

Reference

1979-80
graduate course listing

state university of new york
at
stony brook



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Anatomical Sciences

HBA 530 Microscopic Structure of the Human Body

A lecture and laboratory course designed to fulfill the need of Medical, Dental and Graduate students for a basic understanding of the cytology and histology of the human body. All material will be presented with the goal of integration of structure and function. Presentations will be in formal lectures and self-study laboratory sessions.

Prerequisite: Permission of instructor
Instructors: Drs. Dewey, Blaustein, Brink
Fall, 6 credits

HBA 531 Gross Anatomy of the Human Body

A course comprising (1) laboratories in which detailed dissection of the human body is undertaken and (2) lectures covering topics in gross anatomy including functional and topographic anatomy, clinical correlations and introduction to radiology.

Prerequisite: Permission of instructor
Instructors: Drs. Stern, Fleagle and Staff
Spring modules, 7 credits

HBA 532 Human Embryology

This course in human embryology is designed to present the development of human structure in such a way as to promote understanding of normal adult anatomy and the more common congenital anomalies. Emphasis will be placed on describing the events of early embryonic formation and subsequent organogenesis. Reproductive physiology will be covered in some detail, and an introduction to developmental mechanisms will be offered.

Prerequisites: HBA 530 and concurrently with or after HBA 521/531; permission of instructor

Instructors: Drs. Dewey and Stern
Spring modules, 2 credits

HBA 533 Basic Medical Genetics

Fundamentals of genetics with emphasis on medical aspects; coverage includes autosomal-X-linkage, gene linkage and chromosome mapping, chromosomal aberrations, multiple allelic systems, population genetics and human genetic counseling.

Prerequisite: Permission of instructor for non-Health Science students

Instructors: Drs. Williamson and Creel
Spring modules, 2 credits

HBA 560 Advanced Regional Anatomy

A course in advanced human gross anatomy for graduate students or advanced undergraduates in biology, anthropology and other life sciences.

Prerequisite: Permission of instructor
Instructors: Dr. Fleagle and staff
Fall and spring, variable credits 3-8



HBA 562 Techniques in Electron Microscopy

A laboratory course designed to teach students how to fix and embed tissues, prepare ultrathin sections, obtain and process electron microscope photographs, and interpret ultrastructural details. Theory of electron optics will be discussed where applicable to the above techniques. Methods in routine maintenance of an electron microscope will also be stressed.

Prerequisite: Permission of instructor
Instructors: Drs. Walcott and Dewey
Fall and spring, variable 1 to 4 credits

HBA 563 Aspects of Animal Mechanics

This course comprises an introduction to biomechanics. The first half covers free-body mechanics and kinetics as applied to vertebrate locomotion. The second half deals with the structure and physiology of muscle as it relates to adaptations of the musculoskeletal system.

Prerequisite: Introductory physics and biology or permission of instructor
Instructor: Dr. Stern
Spring, odd years, 2 credits

HBA 565 Human Evolution

Survey of the fossil record of human evolution from the later Tertiary through the Pleistocene. The course will emphasize the record of morphological evolution including evolution of the skull, teeth and limbs. Topics include the ape-human furcation, radiation of the early hominids, the evolution of *Homo erectus*, Neanderthal man, later human ancestors, the evolution of the brain and intelligence, bipedalism and other morphological complexes. The lectures and laboratories will utilize extensive comparative anatomical material, fossil casts and slide collection.

Prerequisite: Permission of instructor
Instructor: Dr. Susman
Spring, odd years, 4 credits

HBA 580 Comparative Anatomy and Evolution of Mammals

A laboratory dissection course on the comparative anatomy of living mammals.

Each student or group of students will dissect a different species and demonstrate the results to the class. Dissections will be supplemented by weekly seminars on the evolution of major groups of mammals and anatomical diversity among different taxa. Emphasis is placed on relating structural diversity to behavior. Seminar can be taken separately as HBA 581.

Prerequisite: Previous course in human or vertebrate anatomy; permission of instructor
Instructor: Dr. Fleagle
Fall, odd years, 4 credits

HBA 581 Evolution of Mammals

A consideration of the evolution and radiation of mammals from the Mesozoic to the present from an anatomical and paleontological perspective. Emphasis is placed on the characteristic morphological features of major groups, the functional significance of anatomical characteristics and the mammalian fossil record.

Prerequisite: Permission of instructor
Instructor: Dr. Fleagle
Fall, odd years, 2 credits

HBA 590 Projects in Anatomical Sciences

Individual laboratory projects closely supervised by faculty members to be carried out in staff research laboratories. Prerequisite: Permission of instructor
Fall and spring, 2 credits each semester

HBA 654 Comparative Neuroanatomy

Emphasis will be placed on the comparative approach to the study of the central nervous system. The form, structure and functional organization of various classes of vertebrates will be discussed.

Prerequisite: HBA 655 and/or permission of instructor
Instructor: Dr. Karten
Spring, 3 credits

HBA 655 Neurosciences

An integrated approach to the study of the mammalian and human nervous system. The anatomy and physiology of the central nervous system will be studied.

Prerequisite: Permission of instructor
Instructor: Staff
Spring, even years, 4 credits

HBA 656 Cell Biology

The purpose of the course is to introduce students to the structural organization of cells and tissues and to the way the structure relates to the function. Particular emphasis will be placed on cell organelle structure and function in specialized cells in tissues. The organization and interaction of cells in tissues will also be covered. The course will be comparative and will include examples of tissues from vertebrates and invertebrates. (Crosslisted with BCD 656.)
Prerequisite: Baccalaureate degree in science or permission of instructor
Instructors: Drs. Dewey, Gordon, Hauber, Walcott and Brink
Spring, 4 credits

HBA 657 Developmental Biology

This course will deal with developing systems at all levels from the morphological to the molecular. Illustrative material from both animal and plant kingdoms will be used. Emphasis will be placed on cellular aspects of these non-equilibrium systems, with special attention to gametogenesis, genetic control of early development, translational control of protein synthesis, the role of cell division and cell movements, and cell-cell interactions in defining developing systems. (Crosslisted

with BCD 657.)

Prerequisite: Permission of instructor
Instructor: Dr. Gordon
Fall, 3 credits

HBA 661 Methods in Research

Students are involved in research projects supervised by staff members in their research laboratories.
Prerequisite: Permission of instructor
Fall and spring, variable and repetitive 1-12 credits

HBA 662 Methodology of Macroscopic Anatomy

Study of the means of displaying structure on the gross level (dissection, sectioning, maceration, cleaning, injection) of all organ systems. Principles of radiologic and ultrasonic demonstrations, their applications to the cadaver. Introduction to measuring techniques (linear, planimetric, volumetric, 3-dimensional).
Prerequisite: Permission of instructor
Instructor: Dr. Inke
Fall and spring, 2 credits each semester

HBA 690 Graduate Seminar

Seminars by graduate students on current literature in the areas of the Anatomical Sciences.
Prerequisite: Permission of instructor
Fall and spring, 2 credits each semester

HBA 692 Advanced Topics in Anatomical Sciences Literature

Tutorial readings in anatomical sciences

with periodic conferences, reports and examinations arranged with the instructor.

Prerequisite: Permission of instructor
Fall and spring, variable and repetitive, 1-2 credits

HBA 694 Thesis Research

Original investigation under supervision of thesis advisor and committee.
Prerequisite: Permission of thesis advisor
Fall and spring, variable and repetitive, 1-12 credits

HBA 695 Practicum in Teaching

Practice instruction in the teaching of Anatomical Sciences carried out under faculty supervision.
Prerequisite: Permission of instructor
Fall and spring, variable and repetitive, 1-4 credits

HBA 760 Postgraduate Clinical Anatomy of the Head and Neck

Gross and radiologic anatomy, embryology and neuroanatomy of the head and neck, with special emphasis on applications for oral surgeons, otolaryngologists and ophthalmologists. Lectures, dissections, prosections, seminar discussions, and clinical presentations with their anatomical correlates.
Prerequisite: Permission of instructor
Instructors: Drs. Inke, Blaustein and M. Stern (Oral Surgery)
Spring, variable credit

Anthropology

ANT 500 Social and Cultural Anthropology

Study of the forms of social organizations: family, kinship, economic, political and religious, as found among simple and complex societies. A basic graduate level course designed for students whose previous background is in other fields.
Instructor: Staff
Variable and repetitive credit

ANT 501, 502 Theory in Cultural and Social Anthropology

Basic issues and approaches in cultural-social anthropological theory.
Instructors: R. Stevenson, L. Faron
3 credits each semester

ANT 503 Evolution of the State

The theories of a number of seminal thinkers in social history, political theory, economics, sociology and anthropology are tested against the empirical results of contemporary anthropological research, both archaeological and ethnographic. Emphasis is upon Asia and Africa, but New World materials are also introduced for purposes of comparison.
Instructor: R. Stevenson
3 credits



ANT 504 Problems in Political and Economic Development

An examination of the political and economic problems faced by undeveloped peoples as they become modern nations, and discussion of some of their successes and failures in political and economic development. Each student carries out independent research on a nation, people or problem, presents material in a seminar, and writes a paper on the research.
Instructors: P. Glick, T. Kennedy
3 credits, repetitive

ANT 505 Anthropological Method

A course for advanced graduate students which examines the scientific foundations of anthropology, explanation, methods of research, and analysis of data. Various examples and types of anthropological method, such as ethnohistory, case method analysis and genealogies, will be considered. The emphasis will be on the relation between problem and method, and the preparation of research proposals.
Prerequisite: One year of graduate study
Instructors: P.B. Glick and Staff
3 credits

ANT 506 Readings and Research in African Ethnology

Intensive readings in research in select problems of African ethnology. Particular attention is given to aspects of social and ecological anthropology as well as culture history.
Instructors: W. Arens, R. Stevens
3 credits, repetitive

ANT 507 Mid-East Anthropology

Emphasis on ethnographic studies of diverse Middle-Eastern Peoples. A focus on unities in the Middle East — Islam, political unities, and ethnic group associations. Discussion of diversity — ethnic hostilities, schisms in religious groups, antagonisms to nation-states,

also will be discussed. The course will be taught within a historical framework.

Instructor: J. Starr

3 credits, repetitive

ANT 508 Seminar in Latin American Cultures

Research and discussion about selected topics in the culture and social structure of Indian and peasant communities in Latin America.

Instructors: P. Carrasco, L. Faron, P. Weigand

3 credits, repetitive

ANT 509 Seminar in European Ethnography

Seminar investigation and discussion of selected topics and problems concerning European societies and cultures. The perspective of culture history is employed as well as that of current fieldwork.

Instructor: Staff

3 credits, repetitive

ANT 511 Problems in Old World Prehistory

This course will present an in-depth analysis of some of the major problems which face archaeologists in the Old World. Emphasis will be on the various theoretical models currently in use to explain these events by archaeologists. Topics might include the food-producing revolution in the Near East and Southeast Asia; the elaboration of the Neolithic way of life that led to the development of civilization; the nature of civilization in the Near East; the Indus Valley, etc., or a discussion of the non-civilized Bronze Age cultures of Europe, Africa and Asia. The specific topics may vary from year to year.

Instructor: E.C. Stone

3 credits

ANT 512 Patterns of Empire

A comparative analysis of the social institutions of the early empires will be offered. The evolution of militarism, secular bureaucracies, long distance trade, land use and tenure, and other topics will be examined.

Instructor: P. Weigand

3 credits

ANT 520 Readings in Topical Problems

Topics will be selected on the basis of the needs of the graduate program. Seminars may consider such topics as: social systems and their models, kinship and marriage, family structure, ecology and economy, political systems, ritual, religious belief, myth, symbols.

Instructor: P. Glick and Staff

3 credits, repetitive

ANT 525 Method in Ethnography and Social Anthropology

An examination of the methods used by ethnographers and social anthropologists in observation, data collection and analysis. Ethnography is discussed as field inquiry and the organization of data for a monograph. Different interests, aims and results will be studied as they characterize ethnographers and social

anthropologists. Contemporary studies of social relations will be stressed.

