professor of Mathematics; Ph.D., University of New Hampshire, 1980.
- Fetzer, Susan J.** (1990)
Assistant Professor of Nursing; M.B.A., New Hampshire College, 1990.
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- Richards, Harry J.** (1979)
Acting Dean of the Graduate School and Adjunct Associate Professor of Education; Ph.D., Florida State University, 1978.
- Ripley, David K.** (1992)
Assistant Professor of Music; M.M., New England Conservatory of Music, 1977.
- Roberts, John M.** (1979)
Extension Specialist, Turf and Associate Professor of Plant Biology; Ph.D., Purdue University, 1977.
- Roberts, Lewis, Jr.** (1972)
Associate Professor of Occupational Education; Ed.D., Auburn University, 1972.
- Robertson, Robert A.** (1993)
Associate Professor of Tourism; Ph.D., University of Illinois at Urbana-Champaign, 1990.
- Rock, Barrett N.** (1987)
Associate Professor of Natural Resources and Earth, Oceans, and Space; Ph.D., University of Maryland, 1972.
- Rock, Steven K.** (1995)
Assistant Professor of Accounting; Ph.D., Pennsylvania State University, 1995.
- Rodgers, Frank G.** (1985)
Professor of Microbiology; Ph.D., University of Surrey, England, 1977.
- Rogers, John E.** (1967)
Professor of Music; M.F.A., Princeton University, 1966.
- Rucinska, Barbara Dziurla** (1994)
Adjunct Assistant Professor of Electrical Engineering; Ph.D., University of New Hampshire, 1991.
- Rucinski, Andrzej** (1984)
Professor of Electrical Engineering; Ph.D., Technical University of Gdansk, Poland, 1982.
- Russell, Robert D.** (1975)
Associate Professor of Computer Science; Ph.D., Stanford University, 1972.
- Russell, Sylvia Weber** (1979)
Adjunct Associate Professor of Computer Science; Ph.D., Stanford University, 1975.
- Ryan, James M.** (1984)
Professor of Physics and Earth, Oceans, and Space; Ph.D., University of California at Riverside, 1978.
- Sahagian, Dork L.** (1995)
Research Associate Professor of Earth Sciences; Ph.D., University of Chicago, 1987.
- Salloway, Jeffrey Colman** (1988)
Professor of Health Management and Policy; Ph.D., Boston University, 1969.
- Salvio, Paula M.** (1992)
Assistant Professor of Education; Ph.D., University of Rochester, 1989.
- Salyer, Lucy E.** (1989)
Associate Professor of History; Ph.D., University of California at Berkeley, 1989.
- Sasner, John J.** (1965)
Professor of Zoology; Ph.D., University of California at Los Angeles, 1965.
- Savage, Godfrey H.** (1965)
Professor of Mechanical and Ocean Engineering; Ph.D., Stanford University, 1970.
- Sawyer, Philip J.** (1952)
Professor Emeritus of Zoology and Adjunct Professor of Zoology; Ph.D., University of Michigan at Ann Arbor, 1956.
- Schaller, George Eric** (1995)
Assistant Professor of Biochemistry and Molecular Biology; Ph.D., University of Wisconsin at Madison, 1990.
- Schibanoff, Susan** (1971)
Professor of English; Ph.D., University of California at Los Angeles, 1971.
- Schlager, Bernard** (1997)
Assistant Professor of History; Ph.D., Yale University, 1996.
- Schmidt, Torsten** (1988)
Associate Professor of Economics; Ph.D., University of Florida, 1990.
- Schram, Thomas H.** (1990)
Associate Professor of Education; Ph.D., University of Oregon, 1990.
- Schwab, Charles G.** (1975)
Professor of Animal Science; Ph.D., University of Wisconsin at Madison, 1974.
- Schwartz, Marc L.** (1967)
Associate Professor of History; Ph.D., University of California at Los Angeles, 1965.
- Schweickart, Patrocínio P.** (1979)
Professor of English; Ph.D., Ohio State University, 1980.
- Scott, Michelle P.** (1990)
Associate Professor of Zoology; Ph.D., Harvard University, 1984.
- Seavey, John W.** (1980)
Professor of Health Management and Policy; Ph.D., University of Arizona, 1973.
- Seidel, Alice C.** (1976)
Associate Professor of Occupational Therapy; Ed.D., Vanderbilt University, 1994.
- Seidel, Lee F.** (1977)
Professor of Health Management and Policy; Ph.D., Pennsylvania State University, 1976.
- Seiler, David E.** (1972)
Professor of Music; M.M., University of Wisconsin at Madison, 1965.
- Seitz, W. Rudolf** (1976)
Professor of Chemistry; Ph.D., Massachusetts Institute of Technology, 1970.
- Selikowitz, Stuart M.** (1987)
Adjunct Associate Professor of Electrical Engineering; M.D., State University of New York School of Medicine, 1962.
- Shea, Christine M.** (1994)
Assistant Professor of Operations Management; Ph.D., University of Western Ontario, Canada, 1994.
- Shepard, Harvey K.** (1969)
Professor of Physics; Ph.D., California Institute of Technology, 1966.
- Sherman, Sarah Way** (1984)
Associate Professor of English; Ph.D., Brown University, 1983.
- Shetty, Sandhya** (1988)
Associate Professor of English; Ph.D., University of Rochester, 1987.
- Shippee-Rice, Raelene** (1979)
Associate Dean of the School of Health and Human Services and Associate Professor of Nursing; Ph.D., Brandeis University, 1990.
- Shore, Barry** (1974)
Professor of Business Administration; Ph.D., University of Wisconsin at Madison, 1968.
- Shore, Samuel D.** (1965)
Associate Dean of the College of Engineering and Physical Sciences and Professor of Mathematics; Ph.D., Pennsylvania State University, 1964.
- Short, Frederick T.** (1989)
Research Associate Professor of Natural Resources and Marine Science; Ph.D., University of Alaska at Fairbanks, 1981.
- Short, Kevin M.** (1994)
Assistant Professor of Mathematics; Ph.D., Imperial College of Science & Technology, London, 1988.
- Siggelakis, Susan J.** (1988)
Associate Professor of Political Science; Ph.D., Johns Hopkins University, 1988.
- Simic, Charles D.** (1973)
Professor of English; B.A., New York University, 1967.
- Simos, Evangelos O.** (1977)
Professor of Economics; Ph.D., Northern Illinois University, 1977.
- Simpson, Robert E.** (1963)
Professor of Physics; Ph.D., Harvard University, 1960.
- Sinha, Debajyoti** (1993)
Assistant Professor of Mathematics; M.A., University of Rochester, 1990.
- Sir, W. Niel** (1970)
Associate Professor of Music; M.A., University of California at Berkeley, 1962.
- Sitkoff, Harvard** (1976)
Professor of History; Ph.D., Columbia University, 1975.
- Sivaprasad, Kondagunta** (1969)
Professor of Electrical Engineering; Ph.D., Harvard University, 1963.
- Smith, Kevin T.** (1996)
Adjunct Associate Professor of Plant Biology; Ph.D., University of Georgia, 1982.