Instructor: P. Glick

3 credits, repetitive

ANT 526 Anthropological Geography: Theory and Applications

Field geographical techniques and skills necessary for anthropologists will be examined from the point of view of ecological evaluations in the progressive formation of cultural landscapes. Settlement pattern analysis (zonal and community), cartographic techniques, aerial-photographic analysis, soil typing, determinants for plant and animal communities, and succession principles will be presented in terms of their geomorphological articulations with cultural ecology.

Instructor: P. Weigand

3 credits

ANT 528 Kinship and Social Organization

The significance of kinship systems and their relationship to other social institutions (e.g., political, economic, religious) in selected societies will be examined through the use of ethnographies and theoretical statements by important contributors to the field.

Instructor: W. Arens

3 credits

ANT 529 Ecology and Social Organization

The relation between societies and their environment: evaluation of resources, technology, land tenure, subsistence, local groups, economy, kin and political relations will be examined. Examples will include food collecting, hunting, agricultural, pastoral and mixed economies.

Instructor: P. Glick

3 credits, repetitive

ANT 540 Readings in Ethnography and Ethnology

A survey of the more important and better documented cultures and societies of selected world ethnographic areas and the implications of data from these for current approaches and problems in ethnology.

Instructors: W. Arens and Staff

3 credits, repetitive

ANT 550 Readings in Cultural History

Applications of the ecological and sociological approaches to the study of evolutionary process and culture history.

Instructors: E. Lanning and Staff

3 credits, repetitive

ANT 551 Economic Anthropology

Economic life of primitive peoples and precapitalistic civilization with emphasis on the integration of the economy with technology and with social and political institutions.

Instructor: P. Carrasco

3 credits

ANT 553 Political Anthropology

Political Anthropology deals with selected readings of major trends of anthropo-

logical political theory, including study of factions, leadership, volunteer associations, patron-client ties, and class conflict. A selected number of monographs will be analyzed in detail, and their relation to diverse political models will be explored.

Instructor: J. Starr

3 credits

ANT 554 Readings in Law and Anthropology

Selected readings in anthropological approaches to the study of legal behavior, including the study of dispute settlement and use of law courts, aggressive behavior in the local community, the treatment of deviates, social misfits and aggressive people. Focus will be in interrelations between community members, and between the local-level community and the nation-state. Anthropological studies of law courts will also be utilized.

Instructor: J. Starr

3 credits

ANT 558 Symbolism

This course deals with the analysis of the variant forms by which symbolism reveals itself, considers such oral literature, ritual, architecture, jural classification and cosmologies of a range of cultures, especially those characteristic of illiterate and ancient peoples. Different techniques of interpretation will be employed — structural, functional, historical, and psychological — so as to give a well-balanced account of symbolism.

Instructor: D. Hicks

3 credits

ANT 557 Seminar in Comparative Religion

Various theoretical and methodological problems in the cross-cultural study of ritual and belief will be examined. Students will be encouraged to review critically a broad spectrum of ethnographic materials in the study of these problems. Emphasis will be on religious systems not generally covered in the nonanthropological literature of religion.

Instructor: R. Jones

3 credits

ANT 560 Readings in Descriptive Linguistics

The findings of linguistic science in terms of their application to field anthropology.

Instructor: N. Bonvillian

3 credits

ANT 561 Peasant Societies and Cultures

The concept of peasantry will be examined from political, religious and social class viewpoints as well as from the more traditional economic view. These agricultural peoples, who are essentially preliterate and preindustrial, are described and analyzed especially in relation to the national societies of which they form a part.

Instructor: L. Faron

3 credits

ANT 600 Practicum in Teaching

Instructor: Staff
Variable and repetitive credit

ANT 601, 602 Research Seminar in Anthropological Theory

Instructor: Staff
Variable and repetitive credit

ANT 604 Tutorial in Anthropological Theory

Instructor: Staff
Variable and repetitive credit

ANT 610 Individual Research

Instructor: Staff
Variable and repetitive credit

ANT 620 Research Seminar in Topical Problems

Instructor: Staff
Variable and repetitive credit

ANT 640 Research Seminar in Ethnography and Ethnology

Instructor: Staff
Variable and repetitive credit

ANT 650 Research Seminar in Cultural History

Instructor: Staff
Variable and repetitive credit

ANT 660 Language as an Analytical Tool

Instructor: Staff
Variable and repetitive credit

ANT 680 Special Seminar

Selected topics in Cultural and Social Anthropology. Topics covered will reflect current interests of faculty and graduate students.
3 credits

ANT 699 Research Seminar in Fieldwork Problems

Instructor: Staff
Variable and repetitive credit

Applied Mathematics and Statistics

MSA 501 Differential Equations and Boundary Value Problems I

Examples of initial and boundary value problems in which differential equations arise. Existence of solutions, systems of linear differential equations and the fundamental solution matrix. Reduction to canonical forms and the matrix exponential. Sturm-Liouville theory and eigenfunction expansion. Green's functions.

Prerequisite: MSA 505

Recommended prerequisite: MSA 504
3 credits

MSA 502 Differential Equations and Boundary Value Problems II

The initial and boundary value problems for the wave, the heat and Laplace's equations illustrated by a number of examples in heat conduction, vibrations, aerodynamics. Transform techniques, separation of variables, conformal mapping and approximation.

Prerequisite: MSA 501

3 credits

MSA 503 Applications of Complex Analysis

A study of those concepts and techniques in complex function theory which are of interest for their applications. Pertinent material is selected from the following topics: harmonic functions, calculus of residues, conformal mapping, and the argument principle. Application is made to problems in heat conduction, potential theory, fluid dynamics, and feedback systems.

3 credits

MSA 504 Foundations of Applied Mathematics

An introductory course for the purpose of developing certain concepts and techniques which are fundamental in modern approaches to the solution of applied problems. An appropriate selection of topics is based on the concepts of metric spaces, convergence, continuity, compactness, normed and Hilbert spaces. Included is an introduction to measure and integration.

Fall, 3 credits

MSA 505 Applied Algebra I

Review of matrix operations. Elementary matrices and reduction of general matrices by elementary operations, canonical forms and inverses. Applications to physical problems.

Fall, 3 credits

MSA 506 Finite Structures

Problem-solving in combinatorial analysis and graph theory, using generating functions, recurrence relations, Polya's enumeration formula, graph coloring and network flows.

3 credits

MSA 511 Methods in Applied Mathematics for Engineers and Scientists

This course is concerned with basic mathematical questions related to solutions frequently encountered in engineering and scientific problems. Topics include series, sequences, convergence; integral formulas and relationships (Gauss, Stokes, Green's theorems); implicit function theorems.

3 credits



MSA 514 Applied Algebra II

This course develops and then applies those concepts and techniques of modern algebra which have been found useful in various computer-oriented disciplines such as automata theory. Included are selected topics from the following areas: general theory of algebraic systems, lattice theory, semi-groups, groups and ring theory.

Prerequisite: MSA 505
3 credits

MSA 516 Special Functions of Applied Mathematics

A study of the more common higher mathematical functions which are required for the analytical solution of engineering and scientific problems. Topics include: orthogonal sets of functions, recursion formulas, series solution of linear differential equations, Fourier-Bessel expansions, functional equations, application to boundary value and initial value problems.

3 credits

MSA 517 Ordinary Differential Equations

This course deals with theory and properties of ordinary differential equations which are of importance in the application of this subject. Among the topics covered are solutions of singular equations; boundary value problems; the Green's function method and eigenvalue problems.

3 credits

MSA 518, 519 Workshop in Finite Mathematical Structures for Teachers, I, II

An introduction to the principles of combinatorial and graph theoretic reasoning especially designed for high school teachers by the utilization of visual aids, games, puzzles and other illustrative models, coupled with a workshop in which these principles are applied to the solution of a broad range of applied problems. The course is developed with reference to the projected New York State high school curriculum requirement in finite mathematics.

Prerequisite: Permission of the instructor
2 credits each semester

MSA 520 Mathematical Modelling in the Analysis of Public Systems

Review of models relating to the questions of the improvement in delivery of urban service systems (e.g. fire, police, health, sanitation, transit). Topics include optimal location and districting of public facilities, distribution networks, models of congestion and delay in municipal services, optimal deployment of emergency vehicles.

3 credits

MSA 521 Mathematical Models in Physiological Sciences

Mathematical models of blood flow and renal function. Numerical solution of the counter current exchange models by utilizing information about the physiological structures in the solution

process. Use of compartmental analysis, sparse matrix techniques and generalized inverses.

3 credits

MSA 524 Theory of Approximation

A survey of various solutions which present special problems in approximation theory. Topics covered include: smoothing of data, least squares methods, Chebyshev approximations, approximation by rational functions, orthogonal functions. Hilbert space methods, general aspects of approximation in normed linear spaces.

3 credits

MSA 526 Numerical Analysis I

Direct and indirect methods for solving simultaneous linear equations and matrix inversion, conditioning and round-off errors. Computation of eigenvalues and eigenvectors.

3 credits

MSA 527 Numerical Analysis II

Numerical integration. Solution of ordinary differential equations. Different methods for partial differential equations; consistency convergence and stability. Numerical solution of integral equations. (MSA 527 may be taken whether or not the student has completed MSA 526.)

3 credits

MSA 530 Linear Programming

Formulation of linear programming problems and solution by simplex method. Duality, sensitivity analysis, dual simplex algorithm, decomposition. Applications to the transportation problem, two-person games, assignment problem, and introduction to integer and non-linear programming.

Corequisite: Linear algebra course
Fall, 3 credits

MSA 531 Generalized Inverses and Sparse Matrices

Moore-Penrose, various other types of generalized inverses; efficient methods for their computation. Condition numbers and scaling. Factored forms of inverses of large sparse matrices and their relationship to elimination and orthogonalization methods. Sparse matrices and graph theory. Applications to applied problems in linear programming.

3 credits

MSA 532 Mathematical Demography

A one-semester introduction to human demography. Topics will include survival and childbearing probabilities, discrete and continuous models for the birth renewal process, marriage models, migration, occupational mobility, kinship and the problems of inferring birth and death rates from census data.

Fall, 3 credits

MSA 533 Integer Programming

Discrete optimization. Linear programming in which the variables are restricted to be integer-valued. Cutting

plane methods, enumeration methods and group theoretic methods. Special treatment of knapsack problem, travelling salesman problem and cutting stock problems.

Prerequisite: MSA 530

Fall, odd-numbered years, 3 credits

MSA 534 Non-Linear Programming

Necessary and sufficient conditions for unconstrained and constrained optima. The geometric background is developed using tangents and cones in finite dimensional spaces. Computational methods, including interior (penalty function), boundary (gradient projection), and exterior (cutting plane) approaches.

Prerequisites: MSA 530 or permission of instructor
Spring, 3 credits

MSA 535 Stochastic Processes

Review of probability theory. Poisson processes. Renewal theory. Markov processes. Applications to queues, statistics and other problems of engineering and social sciences.

Prerequisite: MSA 569 or equivalent
Spring, 3 credits

MSA 536 Queueing Theory

Introduction to the mathematical aspects of congestion. Birth and death processes. Queues with service priorities and bulk service queues. Analysis of transient and steady state behavior. Estimation of parameters. Applications to engineering, economic and other systems.

Prerequisite: MSA 569

Fall, even-numbered years, 3 credits

MSA 537 Inventory Theory

Nature of inventory systems. Design and control. Continuous and periodic review policies. Economic order quantities and the optimality of (R, S) policies.

Prerequisite: MSA 569

Fall, odd-numbered years, 3 credits

MSA 538 Operations Research II: Stochastic Models

Queueing problems under varying assumptions on input, service mechanism and queue discipline. Basic ideas of inventory theory. Introduction to statistical decision theory. Monte Carlo methods.

Prerequisite: MSA 569 or equivalent

3 credits

MSA 539 Network Flows

Theory of flows in capacity constrained networks. Topics include: maximum flow, feasibility criteria, scheduling problems, matching and covering problems, minimum length paths, minimum cost flows and associated combinatorial problems.