- Smith, M. Daniel** (1967)
Associate Professor of Education; Ed.D., Harvard University, 1961.
- Smith, Mark R.** (1966)
Professor of English; B.A., Northwestern University, 1960.
- Smith, Samuel C.** (1961)
Professor of Animal and Nutritional Sciences and Biochemistry and Molecular Biology; Ph.D., Pennsylvania State University, 1962.
- Sohl, Jeffrey E.** (1983)
Professor of Business Administration; Ph.D., University of Maryland, 1983.
- Solloway, Michelle R.** (1996)
Research Associate Professor of Health Management and Policy; Ph.D., University of California at Berkeley, 1991.
- Sower, Stacia A.** (1982)
Professor of Biochemistry and Molecular Biology; Ph.D., Oregon State University, 1980.
- Sparr, T. M.** (1989)
Professor of Computer Science; Ph.D., Texas A & M University, 1972.
- Spillane, Kathleen Wilson** (1986)
Associate Professor of Music; Ed.D., Columbia University, 1987.
- Sprague, Linda G.** (1969)
Professor of Operations Management; D.B.A., Harvard University, 1973.
- Stevens, Douglas E.** (1995)
Assistant Professor of Accounting; Ph.D., Indiana University at Bloomington, 1996.
- Stewart, James A.** (1968)
Associate Dean for Research and Agricultural Experiment Station and Professor of Biochemistry; Ph.D., University of Connecticut, 1967.
- Stibler, Robert** (1978)
Professor of Music; D.M.A., Catholic University of America, 1979.
- Stine, William Wren** (1984)
Associate Professor of Psychology; Ph.D., Georgia Institute of Technology, 1983.
- Stine-Morrow, Elizabeth A.L.** (1991)
Associate Professor of Psychology; Ph.D., Georgia Institute of Technology, 1983.
- Stoddard, James E.** (1993)
Assistant Professor of Marketing; Ph.D., Virginia Polytechnic Institute and State University, 1994.
- Straus, Murray A.** (1968)
Professor of Sociology; Ph.D., University of Wisconsin at Madison, 1956.
- Straussfogel, Debra L.** (1992)
Assistant Professor of Geography; Ph.D., Pennsylvania State University, 1987.
- Sullivan, Judith A.** (1990)
Professor of Nursing; Ed.D., University of Rochester, 1972.
- Sullivan, Patricia A.** (1988)
Associate Professor of English; Ph.D., Ohio State University, 1988.
- Sundberg, Donald C.** (1978)
Vice President for Research and Public Service and Associate Professor of Chemical Engineering; Ph.D., University of Delaware, 1970.
- Sussenberger, Barbara** (1978)
Associate Professor of Occupational Therapy; M.S., Boston University, 1975.
- Swift, M. Robinson** (1976)
Professor of Mechanical Engineering and Ocean Engineering; Ph.D., University of New Hampshire, 1974.
- Tagliaferro, Anthony R.** (1978)
Professor of Nutritional Sciences; Ph.D., Cornell University, 1978.
- Talbot, Robert W.** (1988)
Research Associate Professor of Earth Sciences and Earth, Oceans, and Space; Ph.D., University of Wisconsin at Madison, 1981.
- Taylor, James T.** (1977)
Professor of Zoology; Ph.D., Oregon State University, 1976.
- Taylor, Robert L., Jr.** (1984)
Professor of Animal Science and Genetics; Ph.D., Mississippi State University, 1981.
- Thompson, Allen R.** (1974)
Associate Professor of Economics and Business Administration; Ph.D., University of Texas at Austin, 1973.
- Tillinghast, Edward K.** (1967)
Professor of Zoology; Ph.D., Duke University, 1966.
- Tisa, Louis S.** (1994)
Assistant Professor of Microbiology and Genetics; Ph.D., University of Wisconsin at Madison, 1987.
- Tomellini, Sterling A.** (1985)
Associate Professor of Chemistry; Ph.D., Rutgers, The State University of New Jersey, 1985.
- Torbert, Roy B.** (1989)
Dean of the College of Engineering and Physical Sciences and Professor of Physics and Earth, Oceans, and Space; Ph.D., University of California at Berkeley, 1979.
- Townson, David H.** (1997)
Assistant Professor of Animal Science; Ph.D., Ohio State University, 1993.