Prerequisite: MSA 530 or permission of instructor

Spring, even-numbered years, 3 credits

MSA 540 Modelling Laboratory

Students undertake practical operations research problems. Lectures on case studies of recent systems analysis

projects by faculty and local industrial/governmental groups. Students must present a lecture on their project.
Prerequisite: Permission of the instructor
Spring, 3 credits

MSA 542 Mathematical Theory of Nuclear Reactors

Nuclear reactors as an energy source. Topics to be treated are: introduction to multiplying systems with nuclear reactors as prime examples; transport equations, properties and solutions techniques; problems in moderation theory; the age equation; stochastic and Monte Carlo approaches; problems in homogeneous and heterogeneous reactors; group diffusion equations.
Prerequisites: MSA 251, MSA 551 or MSA 569 or equivalent and MSA 217 or MSA 220 or MSA 517
3 credits

MSA 543 Actuarial Science I: The Theory of Interest

This course will cover the material required for Part 3(b) of the examinations for the Society of Actuaries, basic concepts of interest theory. The different types of annuities, amortization schedules and sinking funds. Bonds; yields and coupon rate; common and preferred stocks.
3 credits

MSA 544 Actuarial Sciences II: Life Contingencies

This course covers the material required for part 4 of the Actuarial Exams. The mortality tables, endowments and insurance. Premiums and premium reserves. Allowance for expenses. Generalizations to multi-life situations. Introduction to populations theory. Solution of sample problems for each topic.
Prerequisite: Actuarial Science I or equivalent
3 credits

MSA 545 Graph Theory and Applications

Basic structure of undirected and directed vector space analysis of graphs, applications.
3 credits

MSA 547 Statistical Methods for Environmental Engineering

A one semester survey course in statistical methods. Applications will be to water and air quality programs. Topics: basic concept of sampling and data analysis, and of linear modelling procedures. The techniques of analysis of variance and linear regression will also be discussed.
Fall, 3 credits

MSA 548 Models for Water Resource Management

Introduction to cost benefit analysis and linear and integer programming techniques. Optimal siting applied to water supply and treatment. Multidimensional regional optimization.
Spring, 3 credits

MSA 549 Models for Water Resources Management II

Advanced topics in water resource management modelling. Linear, nonlinear and dynamic programming. Search techniques for optimization. Simulation. Multidimensional regional optimization. Course requirements will include reading professional journals and the preparation of a water resource system model.
Prerequisites: Calculus, familiarity with programming (preferably FORTRAN), EMP 510 or MSA 548 or their equivalents
3 credits

MSA 550 Algebraic Coding Theory

Utilizing concepts and results from modern algebra and number theory which are developed in the course, a study is made of those error-correcting codes whose basic structure is algebraic. Among the classes of codes considered are those designed, respectively, as: linear, cyclic, BCH, perfect, and residue.
Prerequisite: Permission of the instructor
3 credits

MSA 553 Control Theory

Introduction to optimal control via the calculus of variations. Discussions of functional minimization from optimal control viewpoint. Introduction of state variable form for linear differential equations used to solve linear, quadratic cost, optimal control problem and time minimum control for some simple systems. Derivation of matrix Riccati equation. Presentation of linearization on nonlinear differential equations using perturbation techniques.
Prerequisite: MSA 501
3 credits

MSA 557, 558 Elasticity I and II

This course is identical with ESC 541, 542.
3 credits

MSA 563 Computational Fluid Dynamics

Finite difference methods and relaxation methods for solving the incompressible flow equations. Methods of characteristics, finite difference methods using explicit artificial viscosities and implicit artificial damping for solving the compressible flow equations. Numerical treatment of shocks. Various hydrodynamic codes.
Prerequisite: Permission of instructor
3 credits

MSA 565 Wave Propagation I

Theory of propagation of vector and scalar waves in bounded and unbounded regions. Equivalence theorems of field theory. Development of methods of geometrical optics. Propagation in inhomogeneous and in anisotropic media. Green's function for boundary-value problems.
3 credits

MSA 569 Introduction to Applied Probability

Sample spaces; conditional probability and independence, random variables and functions of random variables; binomial,

Poisson, normal, and other special distributions; moment-generating functions; law of large numbers and central limit theorem; Markov chains. Applications to statistics.
3 credits

MSA 570 Mathematical Statistics I: Estimation

Sampling distribution of means and variances; introduction to moment calculations and order statistics. Theory of maximum likelihood estimates, Pitman estimates and sufficient statistics. Parametric confidence intervals and fiducial intervals. Cramer-Rao bounds, Fisher's Information Matrix, other bounds on variance of estimators.
Prerequisite: MSA 569 or equivalent
3 credits

MSA 571 Mathematical Statistics II: Hypothesis Testing

Decision problems, Neyman-Pearson lemma, likelihood ratio tests, uniformly most powerful tests, unbiased tests, invariant tests, sequential tests, non-parametric tests. Introduction to tests on contingency tables and multivariate data. Bayesian approaches and introduction to current research problems.
Prerequisite: MSA 569 or equivalent
3 credits

MSA 572, 573 Exploratory Data Analysis I, II

Introduction to exploratory techniques: stem and leaf plots, location and scale estimates, common transformations, regression, analysis of residuals. Two-way analysis. Exploratory analysis of more complex tables. Advanced techniques including smoothers.
3 credits

MSA 575 Data Analysis Laboratory

Directed quantitative research problem in conjunction with currently existing research programs outside the department. Students specializing in a particular area will work on a problem from that area; others will work on problems related to their interests, if possible. Efficient and effective use of computers. Each student will give at least one informal lecture to his colleagues on the research problem and its statistical aspects.
Prerequisite: Permission of the instructor
3 credits

MSA 576 Statistical Methods for Social Scientists

This course is an introduction to statistical thinking in the social sciences. The course will cover statistical variability, standard scores, regression, correlation, sampling notions, estimation, confidence intervals, significance testing, conditional probability, and Bayesian manipulations.
Prerequisite: Good standing in a social science department or permission of instructor
3 credits

MSA 578 Regression Theory

Classical least squares theory for regression including the Gauss-Markov theorem and classical normal statistical theory. An introduction to stepwise regression, procedures and exploratory data analysis techniques. Analysis of Variance problems as a subject of regression. Brief discussions of robustness of estimation and robustness of design.
3 credits

MSA 581 Analysis of Variance

Analysis of models with fixed effects. The Gauss-Markov theorem; construction of confidence ellipsoids and tests with Gaussian observations. Problems of multiple tests of hypotheses. One way, two way, and higher way layouts. Analysis of incomplete designs such as Latin squares, incomplete blocks, and nested designs. Analysis of covariance problems. Prerequisite: MSA 569, 570 or 572 or permission of instructor
3 credits

MSA 582 Design of Experiments

Discussion of the accuracy of experiments, partitioning sums of squares, randomized designs, factorial experiments, Latin squares, confounding and fractional replication, response surface experiments and incomplete block designs. Prerequisite: MSA 569 or equivalent
3 credits

MSA 584 Sequential Methods

Sequential decision problems in statistics. The two-armed bandit, selection by relative rank, and other examples. Optimal stopping and sequential analysis. Empirical Bayes and compound decision problems. Fixed-width confidence intervals, confidence sequences, and tests of power one. Adaptive least squares and stochastic approximation. Prerequisite: MSA 570
3 credits

MSA 585 Sampling Techniques

Properties of simple random sampling, application to estimating proportions and sample sizes which give predetermined accuracy. Stratified random samples; Neyman allocation. Ratio and regression estimates, accuracy and bias, systematic sampling, cluster sampling, two stage sampling. Prerequisite: MSA 570
Fall, 3 credits

MSA 586 Time Series

Analysis in the frequency domain. Periodograms, approximate tests, relation to regression theory. Prewhitening and digital filters. Common data windows. Fast fourier transforms. Complex demodulation, Gibbs phenomenon issues. Times domain analysis. Prerequisites: MSA 569 and MSA 570
3 credits

MSA 587 Non-parametric Statistics

This course will cover the applied non-

parametric statistical procedures — one sample Wilcoxon test, two-sample Wilcoxon test, runs test, Kruskal-Wallis test, Kendall's tau, Spearman's rho, Hodges-Lehman estimation, Friedman analysis of variance on ranks. The course will give the theoretical underpinnings to those procedures, showing how existing techniques may be extended and new techniques developed. An excursion into the new problems of multivariate non-parametric inference will be made. Prerequisites: MSA 252, MSA 312 or equivalent
Fall, 3 credits

MSA 588 Biostatistics

Statistical techniques for planning and analyzing medical studies. Planning and conducting clinical trials and retrospective and prospective epidemiological studies. Analysis of survival times including singly-censored and doubly-censored data. Quantitative and quantal bioassay, two-stage assays, routine bioassay. Quality control for medical studies. Prerequisite: MSA 570 or permission of instructor
Fall, 3 credits

MSA 599 Research

Variable and repetitive credit

MSA 604, 605 Probability Theory I, II

Mathematical foundations of probability, distribution functions and characteristic functions, limit theorems, random walks, conditional expectation, Markov property, Brownian motions, Poisson process, infinitely divisible processes, martingales, stochastic integral and stochastic differential equations. Prerequisite: MSA 504 or MSM 512
3 credits

MSA 611 Theory of Partial Differential Equations and Their Applications

Theorem of Cauchy and Kowalesky; classification of partial differential equations in general; characteristics; potential theory and elliptic equations; hyperbolic equations and propagation of discontinuities, parabolic equations, various methods of solving partial differential equations; applications to problems in electromagnetics, solid mechanics, plasma physics. Prerequisite: MSA 502
3 credits

MSA 615 Nonlinear Differential Equations

Existence, uniqueness and continuity theorems. Approximate solutions by method of iteration. Study of autonomous systems. Phase plane analysis, periodic solutions. Singular points, cycles, limit cycles. Theory of bifurcation. Stability theory, Liapunov functions. Analytical and geometrical investigations of second-order equations such as van der Pol's and Lienard's equations. Prerequisite: MSA 501
3 credits

MSA 620 Theory and Applications of Large Scale Networks

A rigorous treatment of mathematical techniques used to answer many practical questions arising in the study and design of large scale networks. Emphasis on the development of algorithms. Several lectures devoted to specific applications to computer networks to be used throughout the course. Prerequisite: MSA 537 or equivalent
3 credits

MSA 621 Numerical Solutions of Partial Differential Equations

Variational form of the problem, Ritz Galerkins, collocation and mixed methods; triangular, rectangular (2-D) and tetrahedral element (3-D); accuracy, convergence, stability, solutions of linear, nonlinear steady state and dynamic problems; implicit, explicit time integration; equivalence of finite element and finite difference methods. Prerequisite: MSA 502 or equivalent
3 credits

MSA 627 Theory of Integral Equations and Their Applications

Integral equations with degenerate kernels, equations of the second kind, iterative solutions, contraction mapping principle, Fredholm theory, spectral theory for symmetric kernels. Volterra equations of the first and second kind, equations with weakly singular kernels, simultaneous systems, applications. Prerequisites: MSA 504 and MSA 505
3 credits

MSA 628 Applications of Functional Analysis

Introduction to such topics as unbounded operators and the closed graph theorem, convexity and weak convergence in Hilbert space and degree theory. Applications to monotone operators and the stability of nonlinear systems, Schwartz distributions and passive linear systems, and to the solution of nonlinear equations.
3 credits

MSA 635, 636 Realizability Theory I and II

Banach-space-valued distributions. The postulational foundations of linear system theory. Time-varying Banach systems, the kernel theorem and composition. Causality and realizability. Time-invariant Banach systems and convolution. Hilbert ports and passivity. The admittance and scattering formalisms. Representation theorems. Synthesis of Hilbert ports. Corequisite: MSA 628 or MSM 554, MSM 555
3 credits

MSA 651 Nonlinear Analysis and Optimization

Iterative methods for solving nonlinear operator equations. Frechet differentials. The Newton-Raphson method in function space and nonlinear boundary value problems. The Courant penalty concept and constrained optimization. General

multiplier rules. Variable metric gradient techniques and gradient projection for nonlinear least square methods, with applications.
3 credits