- Trout, B. Thomas** (1969)
Professor of Political Science; Ph.D., Indiana University at Bloomington, 1972.
- Trubowitz, Rachel** (1986)
Associate Professor of English; Ph.D., Columbia University, 1985.
- Tsang, Paul C.** (1989)
Associate Professor of Animal Science; Ph.D., Boston University, 1986.
- Tsukrov, Igor** (1997)
Assistant Professor of Mechanical Engineering; Ph.D., Tufts University, 1996.
- Tucker, James** (1992)
Assistant Professor of Sociology; Ph.D., University of Virginia, 1992.
- Turner, Elise H.** (1990)
Adjunct Assistant Professor of Computer Science; Ph.D., Georgia Institute of Technology, 1989.
- Turner, Heather A.** (1991)
Associate Professor of Sociology; Ph.D., University of California at San Francisco, 1990.
- Turner, Roy M.** (1990)
Adjunct Assistant Professor of Computer Science; Ph.D., Georgia Institute of Technology, 1989.
- Ulrich, Gael D.** (1970)
Professor of Chemical Engineering; Sc.D., Massachusetts Institute of Technology, 1964.
- Ulrich, Laurel** (1995)
Adjunct Professor of History; Ph.D., University of New Hampshire, 1980.
- Urquhart, Peter W.** (1989)
Associate Professor of Music; Ph.D., Harvard University, 1988.
- Ury, Ann D.** (1973)
Associate Professor of Occupational Therapy; M.S.W., University of Connecticut, 1985.
- Vagts, Peggy A.** (1978)
Professor of Music; M.M., University of Wisconsin at Madison, 1978.
- Van Osdol, Donovan H.** (1970)
Professor of Mathematics; Ph.D., University of Illinois at Urbana-Champaign, 1969.
- Varki, Elizabeth** (1997)
Assistant Professor of Computer Science; Ph.D., Vanderbilt University, 1997.
- Vasudevan, Palligarnai T.** (1988)
Associate Professor of Chemical Engineering; Ph.D., Clarkson University, 1988.
- Veal, Larry J.** (1982)
Associate Professor of Music; M.M.Cello, University of Illinois at Urbana-Champaign, 1976.
- Venkatachalam, A. R.** (1992)
Associate Professor of Management Information Systems; Ph.D., University of Alabama, 1990.
- Vestrand, W. T.** (1987)
Research Professor of Physics and Earth, Oceans, and Space; Ph.D., University of Maryland, 1980.
- Viscari, Dionisio L.** (1996)
Assistant Professor of Spanish; Ph.D., Ohio State University, 1996.
- Von Damm, Karen L.** (1992)
Associate Professor of Geochemistry and Earth, Oceans, and Space; Ph.D., Massachusetts Institute of Technology, 1984.
- Vorosmarty, Charles J.** (1992)
Research Assistant Professor of Earth Sciences and Earth, Oceans, and Space; Ph.D., University of New Hampshire, 1991.
- Vroman, Neil B.** (1984)
Associate Dean of the School of Health and Human Services and Associate Professor of Kinesiology; Ph.D., Pennsylvania State University, 1982.
- Wake, Cameron P.** (1995)
Research Assistant Professor of Earth Sciences and Earth, Oceans, and Space; Ph.D., University of New Hampshire, 1993.
- Walker, Charles W.** (1976)
Professor of Zoology; Ph.D., Cornell University, 1976.
- Wang, Rosemary Y.** (1971)
Associate Professor of Nursing; Ph.D., Boston College, 1982.
- Wansart, William L.** (1985)
Associate Professor of Education; Ed.D., University of Northern Colorado, 1984.
- Ward, Judith D.** (1972)
Associate Professor of Occupational Therapy; Ph.D., The Fielding Institute, 1997.
- Ward, Larry G.** (1989)
Research Associate Professor of Earth Sciences; Ph.D., University of South Carolina, 1978.
- Ward, Sally** (1980)
Professor of Sociology; Ph.D., Brown University, 1977.
- Warner, Rebecca M.** (1981)
Professor of Psychology; Ph.D., Harvard University, 1978.
- Watson, Winsor H., III** (1978)
Professor of Zoology; Ph.D., University of Massachusetts at Amherst, 1978.
- Watt, David W.** (1987)
Associate Professor of Mechanical Engineering; Ph.D., University of Michigan at Ann Arbor, 1987.

- Watters, David H.** (1978)
Professor of English; Ph.D., Brown University, 1979.
- Weathersby, Rita** (1978)
Associate Professor of Organizational Behavior; Ed.D., Harvard University, 1977.
- Webb, Dwight** (1967)
Associate Professor of Education; Ph.D., Stanford University, 1967.
- Weber, James H.** (1963)
Professor of Chemistry; Ph.D., Ohio State University, 1963.
- Webster, Penelope E.** (1987)
Associate Professor of Communication Disorders; Ed.D., Boston University, 1984.
- Weiner, James L.** (1979)
Associate Professor of Computer Science; Ph.D., University of California at Los Angeles, 1979.
- Weisman, Gary R.** (1977)
Professor of Chemistry; Ph.D., University of Wisconsin at Madison, 1976.
- Wells, Otho S.** (1966)
Extension Horticulturist, Vegetables and Professor of Plant Biology; Ph.D., Rutgers, The State University of New Jersey, 1966.
- Weyrick, Richard R.** (1964)
Associate Professor of Forest Resources; Ph.D., University of Minnesota, 1968.
- Wharton-McDonald, M. Ruth** (1997)
Assistant Professor of Education; Ph.D., State University of New York at Albany, 1996.
- Wheeler, Douglas L.** (1965)
Professor of History; Ph.D., Boston University, 1963.
- White, Susan O.** (1969)
Professor of Political Science; Ph.D., University of Minnesota, 1970.
- Wible, James R.** (1984)
Associate Professor of Economics; Ph.D., Pennsylvania State University, 1980.
- Wicklowsky, Barry J.** (1989)
Adjunct Assistant Professor of Zoology; Ph.D., University of New Hampshire, 1982.
- Williams, Daniel C.** (1970)
Associate Professor of Psychology; Ph.D., University of California at Santa Barbara, 1970.
- Williams-Barnard, Carol L.** (1978)
Associate Professor of Nursing; D.N.Sc., Catholic University of America, 1979.
- Wilson, John A.** (1960)
Associate Professor of Mechanical Engineering; Ph.D., Northeastern University, 1970.
- Wirth, Clifford J.** (1981)
Associate Professor of Political Science; Ph.D., Southern Illinois University at Carbondale, 1976.
- Witzling, Mara R.** (1977)
Professor of Art History; Ph.D., Cornell University, 1978.
- Wolper, Ethel Sara** (1996)
Assistant Professor of History; Ph.D., University of California at Los Angeles, 1994.
- Wong, Edward H.** (1978)
Professor of Chemistry; Ph.D., Harvard University, 1975.
- Wood, Craig H.** (1990)
Associate Professor of Operations Management; Ph.D., Ohio State University, 1991.
- Woodruff, Alicia Quiroz** (1994)
Assistant Professor of Spanish; Ph.D., University of California at Davis, 1992.
- Woodward, William R.** (1975)
Associate Professor of Psychology and Adjunct Associate Professor of History; Ph.D., Yale University, 1975.
- Wright, John J.** (1970)
Professor of Physics; Ph.D., University of New Hampshire, 1969.
- Young, Allen J.** (1991)
Lead Extension Dairy Specialist and Assistant Professor of Animal Science; Ph.D., Oregon State University, 1987.
- Zarin, Daniel J.** (1995)
Assistant Professor of Forest Ecology; Ph.D., University of Pennsylvania, 1993.
- Zaso, Gus C.** (1970)
Associate Professor of Tourism; Re.D., Indiana University at Bloomington, 1965.
- Zercher, Charles K.** (1991)
Associate Professor of Chemistry; Ph.D., University of Notre Dame, 1989.
- Zia, Lee L.** (1985)
Associate Professor of Mathematics; Ph.D., Brown University, 1985.
- Zielinski, Gregory A.** (1990)
Research Associate Professor of Earth Sciences and Earth, Oceans, and Space; Ph.D., University of Massachusetts at Amherst, 1987.
- Zsigray, Robert M.** (1970)
Professor of Microbiology and Genetics; Ph.D., Georgetown University, 1969.
- Zunz, Sharyn J.** (1993)
Assistant Professor of Social Work; D.S.W., Fordham University, 1993.