MSA 691 Topics in Applied Mathematics
Varying topics, selected from the list below if sufficient interest is shown. Several topics may be taught concurrently

in different sections.
3 credits
Stochastic Modelling
Control Theory and Optimization
Mixed Boundary Value Problems in Elasticity
Advanced Operational Methods in Applied Mathematics
Applied Mathematics
Approximate Methods in the Boundary

Value Problems in Applied Mathematics
Foundations of Passive Systems Theory
Partial Differential Equations

MSA 698 Practicum in Teaching
3 credits, repetitive

MSA 699 Dissertation Research
Variable and repetitive credit

Applied Sciences

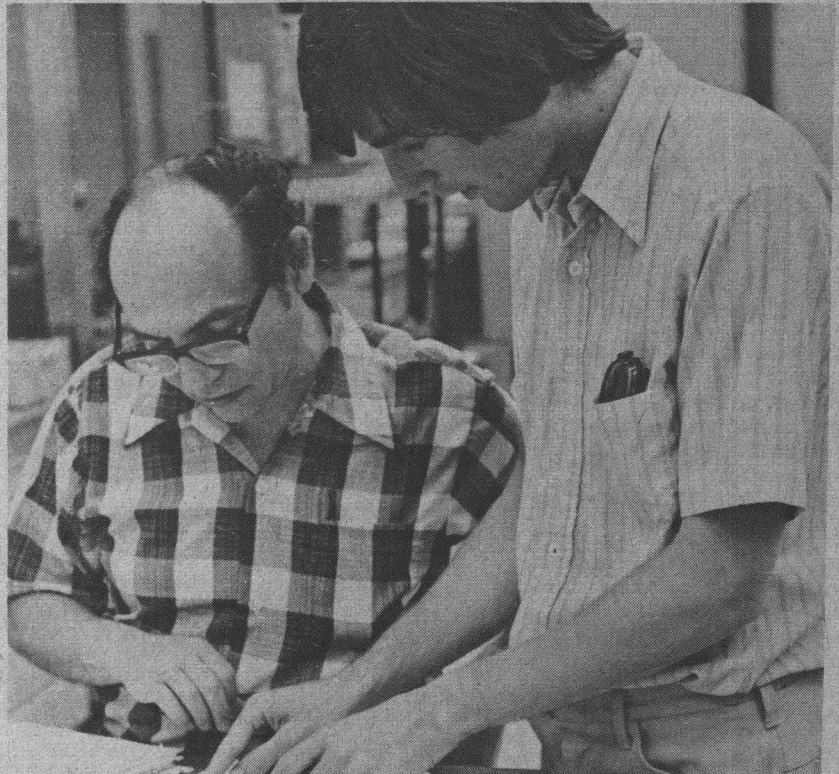
Courses CEN 580, 581, 582, 586 and ESE 583, 584 and 585 are for the M.S. program in Applied Science

CEN 580 Socio-Technological Problems
A series of case studies of current sociotechnological problems encompassing such areas as health service delivery, emergency medical care, auto safety and suburban transportation, and the energy crisis. In each case, the problem dictates the quantitative models from which the alternatives are developed with the corresponding technological, economic, and social constraints.
3 credits

CEN 581 Decision-Making in Technology-People-Environment Problems
Application of basic elements of decision-making (criteria constraints, models, and optimization techniques) to the analysis of potential solution to problems which involve technology and its impact on people and the environment. Areas of study include: technology for forecasting and assessment methods, cost/benefit analysis, resource management, and the matching of technological systems to societal needs.
3 credits

CEN 582 Systems Approach to Technology-People-Environment Problems
Application of system concepts (input-output, feed-back, stability, information analysis) to the analysis of dynamic systems involving technology and society. Areas of study include: automatic compensation of systems through the use of feedback; stability and instability of urban systems, transportation epidemics, and economics; machines and systems for men, including communication and prosthetics.
3 credits

ESE/CEN 583 Computer Literacy
A course to provide a basic understanding of digital computers, their applications, and the benefits from the threats to society from their use. Emphasis will be placed on applications in education, medicine and government. Actual experience with the computer will include introduction to programming, algorithmic problem formulation, and running



existing programs. (Credit will not be given toward other graduate degrees offered in the department.)
3 credits

ESE/CEN 584 Project Seminar in Applied Science
A forum for discussion of research methods and project ideas in Applied Science Education for Graduate Students. Seminar topics include development and implementation of new interdisciplinary applied science curricula for secondary schools and community colleges; design and evaluation of educational technology systems. Students will be required to propose and execute a pilot version of a Master's project. (Credit will not be given toward other graduate degrees offered in the department.)
Prerequisite: CEN 581
3 credits

ESE/CEN 585 Independent Study in Applied Science Education
The primary objective of independent

study is to provide a student with opportunities to interact with faculty members who can be of assistance in his master's project. Students should contract individually with faculty members on work load and credit(s). (Credit will not be given toward other graduate degrees offered in the department.)
Prerequisite: CEN 582
Up to 3 credits

CEN 586 Automation and Feedback in Technology Society Systems
Consists of an examination (through lectures, discussion and laboratory work) of the principles involved in feedback, how feedback is involved in automation and in communications, manufacturing, service industries, and societal systems. The course is presented through lectures, discussion, demonstration and group activities.
Prerequisite: CEN 580 or permission of instructor
3 credits

Biochemistry

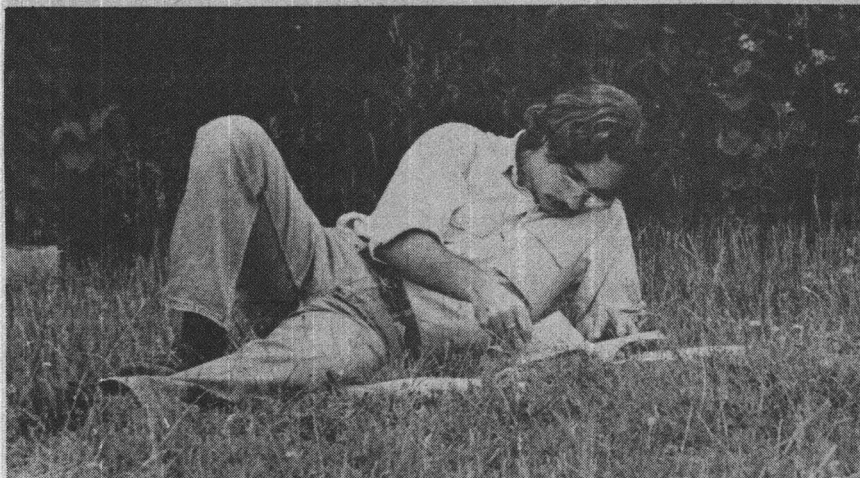
HBC 531 Principles of Biochemistry

An introductory course illustrating the principles of biochemistry in animal systems. The following topics will be emphasized: intermediary metabolism including the generation of metabolic energy and the biosynthesis of macromolecular precursors; the relationship between structure and function of proteins; the structure and biological activity of nucleic acids; and the biosynthesis of proteins.

Prerequisite: Organic chemistry or permission of instructor

Instructors: Drs. Schmidt, Freundlich, Dudock

Fall, 4 credits



Biology

BIO 561 Human Genetics

This course assumes a knowledge of the fundamentals of general genetics. It focuses upon the study of genes in human kindreds and populations, giving attention to human cytogenetics and to the importance of genetic factors in human development, disease, society and evolution.

Fall, 3 credits

BIO 571 Biology and Ethics

A consideration of ethical problems growing out of recent developments in molecular biology, genetics, reproductive physiology, pharmacology, and psychology, as well as other branches of the biological sciences. Topics to be considered include the ethical animal; evolutionary basis and the naturalistic fallacy; levels of organization and conflicting values; the ethics of the gene pool; senescence and the prolongation of life; death-necessity and dignity; and reproduction.

Instructor: Ms. Mallon

Spring, 3 credits

BIO 563 Laboratory in Research Techniques

Experimentation with teaching methods, including demonstration and analysis of biological processes in a high school laboratory. Emphasis will be placed on techniques for utilizing living organisms, making quantitative observations, and analyzing group data. Includes component involving ideas, procedures and practice in conducting research as an extension of the local instructional program.

Instructor: Prof. Laser

Fall, 3 credits



BIO 593-598 Special Seminars

Topics to be arranged.

Instructor: Ms. Mallon

Fall, spring, summer, variable and repetitive credit

independent laboratory, field or theoretical research project.

Fall, spring, summer, credit to be arranged

BIO 599 Research

Under the supervision of a member of the graduate staff, the student does an

Note: Additional courses are available from the offerings of other graduate programs.

Cellular and Developmental Biology

BCD 500 Directed Readings in Genetics and Developmental Biology

Directed readings in topics of current interest, under supervision of a faculty sponsor culminating in one or more critical review papers.

Prerequisite: Sponsor and approval of Masters Programs Executive Committee

Instructor: Staff
Yearly, 1-3 credits, repetitive

BCD 510 Seminar in Human Genetics and Cytogenetics

A survey of current literature from periodicals with discussion; each student will also prepare a review of a major disorder or new technique using the *index medicus* for recent references.

Prerequisite: BIO 220 or equivalent

Instructor: Elof Carlson
Spring, 3 credits

BCD 512 Contractile and Cytoskeletal Mechanisms in Developing Systems

The molecular characteristics of the three major microfilament systems of cells; evidence concerning the involvement of actins and myosins in the contractile programs of non-muscle cells; a survey of the role of cell movements and shape changes in developing animal eggs and embryos.

Prerequisites: Biochemistry and Cell Biology courses

Instructor: Robert W. Merriam
Fall, 2 credits

BCD 527 Photoperiodic Control of Plant and Animal Development

Examination of seasonally correlated developmental processes that are modulated and controlled by light, the physiological and biochemical pathways whereby the control is mediated, and the nature of the biological timing mechanism involved. Topics will include flowering and phytochrome system; insect development; annual reproductive cycles in birds and mammals; the Bunning hypothesis; and circannual rhythms.

Instructor: Edmunds
Fall, alternate years, 3 credits

BCD 529 Organelle Development

This course is concerned primarily with the development of the mitochondrion and the chloroplast. Subjects will include the biogenesis of these organelles and their relation to and interaction with the nucleus. Emphasis will be on genetical and biochemical analysis.

Instructor: Lyman
Fall, alternate years, 3 credits

BCD 530 Projects in Developmental Biology

Individual laboratory projects, closely supervised by staff members, to be carried

out in staff research laboratories on a rotation basis.

Fall and spring, 2 credits

BCD 531, 532 Graduate Seminar in Developmental Biology

Seminars are given by graduate students on current literature in the field of developmental biology.

Fall and spring, 1 credit

BCD 535 Physiology and Development of Higher Plants

Survey of selected topics in plant physiology with emphasis on developmental aspects. Areas from which specific problems will be selected include photomorphogenesis, hormonal control of plant growth, and plant tissue culture.

Fall, 2 credits

BCD 537 Physiology and Biochemistry of the Cell Cycle

An integrated view of the cell developmental cycle in prokaryotes and eukaryotes. Topics considered will include cell cycle anatomy; cell population dynamics; general patterns of nucleic acid synthesis; regulation of enzyme activity during the cell cycle; temporal control of gene expression; development and function of cellular organelles during the cell cycle; and the control of cell division.

Instructor: Edmunds
Fall, alternate years, 3 credits

BCD 560 Microbial Ecology

A course intended to cover the basic aspects of the interaction of microorganisms with their environments, and the various environmental variables which influence their growth. Methods of field and laboratory study of the ecology of microorganisms will be discussed. Examples will be taken from the algae, fungi, slime molds, bacteria, protozoa, and bryophytes. There will be an initial series of lectures followed by student presentations and discussions using material from the literature. Hours to be arranged. Open to qualified undergraduates by permission of the instructor.

Prerequisites: Inorganic and organic chemistry, general zoology, general botany

Instructor: E.H. Battley

Spring, 2 credits

BCD 599 Research

Original investigation under the supervision of a member of the staff.