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DIRECTIONS TO CAMPUS

By Car FROM BOSTON, MASS. Follow I-95 North. When approaching the Portsmouth, N.H., area, take the exit bearing left, marked "NH Lakes and White Mountains, Routes 4 & 16." Continue on that road to Exit 6W (Concord-Durham) and follow Route 4 West. Exit at 155A and turn toward Durham. Follow 155A through a short stretch of farmlands and fields to the UNH campus.

FROM HARTFORD, CONN. Take I-84/I-86 East out of Hartford to the Mass. Pike (I-90) to Auburn Exit 10 then East on I-290 to I-495 North. Drive east on I-495 North, Exit 26. Continue north on I-95, then follow the directions above for driving from Boston.

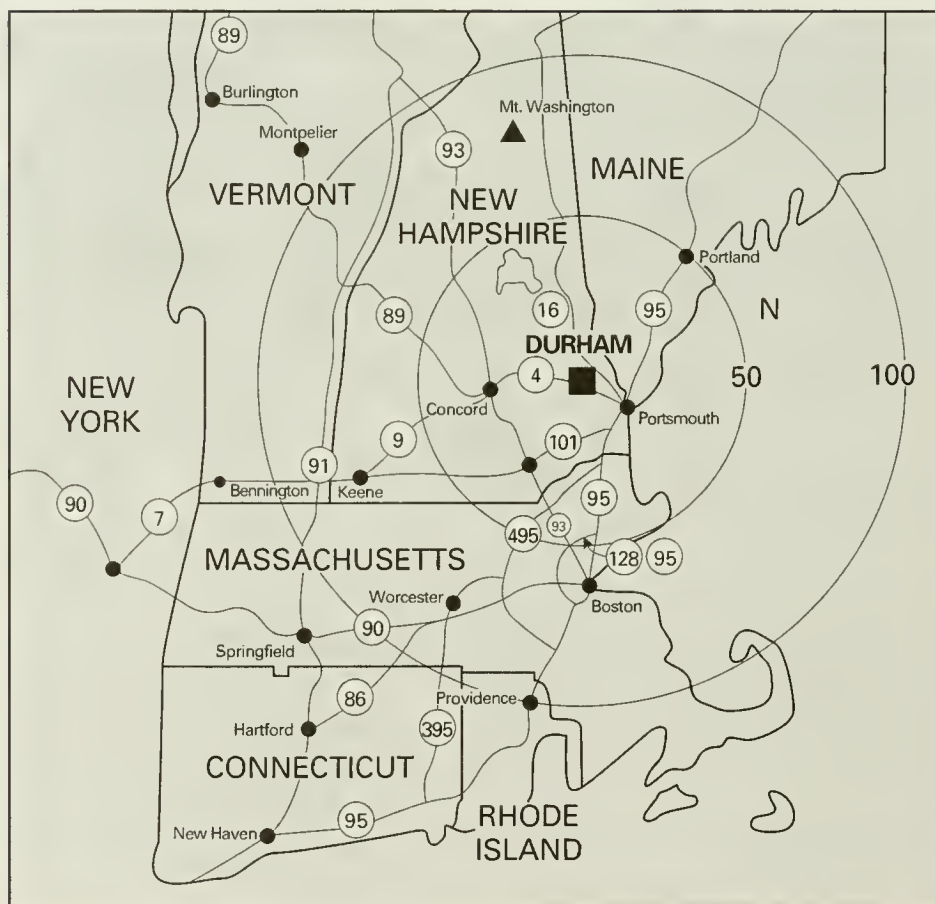
FROM PORTLAND, ME. Follow either I-95 or Route 1 South to the Portsmouth traffic circle. Take the Spaulding Turnpike north to Exit 6W (Concord-Durham). Then follow the directions above for driving from Boston.

FROM CONCORD, N.H. Follow Route 4 East, and take the UNH/Durham exit at 155A. Follow a short stretch of farmlands and fields to the UNH campus.

FROM MANCHESTER, N.H. Take Route 101 to the junction of Route 125. Follow Route 125 North to the Lee traffic circle. Drive east on Route 4, and then follow the directions above for driving from Concord.

By Plane From Logan International Airport, Boston, you may use the C & J Trailways Airport Bus Service. Advance reservations are not required. For further information call (603) 742-5111 or, outside New Hampshire, (800) 258-7111.

By Bus Depart C & J Trailways Bus Lines across from South Station in Boston. For further information call (603) 742-5111 from New Hampshire or (800) 258-7111 outside of New Hampshire.



CAMPUS MAP AND KEY



RESIDENCE AND DINING HALLS

- 1 Hetzel Hall
- 2 Alexander Hall
- 3 Fairchild Hall
- 4 Huddleston Dining Hall
- 5 Englehardt Hall
- 6 Hunter Hall
- 7 Gibbs Hall
- 8 Devine Hall
- 9 Randall Hall
- 10 Hitchcock Hall
- 13 Babcock House
- 23 Hubbard Hall
- 24 Philbrook Dining Hall
- 25 Christensen Hall
- 26 Williamson Hall
- 27 Mini-dorms
- 33 Smith Hall
- 34 Sawyer Hall
- 35 Scott Hall
- 36 Stoke Hall
- 37 Stillings Dining Hall
- 39 Jessie Doe Hall
- 40 Lord Hall
- 41 McLaughlin Hall
- 42 Congreve Hall

APARTMENT COMPLEXES

- 28 Forest Park Apartments
- 61 Woodside Apartments
- 70 The Gables

ACADEMIC BUILDINGS

- 12 McConnell Hall
- 19 Hamilton Smith Hall
- 21 Horton Social Science Center
- 22 Parsons Hall
- 29 Kingsbury Hall
- 30 Paul Creative Arts Center
- 31 Dimond Library
- 43 Morrill Hall
- 44 Murkland Hall
- 45 DeMerritt Hall
- 46 James Hall
- 47 Conant Hall
- 48 Hewitt Hall
- 49 Spaulding Life Sciences Center
- 50 Rudman Hall
- 51 Morse Hall
- 53 Pettee Hall
- 54 Taylor Hall
- 55 Kendall Hall
- 56 Nesmith Hall

- 57 New Hampshire Hall
- 63 Human Nutrition Center
- 64 Ocean Engineering Building
- 67 Greenhouses
- 68 Putnam Hall
- 69 Barton/Cole Halls
- 71 Equestrian Center

ADMINISTRATIVE OFFICES/SUPPORT SERVICES

- 14 Wolff House
- 15 Health Services
- 16 Pettee House
- 17 Verrette House
- 18 Grant House, Office of Admissions
- 20 Hood House
- 32 Thompson Hall
- 52 Zais Hall
- 60 Elliott Alumni Center
- 66 Visitor Information Center

STUDENT ACTIVITIES/LODGING

- 11 Memorial Union Building
- 38 The New England Center
- 58 Hamel Student Recreation Center
- 59 Whittemore Center Arena
- 62 Dairy Bar
- 65 Field House

GRADUATE CALENDAR 1997-1999

**1997-1998
Semester I****September 1, Monday**

Labor Day, university offices closed.

September 2, Tuesday

8 A.M. Classes begin. Follow Tuesday schedule.

September 9, Tuesday

Last day to register without \$25 late fee.

September 19, Friday

Last day to register and pay without having degree status discontinued.

Last day to add courses without dean's approval and \$25 per course late add fee.

Last day to drop courses without \$25 late fee.

Last day to choose credit/fail option.

October 2, Thursday

Rosh Hashanah.*†

October 3, Friday

Last day for graduate students to withdraw or drop courses and qualify for ½ tuition refund.

Last day to drop courses without dean's approval and grade of W.

Last day to change to audit without dean's approval.

Last day to carry more than 16 credits without a surcharge.

October 11, Saturday

Yom Kippur.*†

October 17, Friday

Midsemester; fall break, no classes.

Last day to drop courses or withdraw from the university without academic liability (a grade of WP/WF).

Last day to file Intent-to-Graduate card for December 1997 graduation without late fee.

October 31, Friday

Last day to file Intent-to-Graduate card for December 1997 with late fee.

November 3, Monday

Application forms for part-time tuition scholarships for Semester II are available at the Graduate School.

November 4, Tuesday

Election Day, no exams can be scheduled.

November 11, Tuesday

Veterans Day holiday, no classes.

November 26, Wednesday

Last day for Ph.D. dissertation defense (December graduation).

Classes follow Friday schedule.

November 27-28, Thursday-Friday

Thanksgiving holiday, no classes.

December 1, Monday

8 A.M. Classes resume.

Last day for completing application for admission to graduate study, request for change in degree program, or application for readmission for Semester II, 1997-98.

Last day for completing application for part-time tuition scholarships for Semester II, 1997-98.

Application materials for 1998-99 Dissertation Year Fellowships and 1998 Summer TA Fellowships are available at the Graduate School.

FAFSA forms for 1998-99 need-based financial aid available at the Financial Aid Office.

December 5, Friday

Last day an announced oral or written exam may be given before finals.

December 12, Friday

Last day of classes.

Last day for resolving incompletes from Semester II, 1996-97, and/or summer 1997.

Last day for presenting final copies of doctoral dissertation or master's thesis to the Graduate School for binding (December graduation).

Last day to take final comprehensive examination for the master's degree.

December 15, Monday

Reading Day.

December 16-20, Tuesday-Saturday

Final exams.

December 22-26, Monday-Friday

Christmas holidays, offices closed.

December 31, Wednesday

Graduation date (no ceremony).

January 1-2, Thursday-Friday

New Year's holidays, offices closed.

January 19, Monday

Martin Luther King, Jr. holiday, university offices closed.

January 20, Tuesday

8 A.M. Classes begin. Follow Tuesday schedule.

January 27, Tuesday

Last day to register without \$25 late registration fee.

February 6, Friday

Last day to register and pay without having degree status discontinued.

Last day to add courses without dean's approval and \$25 per course late add fee.

Last day to drop courses without \$25 late fee.

Last day to choose credit/fail option.

February 10, Tuesday

Last day for completing application for 1998 Summer TA Fellowships.

February 19, Thursday

Last day for completing application for admission to graduate study for Semester I, 1998-99, to ensure consideration for financial assistance for the 1998-99 academic year.

February 20, Friday

Last day to withdraw or drop courses and qualify for ½ tuition refund.

Last day to drop courses without dean's approval and grade of W.

Last day to change to audit without dean's approval.