Fall and spring, credit to be arranged

BCD 621, 622 Developmental Biology Seminar

A weekly series of seminars by members of the staff, postdoctoral students, advanced graduate students, and visiting scientists



on current research in developmental biology.

Fall and spring, 1 credit

BCD 656 Comparative Cell and Tissue Biology

Introduction to the structural organization of cells and tissues and to the way structure relates to function. Particular emphasis placed on cell organelle structure and function in specialized cells in tissues. The organization and interaction of cells in tissues will also be covered. The course will be comparative and will include examples of tissues from vertebrates and invertebrates.

(Crosslisted with HBA 656)

Spring, 4 credits

BCD 657 Principles of Development

This course will deal with developing systems at all levels from the morphological to the molecular. Illustrative material from both animal and plant kingdoms will be used. Special attention will be given to gametogenesis, genetic control of early development, translational control of protein synthesis,

the role of cell division; and cell movements, and cell-cell interactions in defining developing systems.

Prerequisite: BCD 656
(Crosslisted with HBA 657)
Fall, 3 credits

BCD 661 Insect Development

This course covers selected aspects of insect development, with emphasis on

common principles rather than on variability and exceptions. Topics include: gametogenesis and fertilization; sex determination; morphogenesis; regeneration; homeostasis; hormonal control.

Prerequisites: Introductory courses in Animal Development, Cell Biology and Genetics

Instructor: Siegwald Strub
Fall, 2 credits

BCD 681-684 Advanced Seminars

Topics to be arranged.

Fall and spring, variable and repetitive credit

BCD 699 Dissertation Research

Original investigations undertaken as part of the Ph.D. program under supervision of research committee.

Fall and spring, credit to be arranged

Chemistry

CHE 501 Structural Organic Chemistry

A discussion at an advanced level of the most important features in structural theory, such as steric hindrance and strain, conformation analysis, stereochemistry, aromaticity, applied molecular orbital theory, and the modern methods of structure determination.

Fall or spring, 3 credits

CHE 502 Mechanistic Organic Chemistry

A consideration of the most important means of dissecting the detailed pathways of organic reactions. The use of substituent and medium effects on reactions proceeding through heteropolar, free radical and isopolar transition states is discussed; some unstable intermediates and unusual molecules are included.

Fall or spring, 3 credits

CHE 503 Synthetic Organic Chemistry

A survey of the most important organic reactions from the viewpoint of synthetic utility, including many recent innovations in this field. The mechanisms of these reactions are discussed with the purpose of bringing out unifying features among them.

Fall or spring, 3 credits

CHE 511 Structural Inorganic Chemistry

Properties and reactions of inorganic compounds are considered from the viewpoint of molecular and electronic structure. Various models used to describe and/or predict molecular structures are considered. Valence bond, crystal field, and molecular orbital theory are applied to inorganic compounds. Relationships between molecular and electronic structure are discussed.

Fall, 3 credits

CHE 512 Physical Methods in Inorganic Chemistry

Information from modern physical methods concerning the molecular and electronic structures of inorganic compounds is surveyed. The relationship of this information to the chemical and other physical properties of these compounds is discussed.

Spring, 3 credits



CHE 513 Reaction Mechanisms in Inorganic Chemistry

Reactions of inorganic and organometallic compounds taken from throughout the periodic table are studied from a mechanistic viewpoint. Modern techniques used in the elucidation of mechanisms are surveyed, experimental results are evaluated, and theoretical interpretations are discussed in the context of thermodynamic and structural parameters.

Spring, 3 credits

CHE 521 Quantum Chemistry I

Quantum theoretical concepts are discussed. Schrodinger wave mechanics and related mathematical techniques are illustrated by treatment of systems of chemical interest. Designed to form the theoretical basis for the study of chemical bonding, molecular structure, spectroscopy, and molecular collision phenomena.

Fall, 3 credits

CHE 522 Quantum Chemistry II

Martix representations of quantum mechanical operators. Problems in time dependent quantum mechanics with the derivation of both approximate and exact solutions. The elements of group theory with applications to atomic, molecular, and solid state systems.

Spring, 3 credits

CHE 523 Chemical Thermodynamics

A rigorous development of the fundamentals of thermodynamics and its application to a number of systems of interest to chemists. These systems include electrochemical cells, gases, homogeneous and heterogeneous equilibrium systems. An introduction to statistical mechanics will also be included.

Fall, 3 credits

CHE 524 Chemical Kinetics

An intensive study of rates of chemical reactions and in particular the relationship of kinetic studies to the determination of reaction mechanisms. Experimental methods will be discussed with emphasis on the determination of rate laws. The theoretical treatment will include discussions of the kinetic theory and the transition-state theory approaches to chemical kinetics.

3 credits

CHE 528 Statistical Mechanics

Theory of the canonical and grand ensembles of quantum mechanical systems. Study of the effect of intermolecular forces upon the thermodynamic functions of classical fluids via the theory of the configuration integral, the theory of molecular distribution functions, and the McMillan-Meyer solution theory. This includes a

study of some approximation methods such as cluster expansions and integral equations. An introduction to the theory of transport and relaxation coefficients of systems of interacting molecules.
3 credits

CHE 529 Nuclear Chemistry

Topics include the properties of radioactive substances and their use in the study of chemical problems; nuclear structure; nuclear reactions; radioactive decay and growth; interactions of radiation with matter; detection and measurement of radiation; application of radioactivity to chemical problems such as kinetics, structure and analysis; artificially produced elements.
Fall or spring, 3 credits

CHE 530 Physical Chemistry of Macromolecules

An investigation of the gross and fine structure of macromolecules in solution as revealed by hydrodynamic behavior (e.g., ultracentrifugation, viscosity), spectroscopic properties (e.g., ultraviolet hypochromism, circular dichromism, magnetic resonance spectra), and the thermodynamics of interaction with small molecules. Theory of conformation changes.
3 credits

CHE 531 Departmental Research Seminar

Meetings at which first-year graduate students learn about the research activities of the departmental faculty.
Fall, 1 credit

CHE 532 Literature Seminar

Students select and discuss topics from the current literature.
Spring, 1 credit

CHE 557/558 Methods and Techniques of Experimental Chemistry

Principles and practice of techniques currently used in the study of molecular properties and for the synthesis, isolation, purification, and identification of compounds. Students select experiments that are organized as modules in their area of interest.

CHE 589 Directed Study

Subject matter varies according to needs of student.
Variable and repetitive credit

CHE 590 M.S. Term Paper

Independent study leading to a term paper on a selected topic in chemistry, chemical applications, or chemical pedagogy.
Summer, fall, or spring, 3 credits

CHE 601 Special Topics in Synthetic Organic Chemistry

The subject matter varies depending on interests of students and staff. It may cover such areas as heterocyclic chemistry, organometallic chemistry and the chemistry of organic molecules containing second-row elements. The emphasis is on fundamental considerations and recent developments.
Variable and repetitive credit

CHE 602 Special Topics in Physical Organic Chemistry

The subject matter varies depending on interests of students and staff. It may cover such areas as photochemistry, theoretical organic chemistry and the chemistry of unstable intermediates; the emphasis is on fundamental considerations and recent developments.
Variable and repetitive credit

CHE 610 Practicum in Teaching

Practice instruction in chemistry at the undergraduate level, carried out under faculty orientation and supervision. A minimum of two semesters of CHE 610 is required of all candidates for graduate research degrees in chemistry, unless explicitly waived by the chairman.
Variable and repetitive credit

CHE 623 Molecular Spectroscopy

A detailed description of the theory and practice of molecular spectroscopy. Topics in the time evolution of molecular energy states encompassing both theory and recent developments in the experimental techniques also are presented.
2 credits

CHE 624 Magnetic Resonance

The theory of magnetic and electrostatic interactions among nuclei and electrons, and of the magnetic resonance methods used to investigate them. Applications of magnetic resonance spectroscopy to a number of topics, including rate processes, electronic structures, conformations, and motions of molecules.

structures and electronic properties of solids, and biological problems.
2 credits

CHE 625 Molecular Structure and Crystallography

Experimental methods in the determination of molecular structure. The relationship of structure to chemistry. The emphasis will be on the determination of structure in the solid state, particularly by X-ray crystallography.
2 credits

CHE 626 Computer-Controlled Experimentation in Chemistry

Basic concepts and practice in on-line data acquisition and display, interfacing techniques, feedback control as applied to chemical instrumentation. Students will design, simulate, and/or perform actual experiments with the computer.
3 credits

CHE 682 Special Topics in Inorganic Chemistry

Subject matter varies, depending on interests of students and staff, but will cover recent developments in inorganic chemistry.
Variable and repetitive credit

CHE 683 Special Topics in Physical Chemistry

Subject matter varies, depending on interests of students and staff, but will cover recent developments and advanced topics in physical chemistry.
Variable and repetitive credit

CHE 694 Chemical Biology Seminar

1 credit, repetitive

CHE 695 Inorganic Chemistry Seminar

1 credit, repetitive

CHE 696 Organic Chemistry Seminar

1 credit, repetitive

CHE 697 Physical Chemistry Seminar

1 credit, repetitive

CHE 698 Colloquium

Variable credit

CHE 699 Dissertation Research

Variable and repetitive credit

Coastal Oceanography

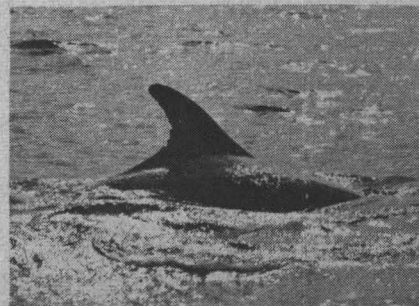
OCN 601 Planktonic Herbivory - An Experimental Approach

Course focuses on methods and hypotheses used to investigate zooplankton as herbivores in the coastal ocean. Review of literature and experience with experimental techniques. Participation in relevant research conducted by MSRC faculty.

Prerequisite: MAR 502
Spring, 3 credits

OCN 602 The Marine Nitrogen Cycle

Course focuses on nitrogen fixation, nitrification, denitrification, nitrogen uptake and excretion by marine organisms. Emphasis is on microbial activities. Techniques and recent



advances in the field are presented.

Prerequisite: MAR 502

Fall, 3 credits

OCN 603 Concepts and Practices in the Management of Shellfish Resources

Introductory review of general management concepts including emphasis on the hard clam fishery. Discussion of the possible role of aquaculture in shellfish management generally, with specific reference to the hard clam industry. Field trips to Great South Bay and hard clam aquaculture centers. Laboratory projects involving culture of hard clams from gametogenesis, spawning, early development and growth of larval clams, metamorphosis, and handling of 'seed' clams. Laboratory work emphasizes hard clam biology and the state of the art of aquaculture, and focuses on management implications. Guest presentations from industry and management agencies representatives.

Prerequisite: Consent of instructor

Spring, 3 credits

OCN 604 Diffusion in Aquatic Environment

Course focuses on environmental diffusion problems arising in the sea, lakes and rivers, such as dilution of pollutants. Main topics include classical turbulent diffusion theory, statistical theory of diffusion by random movements,

dispersion in shear flow, and concentration fluctuations in diffusion. Course concludes with a study of the effect of diffusion on the space-time behavior of non-conservative properties such as chemical reactants and planktonic organisms.

Prerequisite: Parital differential equations

Fall, 3 credits

OCN 605 Acoustic Techniques in Coastal Marine Geology

Theory and practice of seismic techniques and echo-sounding in examination of geological features and processes. Study of seismic reflection and refraction methods and records interpretation to describe subsurface structure. Use of acoustic devices to study sediment transport, including discussion of acoustic monitoring of suspended sediment and bathymetric surveying of bedforms. A field project is required.

Prerequisite: MAR 506

Fall, 3 credits

OCN 606 Design of Field Experiments

Series of seminars focusing on experimental design and planning and implementation of field observations in the coastal zone. Emphasis will be directed at geological, physical, biological and/or chemical oceanographic aspects, depending on student interest and demand.

Prerequisite: Completion of core courses

and permission of instructor
Spring, 3 credits

OCN 609 Estuarine Oceanography

Physical and chemical properties of estuarine waters, and the classification of estuaries by geomorphological and hydrographic parameters. Kinematics and dynamics of motion and mixing in estuaries.

Prerequisites: MAR 501 and MAR 504

Fall, 3 credits

OCN 610 Waves and Tides

Theory of surface and internal waves; wave generation and forecasting; tide theory; analysis and predictions of tides and tidal currents.

Prerequisites: MAR 501 and MAR 504

Spring, 3 credits

OCN 650 Dissertation Research

Original investigation undertaken with the supervision of research committee.

Fall and spring, variable and repetitive credit

OCN 651 Special Topics

Presentation of advanced courses, intensive short courses, and seminar series on subjects of special interest. Topics will vary from semester to semester.

Section I: Tutorial

Prerequisite: Permission of instructor

Fall and spring, variable and repetitive credit

Comparative Literature

CLT 500 Literary Theory I: From Antiquity to the 19th Century

An examination of the basic texts in criticism and critical theory from antiquity to the 19th century. Stress will be placed on prevailing philosophical and aesthetic issues, on cultural contexts, and on the basic concepts of the nature and function of literature.

Instructor: H. Gross

Fall, 3 credits

CLT 501 Literary Theory II: Modern Trends

This course will consider trends in the development of literary theory from the beginnings of the 19th century to the present.

Instructor: H. Gross

Spring, 3 credits

CLT 502 Problems in Translation

After suitable theoretical preparation, the student plans and carries out a translation of a literary text.

French language translation—

Instructor: K. Bieber

Fall, 3 credits, repetitive

German language translation—

Instructor: J. Russell

Spring, 3 credits, repetitive

CLT 504 Comparative Studies in Genre

Drama: Theory of Tragedy—

Instructor: H. Weisinger

Fall, 3 credits

Drama: Pre-modern drama from Ibsen to Chekov and from Kleist to Expressionism, including Brecht—

Instructor: J. Kott

Spring, 3 credits

CLT 508 Literature in Relation to Other Disciplines: Scandinavian Mythology

The course will cover Scandinavian pre-history and the mythology of the Viking Age through reading *The Prose Edda*, and selected Old Norse myths. Definitions of myth, kinds of myths, theories of the origin of religion, Scandinavian sources, and the history and present status of research will be considered, along with study of the influence of Old Norse myths on English writers. This course is cross-listed with GER 555.

Instructor: J. Sjoberg

Spring, 1980

CLT 597 Directed Readings for MA Students

Variable and repetitive credit



CLT 599 Independent Study

Variable and repetitive credit

CLT 601 Seminar in Literary Theory: Problems in Realism

Studies in George Lukac's later works: *Wider den miBverstandenen Realismus* and his *Aesthetik*, with reference to the

international development of Marxist literary sociology (Benjamin, Brecht, Caudwell). This course is cross-listed with GER 549 and will be conducted in German.

Instructor: K. Schroter
Fall, 3 credits

CLT 602 Interdisciplinary Seminar: Text, Context and Interpretation

A seminar on the most significant

interpretations of texts, dealing mostly with structuralist and post-structuralist methodology. Text here is understood in a large sense: the literary work as well as the versions of myth, dreams, even pictures.
Instructor: J. Kott
Spring, 3 credits

CLT 698 Practicum in Teaching
3 credits, repetitive

CLT 699 Directed Readings for Doctoral Candidates

Variable and repetitive credit

CLT 690 Dissertation Research

Variable and repetitive credit

Computer Sciences

MSC 502 Computer Architecture

Starts with functional components at the level of registers, busses, arithmetic, and memory chips, and then uses a register transfer language to manipulate these in the design of hardware systems up to the level of complete computers. Specific topics also included are micro-programmed control, I/O systems and device interfaces, control of memory hierarchies, and parallel processing organizations.

Prerequisites: MSC 102 and ESE 318
Fall, 4 credits

MSC 520 Techniques for Software Design

Topics relevant to software design and development especially those relating to commercial/industrial programming environment. To include system and module construction and decomposition methodologies (top down, bottom up, hierarchical), structured programming concepts, maintainability, reliability, program and system documentation (design spec's, implementation spec's, user manual), management of software ("Mythical Man Month," etc.), psychology of computer programming, and programmers.

Fall, 4 credits

MSC 521 Data Structures

Representation and organization of information as data inside and outside a computer. Basic concepts and formal descriptions of data structures. Implementation and storage management.

Fall, 4 credits

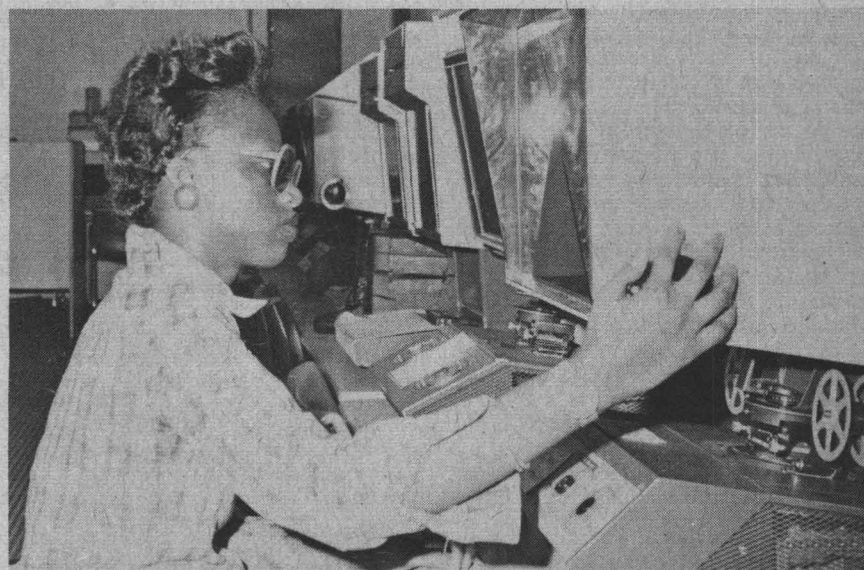
MSC 522 Compiler Design

Investigates contemporary methods of programming language implementation, including table-driven syntax analysis, run-time storage management, symbol table organizations, error recovery, code generation, compiler checkout and verification. Students will participate in a term project involving design of an actual compiler.

Spring, 4 credits

MSC 524 Laboratory in Computer Science

A significant programming problem or digital system design will be undertaken. Solutions are to include all aspects of large-scale problem-solving including



cost analysis, design, testing, and documentation. The course will extend over two semesters.

Fall semester, 2 credits
Spring semester, 3 credits

MSC 525 Operating Systems

Review of batch processing systems. Discussion of topics such as virtual memory, protection, interprocess communication and directory structures in the context of several modern operating systems. Sequential processes, asynchronous operation and modularization of systems.

Prerequisites: MSC 521 and MSC 522
Spring, 4 credits

MSC 526 Programming Language Design

Design and implementation of programming languages. Syntax and semantics. Data and control structures. Parallelism. Implementation problems of ALGOL 68. Other examples from LISP, SNOBOL, MACROGENERATOR, PL/1, CPL.L⁶. Machine dependence, interface problems, and portability considerations. Systems specification and implementation languages.

Corequisite: MSC 522
Spring, 3 credits

MSC 530 Simulation and Modeling

Statistical aspects of systems modeling. Syntax and usage of General Purpose

Systems Simulator (GPSS). Mathematical-analytic tools of systems modeling. Analog computer as a modeling guide. Construction of GPSS working models in engineering, biology and the social sciences. Simulation using the FORTRAN language in physics, chemistry and engineering.

Corequisite: MSC 521
Fall, 3 credits

MSC 532 Information Organization and Retrieval

The construction of natural language or textual data banks. String manipulation and text editing. Methods to input, edit and output textual information with a view to reorganization and presentation of texts and their derived data. Frequency dictionaries, concordances, combinatorial concordances, indices, permuted indices, and catalogs. List processing techniques on direct access devices and their use in information retrieval, selective dissemination of information, and real-time interrogation of data banks.

Prerequisite: MSC 521
Spring, 4 credits

MSC 540 Foundations of Computer Science

The student will be introduced to those topics in theoretical computer science necessary for successfully completing subsequent courses (MSC 522, MSC 525).

Elements of formal languages, computability, discrete mathematics, and verification will be covered.
Fall, 3 credits

MSC 541 Theoretical Foundations of Computing I

The mathematical and logical foundations of computing considered at an advanced level. General syntax of formal languages, formal logistic systems, proof theory. Decision procedures. Functional calculi of the first order. Axiomatization of elementary arithmetic within the first order functional calculus. Post canonical systems. The informal notion of an algorithm. Formal characterizations of the algorithmic functions. Introduction to recursive function theory, computability, and unsolvability.
Spring, 3 credits

MSC 542 Theoretical Foundations of Computing II

Recursive function theory and effective computability. The partial recursive functions. Church's thesis. The universal partial function, the halting problem for Turing machines, recursive unsolvability. Recursive invariance. The recursive theorem. Reducibility orderings and the structure of unsolvability degrees.
Fall, 3 credits

MSC 543 Automata Theory I

Finite-state machines and regular expressions, context-free languages and push-down automata. Turing machines and the halting problem, complexity of computation.
Prerequisite: MSA 514
Fall, 3 credits

MSC 544 Automata Theory II

This course will center around algebraic methods and their applications to computer science. Algebraic theory of languages. Loop-free decomposition of sequential machines by the methods of Hartmanis-Stearns, Krohn-Rhodes and Zeiger. Tree automata. Applications to semantics of programming languages.
Prerequisite: MSA 514
Spring, 3 credits

MSC 548 Analysis of Algorithms

Complexity of computation as measured by the time, space and number of operations required to solve various problems under different methods of computation. Upper and lower bounds on sorting, searching, graph and arithmetic problems. Asymptotic behavior of fast algorithms based on divide-and-conquer techniques, recursion and choice of data structures. Among the topics to be considered are: quicksort, shortest-path algorithms, transitive closure, Strassen's algorithm, the fast Fourier transform, NP-completeness, intractable problems and other related topics in the current literature.
Prerequisite: MSA 506
Spring, 3 credits

ESE/MS 552 Microprocessor Design and Application

This course covers the hardware of current microprocessors and associated large scale integration chips, typical available software including language and small operating system design, and finally application examples. Student experience with cross compiler, cross assembler, and cross simulator is included.
Fall, 4 credits

MSC 599 Research

Variable and repetitive credit

MSC 620 Analysis of Computer Systems

This course will be devoted to an examination of various methods of computer systems. The basic mathematical tools to be introduced include elementary queuing theory and Markov chain theory. Topics to be discussed include models of time sharing systems and their components as well as algorithms used for scheduling, resource allocation and the management of virtual memory.
Prerequisite: MSC 525
Fall, 3 credits

MSC 621 Seminar in Programming Languages

3 credits, repetitive

MSC 622 Seminar in Operating Systems

3 credits, repetitive

MSC 630 Seminar in Artificial Intelligence

3 credits, repetitive

MSC 631 Seminar in Information Organization and Retrieval

3 credits, repetitive

MSC 641 Mathematical Theory of Computation

Logical foundations of computation are studied. Topics include: correctness models; semantic models; schemata. Mathematical logic will be a principal investigative tool.
Prerequisite: MSC 542
Fall, 3 credits

MSC 645 Seminar in Theory of Computation

3 credits, repetitive

MSC 681 Special Topics in Programming Languages

3 credits, repetitive

MSC 682 Special Topics in Computer System Design

3 credits, repetitive

MSC 683 Special Topics in Computer Applications

3 credits, repetitive

MSC 684 Special Topics in Computer Architecture

3 credits, repetitive

MSC 685 Special Topics in Artificial Intelligence

3 credits, repetitive

MSC 686 Special Topics in Theory of Computation

3 credits, repetitive

MSC 698 Practicum in Teaching

3 credits, repetitive

MSC 699 Dissertation Research

Variable and repetitive credit

Earth and Space Sciences

ESS 505 Experimental Petrology Laboratory

The course is designed to give the student experience in some or all of the following techniques of experimental petrology: evacuated silica-glass tube experiments; one-atmosphere quenching experiments (with and without controlled atmospheres); 1 to 5 kbar hydrothermal systems (using oxygen buffers where necessary); gas-media experiments up to 7 kbar; solid-media piston-cylinder experiments.
Requirement: Completion of a project involving several of the above techniques;

written report.