Last day to carry more than 16 credits without a surcharge.

February 27, Friday

Priority deadline for receipt of FAFSA by the federal processor for application for need-based financial aid for 1998-99 through the Financial Aid Office.

March 13, Friday

Midsemester.

Last day to drop courses or withdraw from the university without academic liability (grade of WP/WF).

Last day to file Intent-to-Graduate card for May graduation without late fee.

March 16-20, Monday-Friday

Spring recess.

March 23, Monday

8 A.M. Classes resume.

April 3, Friday

Last day to file Intent-to-Graduate card for May 1998 graduation with late fee.

Last day for completing application for admission to graduate study, request for change in degree program, or application for readmission for Summer Session 1998. Recommended deadline for fall 1998 admission.

Semester II**January 14, Wednesday**

Last day for submitting application for 1998-99 Dissertation Year Fellowships.

*These holidays, important to many members of the university community, are not university holidays, but they are listed here to facilitate planning of university events. Faculty and staff should be sensitive to the needs of those who celebrate these and other holidays.

†Jewish holidays begin at sundown the day preceding the holiday.

April 6, Monday

Application forms for part-time tuition scholarships for Semester I, 1998–99, are available at the Graduate School.

UNH application forms for summer college work-study available through the Financial Aid Office.

April 10, Friday

Good Friday.*

April 11, Saturday

Passover.**

April 17, Friday

Orthodox Good Friday.*

April 22, Wednesday

Last day for final Ph.D. dissertation defense (May graduation).

May 1, Friday

Last day for presenting final copies of doctoral dissertation or master's thesis to the Graduate School for binding (May graduation).

May 4, Monday

Last day an announced oral or written exam may be given before finals.

May 11, Monday

Last day of classes.

Last day for resolving incompletes from Semester I, 1997–98.

Last day to take final comprehensive examination for the master's degree (May graduation).

May 12–13, Tuesday–Wednesday

Reading Days.

May 14–15, 18–21, Thursday–Friday, Monday–Thursday

Final exams.

May 23, Saturday

Commencement ceremony.

Summer Session 1998**May 29, Friday**

Last day for completing application for part-time tuition scholarships for Semester I, 1998–99.

July 1, Wednesday

Last day for completing application for admission to graduate study, request for change in degree program, or application for readmission for Semester I, 1998–99.

July 3, Friday

Last day to file Intent-to-Graduate card for September 1998 graduation without late fee.

July 17, Friday

Last day to file for September 1998 graduation with late fee.

July 29, Wednesday

Last day for final Ph.D. dissertation defense (September graduation).

August 7, Friday

Last day for presenting final copies of doctoral dissertation or master's thesis to the Graduate School for binding (September graduation).

September 1, Tuesday

Graduation date (no ceremony).

1998–1999**Semester I****September 2, Wednesday**

8 A.M. Classes begin. Follow Wednesday schedule.

September 7, Monday

Labor Day, university offices closed.

September 9, Wednesday

Last day to register without \$25 late fee.

September 18, Friday

Last day to register and pay without having degree status discontinued.

Last day to add courses without dean's approval and \$25 per course late add fee.

Last day to drop courses without \$25 late fee.

Last day to choose credit/fail option.

September 21, Monday

Rosh Hashanah.**

September 30, Wednesday

Yom Kippur.**

October 2, Friday

Last day to withdraw or drop courses and qualify for ½ tuition refund.

Last day to drop courses without dean's approval and grade of W.

Last day to change to audit without dean's approval.

Last day to carry more than 16 credits without a surcharge.

October 21, Wednesday

Second half classes begin.

October 23, Friday

Midsemester.

Last day to drop courses or withdraw from the university without academic liability (grade of WP/WF).

Last day to file Intent-to-Graduate card for December 1998 graduation without late fee.

November 2, Monday

Application forms for part-time tuition scholarships for Semester II are available at the Graduate School.

November 3, Tuesday

Election Day, no exams can be scheduled.

November 6, Friday

Last day to file Intent-to-Graduate card for December 1998 with late fee.

November 11, Wednesday

Veterans Day holiday, no classes.

November 25, Wednesday

Last day for Ph.D. dissertation defense (December graduation).

November 26–27, Thursday–Friday

Thanksgiving holiday, no classes.

November 30, Monday

8 A.M. Classes resume.

December 1, Tuesday

Last day for completing application for admission to graduate study, request for change in degree program, or application for readmission for Semester II, 1998–99.

Last day for completing application for part-time tuition scholarships for Semester II, 1998–99.

Application materials for 1999–00 Dissertation Year Fellowships and 1999 Summer TA Fellowships are available at the Graduate School.

FAFSA forms for 1999–00 need-based financial aid available at the Financial Aid Office.

December 7, Monday

Last day an announced oral or written exam may be given before finals.

December 11, Friday

Last day for presenting final copies of doctoral dissertation or master's thesis to the Graduate School for binding (December graduation).

December 14, Monday

Last day of classes.

Last day for resolving incompletes from Semester II, 1997–98, and/or summer 1998.

Last day to take final comprehensive examination for the master's degree.