Prerequisite: Permission of instructor
Fall, 1 credit

ESS 506 Theoretical Petrology

Theory of phase diagrams, Schreinemaker's Rules, heterogeneous equilibria, experimental systems of petrologic interest, properties of solutions.
Prerequisites: Metamorphic and igneous petrology and Physical Chemistry or Thermodynamics; or permission of instructor
Spring, 3 credits



ESS 507 Petrogenesis

Discussion of the origin and evolutionary history of selected types of igneous and metamorphic rocks by integrating the principles of heterogeneous phase equilibria, trace element and isotopic geochemistry, crystal chemistry, and geologic occurrence.
Fall, 3 credits

ESS 508 The Rock Forming Minerals

Study of the crystal chemistry, intracrystalline cation distribution (homogeneous equilibria), stability and paragenesis of the rock forming minerals. Special emphasis will be placed on amphiboles, feldspars, micas and pyroxenes.
Fall, 3 credits

ESS 510 Global Geology

A study of the global distribution and geologic history of platforms and orogenic belts. Emphasis on data necessary for paleogeographic reconstruction.
Fall, 3 credits

ESS 511 Advanced Paleontology

An introductory graduate-level course that stresses an integration of practical field and laboratory study of fossil assemblages with quantitative statistical analyses of data. The actual content of the course varies from year to year; field collecting will normally be carried out in the lower or middle Paleozoic of the Central Appalachians or the Tertiary of the Atlantic Coastal Plain.
Fall, 3 credits

ESS 513 Sedimentary Processes

An examination of the physical, chemical and biological processes which combine to produce the sedimentary features preserved in rocks. Topics include: the basic fluid mechanics of sediment movement, theoretical and empirical constraints of bedforms, the significance of layering and the nature and origin of syndepositional disruptions. Laboratories will emphasize the recognition of sedimentary structures in slabbed hand specimens and outcrops and their application to the reconstruction of the depositional conditions.
Fall, 4 credits, alternate years

ESS 514 Advanced Stratigraphy

Study of the evolution of ideas concerned with interpretation of the physical and historical interrelationships of layered rocks and of the application of these ideas to selected stratigraphic problems.
Fall, 3 credits

ESS 515 Seminar in Detrital Sedimentation

Focus will be on continental margin and adjacent oceanic sedimentation. Topics: formation of continental shelves; sedimentary processes on continental slopes, including mass gravity processes and canyon formation; sedimentation on continental rises including turbidite fan models; concepts of geosynclines; and relationship of continental margin

sedimentation to plate tectonics.
Spring, 3 credits, alternate years

ESS 516 Paleocology

Relation of ecological theory and practice to paleoecological problems. Topics: mode of formation of fossil assemblages; biotic diversity; communities; evolution of provinces; estimation and significance of survivorship in the fossil record; autoecology of selected fossil invertebrate groups; and spatial distribution.
Fall, 3 credits

ESS 518 Carbonate Sediments

An intensive study of the formation, deposition, lithification and diagenesis of carbonate sediments. Lectures and seminars will emphasize principles of carbonate deposition, facies relationships, and chemistry. Laboratories will emphasize binocular and petrographic analysis of recent and ancient carbonates.
Spring, 4 credits, alternate years (even)

ESS 519 Major Features of Evolution

A seminar exploring the concept of pattern and rate in evolution; evolutionary patterns seen in the fossil record. Topics: types of evolutionary rates; evolutionary trends; extinction; adaptation and adaptive radiation; the origin of higher taxa; and large scale interactions between biological and physical history of the earth.
Spring, 3 credits, alternate years (even)

ESS 520 Advanced Facies Analysis

An in-depth study of sedimentary rock packages, their lateral variability, their vertical successions and their interpretation using comparative sedimentology and integrated sub-environment models. Modern and ancient sedimentary systems will be compared and evaluated including: fluvial environments, deltas, beaches, tidal flats, basinal evaporites and lacustrine complexes.
Fall, 3 credits, alternate years

ESS 521 Isotope Geology

Radioactive decay schemes useful for determining the age of rocks and minerals. Evaluation of the various methods and consideration of problems of interpreting data. Application of radioactive isotopes and trace elements to the study of geologic processes and crustal evolution.
Fall, 3 credits

ESS 522 Planetary Sciences II

The chemical, physical and petrologic properties of meteorites are reviewed. These data and data for the Moon and the terrestrial planets are used to form a picture of the origin, chemical evolution, and accretion of planetary material.
Fall, 3 credits

ESS 525 Marine Geochemistry

The chemistry of the oceans will be considered. The various mechanisms for regular ocean chemistry and the influence

of ocean circulation on ocean chemistry will be discussed. The chemistry of the sea floor, including the ocean sediments, will be considered.

Prerequisite: Physical Chemistry
Fall, 3 credits, alternate years

ESS 526 Principles of Chemical Sedimentology

A chemical approach to the study of sediments. Fundamental principles of chemical thermodynamics and kinetics, including isotope effects, as they pertain to low temperature geochemical processes, are presented and utilized in the discussion of sedimentological processes.
Fall, 3 credits, alternate years

ESS 531 Crystalline Solids

Principles of symmetry, single crystal and powder x-ray diffraction techniques and elements of crystal structure determination are considered. Use of crystallographic data in the study of mineral systems. Laboratory in diffraction techniques includes extensive use of digital computers.
Fall, 3 credits, alternate years

ESS 532 Solid-State Geochemistry

The application of crystallographic techniques to problems in mineral chemistry. Concepts of the crystalline state, order-disorder, atom radii, chemical bonding, atom coordination, solid solutions, and physical properties of minerals. Emphasis on silicate and sulfide crystal structures.
Fall, 3 credits, alternate years

ESS 543, 544 Laboratory Course in Astronomical Techniques I, II

A course designed to introduce the theory, design and operation of modern astronomical instrumentation and to familiarize the student with the use of telescopes. Current astronomical techniques will be discussed with emphasis on methods of observational measurements and reduction of data. Fall term will emphasize optical techniques appropriate for wavelengths shorter than one micron, while spring term will deal with infrared and radio techniques. Either term may be taken independently of the other. Extensive laboratory and observing exercises may be expected.
Fall and Spring, 3 credits each semester

ESS 548 Cosmochemistry

The chemical composition of parts of the galaxy, the cosmic rays, stars, the sun, the solar wind, comets, meteorites and other solid objects in the solar system. Relationships and evolutionary changes in chemical composition. Additional topics: 1) cosmochronology as evidenced by isotopic variations in meteorites; and 2) the interaction of cosmic rays with solid objects in the solar system.
Spring, 3 credits, alternate years

ESS 550 Global Tectonics

Displacements of lithospheric plates in time and space. Geological and

geophysical evidence related to the concept of plate tectonics. Kinematics and dynamics of plate motions. Origin of first-order crustal structures of continents and ocean basins.
Spring, 3 credits

ESS 551 Physics of the Earth I

Study of the internal structure and properties of the earth as revealed by field and laboratory investigations. Topics to be discussed include the rotation and figure of the earth, gravity anomalies, solid-earth tides, geomagnetism and paleomagnetism, electromagnetic induction, and heat flow and the earth's present and past thermal states. May be taken independently of ESS 552.
Fall, 3 credits

ESS 552 Physics of the Earth II

Study of the earth's structure and properties based on evidence from seismology and high-pressure geophysics. Topics to be discussed include fundamental principles of elastic wave theory, body and surface wave propagation in layered media, earthquake source mechanisms, free oscillations of the earth and rheological properties of the earth's interior. May be taken independently of ESS 551.
Spring, 3 credits

ESS 553, 554 Stellar Physics I, II

A survey of the physical principles and the results of astrophysical importance in the study of stellar structure and composition. Fall term treats the problem of stellar interiors and evolution. Specific topics include: the equation of state, nuclear reactions, stellar opacity sources, and energy transfer mechanisms. Spring term treats stellar atmospheres and chemical abundance determinations. Topics will include: radiative transfer, thermodynamics in the presence of a radiation field, line formation, and the determination of stellar temperatures, surface gravities and compositions. Either term may be taken independently of the other. Two one-and-one-half hour lectures per week.
Fall and Spring, 3 credits each semester

ESS 556 Solid-State Geophysics

Application of lattice dynamics and equations of state of solids to studies in high-pressure, high-temperature geophysics. Reviews experimental data from physical acoustics, static and shock wave compression, and theoretical results from finite strain and atomistic models. Prerequisites: ESS 551 and 552 or permission of instructor
Spring, 3 credits

ESS 560 Advanced Structural Geology

Theory of finite strain as applied to naturally deformed rocks. Topics of discussion include the finite and incremental strain ellipsoid in relation to strain histories, examples of strain analysis, significance and development of minor structures (foliations, lineations, etc.) and mechanisms of folding.

Laboratory emphasizes the analysis of structural geometry and interpretation of deformational history.
Spring, 3 credits

ESS 581 Astronomy for Physicists

The course is intended as a survey of astronomy for a student whose background is physics. It can serve either as an elective or as a springboard for deeper involvement in the astronomy field. Topics to be covered include: basic properties of stars; the solar system; stars from birth to death (formation, evolution, white dwarfs, supernovae, neutron stars, black holes); the interstellar medium; molecular astronomy; the structure and dynamics of galaxies and clusters of galaxies; radio sources and quasars; cosmology.
Spring, 3 credits

ESS 582 Astrophysical Processes

A diverse course that treats in depth various physical processes of importance in astrophysics. Topics include theory and astrophysical application of: statistics, hydrodynamics, MHD, plasmas, general aspects of wave propagation, self-gravitating systems, physics of collisionless fluids, theory of thermal and non-thermal emission E-M radiation, radiative transfer, and cosmology.
Two one-and-one-half hour lectures per week.

Fall, 3 credits

ESS 583, 584 Galactic Astrophysics I, II

A study of the Galaxy and galaxies. Specific areas to be treated are: the interstellar medium including the dynamics, thermodynamics, and chemistry of HI regions, molecular clouds and HII regions; star formation; the dynamics and kinematics of the Galaxy including galactic rotation; kinematics of various galactic components including globular clusters, late type stars, planetary nebulae, pulsars, atomic hydrogen, molecular clouds, HII regions; the concept of stellar populations; galactic and extragalactic radio astronomy; galaxy morphology and evolution, clusters of galaxies and the problem of the missing mass; the Hubble law and observational tests of cosmology including the microwave background radiation. This is a full-year course. Two one-and-one-half hour lectures per week.
Fall and Spring, 3 credits each semester

ESS 585 Physical Cosmology

Current research in cosmology will be discussed from a physical point of view. The course is intended for students with a background in undergraduate physics. Topics to be covered will be: extragalactic objects of special interest, such as clusters of galaxies, radio sources, and quasars; the expansion of the universe and the big bang; the cosmic microwave and X-ray background radiations; the extragalactic distance scale; observational tests of cosmology; big bang nucleosynthesis; gravitational instabilities. No astronomy prerequisite is

required and the astronomy background will be developed as the course progresses.
Fall, 3 credits

ESS 597 Methods of Astronomical Research

This course is designed to acquaint beginning graduate students with current research in the department and to develop basic techniques of research in astronomy. Students work directly with one or more faculty members on short research projects that may involve using the astronomical literature, computer programming, or instrumentation in one of the laboratories.