December 15–16, Tuesday–Wednesday

Reading Days. Final exams for classes meeting Tuesday or Wednesday evenings.

December 17–19, 21–22 Thursday–Saturday, Monday–Tuesday

Final exams.

December 31, Thursday

Graduation (no ceremony).

Semester II

January 13, Wednesday

Last day for submitting application for 1999–00 Dissertation Year Fellowship.

January 18, Monday

Martin Luther King, Jr. holiday, university offices closed.

January 19, Tuesday

8 A.M. Classes begin. Follow Tuesday schedule.[‡]

January 26, Tuesday

Last day to register without \$25 late registration fee.

February 5, Friday

Last day to register and pay without having degree status discontinued.
Last day to add courses without dean's approval and \$25 per course late add fee.
Last day to drop courses without \$25 late fee.
Last day to choose credit/fail option.

February 9, Tuesday

Last day for completing application for 1999 Summer TA Fellowships.

February 12, Friday

Last day for completing application for admission to graduate study for Semester I, 1999–00, to ensure consideration for financial assistance for the 1999–00 academic year.

February 19, Friday

Last day to withdraw or drop courses and qualify for 1/2 tuition refund.
Last day to drop courses without dean's approval and grade of W.
Last day to change to audit without dean's approval.
Last day to carry more than 16 credits without a surcharge.

March 1, Monday

Priority deadline for receipt of FAFSA by the federal processor for application for need-based financial aid for 1999–00 through the Financial Aid Office.

March 12, Friday

Midsemester.
Last day to drop courses or withdraw from the university without academic liability (grade of WP/WF).
Last day to file Intent-to-Graduate card for May 1999 graduation without late fee.

March 15–19, Monday–Friday

Spring recess.

March 22, Monday

8 A.M. Classes resume.

April 1, Thursday

Passover.*†

April 2, Friday

Good Friday.*
Last day to file Intent-to-Graduate card for May 1999 graduation with late fee.

April 5, Monday

Last day for completing application for admission to graduate study, request for change in degree program, or application for readmission for Summer Session 1999.
Recommended deadline for fall 1999 admission.
Application forms for part-time tuition scholarships for Semester I, 1999–00 are available at the Graduate School.
UNH application forms for summer college work-study available through the Financial Aid Office.

April 9, Friday

Orthodox Good Friday.*

April 21, Wednesday

Last day for final Ph.D. dissertation defense (May graduation).

May 3, Monday

Last day an announced oral or written exam may be given before finals.

May 7, Friday

Last day for presenting final copies of doctoral dissertation or master's thesis to the Graduate School for binding (May graduation).
Last day to take final comprehensive examination for the master's degree (May graduation).

May 10, Monday

Last day of classes.
Last day for resolving incompletes from Semester I, 1998–99.

May 11–12, Tuesday–Wednesday

Reading Days.

May 13–14, 17–20, Thursday–Friday, Monday–Thursday

Final exams.

May 22, Saturday

Commencement ceremony.

Summer Session 1999

June 4, Friday

Last day for completing application for part-time tuition scholarships for Semester I, 1999–00.

July 1, Thursday

Last day for completing application for admission to graduate study, request for change in degree program, or application for readmission for Semester I, 1999–00.

July 2, Friday

Last day to file Intent-to-Graduate card for September 1999 graduation without late fee.

July 16, Friday

Last day to file Intent-to-Graduate card for September 1999 graduation with late fee.

July 28, Wednesday

Last day for final Ph.D. dissertation defense (September graduation).

August 6, Friday

Last day for presenting final copies of doctoral dissertation or master's thesis to the Graduate School for binding (September graduation).

September 1, Wednesday

Graduation date (no ceremony).

[‡]First day of classes subject to change.



FREQUENTLY CALLED NUMBERS

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UNIVERSITY OPERATORS	(603) 862-1234 (OFF-CAMPUS)
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The University of New Hampshire has adopted a grievance procedure to provide for the resolution of complaints under this policy. A copy of the grievance procedure may be obtained through the Affirmative Action Office, Room 305, Thompson Hall.

The university is in compliance with federal guaranteed student loan regulations and will supply information about the employment fields. This information may be obtained upon request from the university's Office of Career Services, which is available to all students. 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 full information pertaining to the Family Educational Rights and Privacy Act of 1974 (the "Buckley Amendment") in the annual publication *Student Rights, Rules, and Responsibilities*. It also contains university regulations and policies regarding student conduct. Information is also available from the offices of the vice president for student affairs and the vice president for academic affairs.

Course descriptions and program descriptions may vary from the actual content or requirements because of advancements in the discipline or the active nature of academic planning and decision making. Accordingly, the university reserves the right to make whatever changes are deemed necessary in schedules, course content, requirements, academic programs (including their termination), calendar, tuition and fees, services, or any other aspect of the university's operations, giving whatever notice thereof is reasonable under the circumstances. Therefore, the provisions of this catalog are not an irrevocable contract between the students and the university. The university is also not responsible for failure to provide or for delay in providing expected services and/or facilities when such failure arises from causes beyond the reasonable control of the university.

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