ESS 599 Research

Fall and Spring, variable and repetitive credit

ESS 600 Practicum in Teaching

1 to 3 credits, repetitive

ESS 601 Advanced Topics in Astronomy-Astrophysics

Fall and Spring, 3 credits per semester, repetitive

ESS 603 Topics in Petrology

Variable, 1 to 3 credits

ESS 604 Topics in Geo-Cosmochemistry

Variable, 1 to 3 credits

ESS 605 Topics in Sedimentary Geology-Paleontology

Variable, 1 to 3 credits

ESS 607 Topics in Geophysics

Variable, 1 to 3 credits

ESS 609 Topics in Mineralogy and Crystallography

Variable, 1 to 3 credits

ESS 612 Seminar in Astronomy-Astrophysics

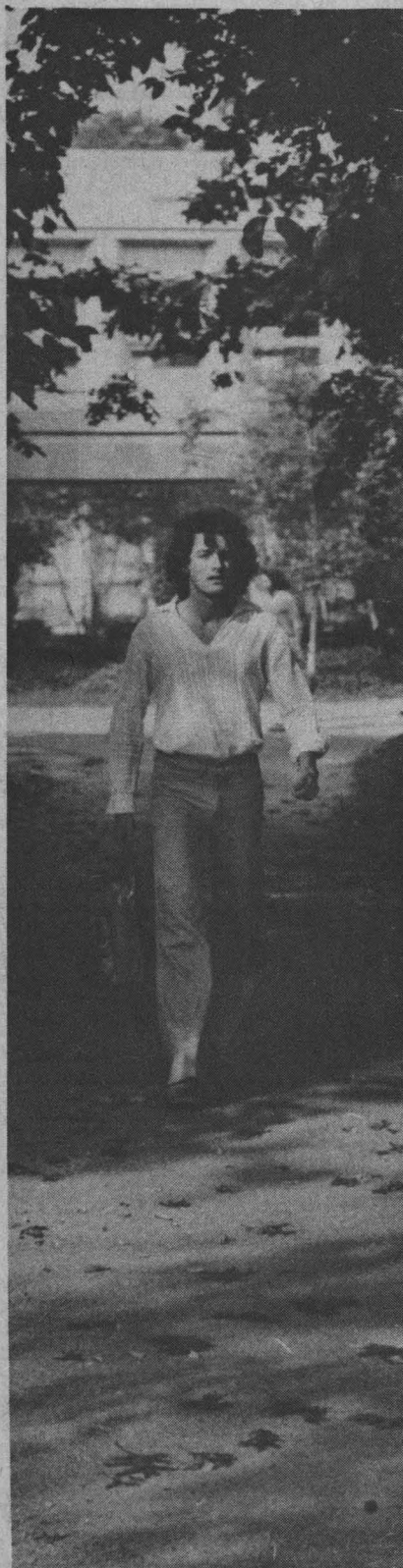
Designed to treat specific subject areas in depth, either extending material introduced at the 500 level or covering topics not presented there. Topics recently offered or anticipated in the near future include: Observational Cosmology, Atomic and Molecular Processes, Planetary Atmospheres, Interstellar Molecules, Advanced Topics in Radiative Transfer, Interstellar Grains, Quasars, and Galactic Nuclei. Two one-and-one-half hour lectures per week.
Spring, 1 to 3 credits per semester, repetitive

ESS 619 Electron Probe X-Ray Microanalysis

Theory of electron excitations of x-rays, matrix effects and practical aspects of electron probe x-ray microanalysis. Intended for advanced graduate students who need the instrumental capabilities for their thesis or research. Registration limited to a maximum of six students. Prerequisites: Advanced graduate standing and permission of instructor
Fall and Spring, 3 credits

ESS 699 Dissertation Research

Independent research for Ph.D. degree. Open only to candidates for the Ph.D. who have passed Preliminary Examination. Each semester, variable and repetitive credit



Ecology and Evolution

BEE 500 Directed Readings in Population Biology

Directed readings in topics of current interest, under supervision of a faculty sponsor culminating in one or more critical review papers.

Prerequisites: Sponsor and approval of Masters Programs Executive Committee
Instructor: Staff

Yearly, 1 to 3 credits, repetitive

BEE 501 Directed Readings in the Biology of Organisms

Directed readings in topics of current interest, under supervision of a faculty sponsor culminating in one or more critical review papers.

Prerequisite: Sponsor and approval of Masters Programs Executive Committee
Instructor: Staff

Yearly, 1 to 3 credits, repetitive

BEE 550 Principles of Ecology

This course examines the interactions of organisms. The development of theoretical concepts of community structure and their biological and evolutionary implications will be emphasized.

Fall, 4 credits

BEE 551 Principles of Evolution

Biological evolution including the genetics of populations, speciation, evolution of higher taxa, the fossil record, and biogeography. This is a continuation of the introductory sequence for graduate students in Ecology and Evolution (following on course 550).

Spring, 4 credits

BEE 552 Biometry

An intensive course in statistical theory and methodology. The analysis of real biological data is emphasized. Topics include analysis of variance, simple, multiple, and curvilinear regression analysis, correlation analysis, and goodness of fit tests.

Fall, 4 credits

BEE 553 Multivariate Analysis in Biology

An introduction to the multivariate statistical analysis for biologists. Topics include: general least squares analysis, MANOVA, path analysis, cluster analysis, and factor analysis.

Prerequisite: BEE 552 or equivalent

Spring of odd-numbered years, 3 credits

BEE 554 Population Genetics and Evolution

A general introduction to mathematical population genetics and evolutionary theory. The effects of mutation, recombination, selection and migration are studied. Modern concepts in both theoretical and experimental population genetics are covered.

Prerequisite: BIO 220, BEE 552, or their equivalents and a course in evolution
Spring of even-numbered years, 3 credits

BEE 555 Isoenzyme Methods in Ecological Genetics

An introduction to biochemical techniques for investigations in ecology and population genetics with an emphasis on the use of electrophoresis for ecological studies of natural and experimental populations. Topics include an introduction to the properties of proteins, particularly enzymes, genetic variation of populations, and the molecular basis of genetic and non-genetic variability of enzymes.

Spring of odd-numbered years, 4 credits

BEE 556 Research Areas of Ecology and Evolution

A description of the current research areas of ecology and evolution broadly conceived. All first year Ecology and Evolution students are expected to participate.

Fall, 1 credit

Spring, variable credits

BEE 557 Numerical Taxonomy

The application of numerical techniques to classificatory problems.

Spring of odd-numbered years, 3 credits

BEE 558 Tutorial Readings

Individual tutorial study with an instructor in the Ecology and Evolution Program for the purpose of background reading in an area of ecology and evolution.

Fall and spring, variable credit

BEE 559 Individual Studies in Organisms

A detailed study of the biology of a selected systematic group chosen by the graduate student and a faculty member. This is conducted as a tutorial course.

Fall and spring, variable credit

BEE 561 Theoretical Ecology

Introduction to the construction, analysis, and interpretation of mathematical models in population, community, and evolutionary ecology.

Prerequisites: BEE 550

Spring, 3 credits

BEE 562 Advanced Invertebrate Zoology

Lectures, student seminars and discussions on selected topics in invertebrate zoology, with emphasis on the local and tropical American faunas.

Spring, 2 credits, repetitive

BEE 571 The Institutions of Environmental Policy

The environmental effects of existing economic, legal, and other social institutions will be examined with emphasis on identification of areas of

agreement and conflict with ecological theory.

Fall, even-numbered years, 3 credits

BEE 575 Phylogenetics

A survey of principles and methods of phylogenetic systematics, covering both principles of classification and methods for inferring phylogenetic relationships. A quantitative approach is stressed throughout, and instruction on computer methods of phylogenetic analysis is included. The connection between phylogenetic and biogeographical theories is also covered.

Fall, even-numbered years, 3 credits

BEE 587 Computer Programming Techniques in Biology

An introduction to assembly language and FORTRAN programming applications in ecology, population genetics, and taxonomy. Simulation and graphic techniques will be emphasized.

Fall, 2 credits

BEE 588 Current Topics in Ecology and Evolution

The subject matter of the special topics course varies from semester to semester, depending upon the interests of students and staff.

Fall and spring, variable and repetitive credit

BEE 599 Research

Original investigation undertaken with the supervision of a member of the staff.

Fall and spring, credit to be arranged

BEE 670 Informal Seminar

Presentation of preliminary research results and current research problems by students and faculty.

Fall and spring, no credit

BEE 671, 672 Ecology and Evolution Colloquium

A weekly series of research seminars presented by visiting scientists as well as by the faculty. Required of all Ecology and Evolution graduate students.

Fall and spring, no credit

BEE 689 Seminar on Adaptation of Marine Organisms

Seminars on selected topics concerning ecological, genetical and evolutionary problems in the marine environment.

Fall and spring, 2 credits, repetitive

BEE 690 Seminar on Evolutionary Processes

Seminars on selected topics concerning evolutionary processes.

Fall and spring, 2 credits, repetitive

BEE 691 Seminar on Systematics and Phylogeny

Seminars on selected topics in systematics. Topics will include the theory of classification and numerical taxonomy, both phenetic and cladistic.

Fall and spring, 2 credits, repetitive

BEE 692 Seminar on the Environment and Human Affairs

Student seminars on selected topics concerned with the effect of man on his environment. Application of ecological and evolutionary theory to the solution of human problems.

Fall and spring, 2 credits, repetitive

BEE 693 Seminar on Population and Community Ecology

Student seminars on selected topics in population and community ecology.

Fall and spring, 2 credits, repetitive

BEE 699 Dissertation Research

Original investigations undertaken as part of the Ph.D. Program in Ecology and Evolution.

Prerequisite: Advancement to candidacy
Fall and spring, credit variable and repetitive

Economics

PH.D. PROGRAM IN ECONOMICS

ECO 500 Microeconomics I

The first semester of a one-year course, ECO 500 deals with traditional microeconomic theory, including consumer time choice theory, theory of production, cost curves, market equilibrium, market forms, and general equilibrium.

Fall, 3 credits

ECO 501 Microeconomics II

A continuation of ECO 500, focusing on decision-making under certainty, risk and uncertainty. Topics include linear programming, non-linear programming, the Kuhn-Tucker theorem, utility theory, game theory, group decision-making and Arrow's impossibility theorem.

Spring, 3 credits

ECO 510 Macroeconomics I

The first semester of a one-year course in the theory of income and employment, including examination of principal determinants of aggregate levels of income and employment, interactions of product and money markets, analysis of changes in the level of economic activity over time, growth and inflation.

Fall, 3 credits

ECO 511 Macroeconomics II

A continuation of ECO 510.

Spring, 3 credits



ECO 520 Mathematical Statistics

The first semester of a one-year course in quantitative methods. Statistical methods and their properties of particular usefulness to economists. Topics include: probability theory and its empirical application; univariate and multivariate distributions; limiting distributions; point and interval estimation.

Fall, 3 credits

ECO 521 Econometrics

A continuation of ECO 520. The application of mathematical and statistical methods to economic theory,

including the concept of an explanatory economic model; multiple regression; hypothesis testing; simultaneous equations models and estimating techniques. Emphasis is placed on the application of econometric methods to economic issues and the interpretation of econometric studies.

Spring, 3 credits

ECO 527 Operations Research I

Offered concurrently with MSA 530. Elementary maxima and minima problems and the Lagrange multiplier. Linear programming including the simplex

technique. The transportation problem. Queuing problems under different assumptions on input, service mechanism, and queue discipline. Dynamic programming. Basic ideas of inventory theory.
3 credits

ECO 528 Operations Research II

Offered concurrently with MSA 538. Non-linear programming and programming under uncertainty; introduction to statistical decision theory and game theory. Monte Carlo techniques. Applications such as inventory theory or traffic theory according to the interest of the class.

Prerequisite: ECO 527
3 credits

ECO 590 Mathematical Foundations of Contemporary Economic Theory I

Examination of those topics in set theory, topology, linear algebra that are relevant to economic theory. Application of these topics to economic theory will be developed as time permits.

Fall, 3 credits

ECO 591 Mathematical Foundations of Contemporary Economic Theory II

Examination of those topics in linear differential equation systems, convexity, fixed point theorems, n-variable calculus that are relevant to economic theory. Application of these topics to economic theory will be developed as time permits.

Prerequisite: ECO 590 or the equivalent
Spring, 3 credits

ECO 598 Economic Fundamentals

Directed work for individuals or small groups enrolled in graduate programs, on topics in which students are inadequately prepared at the time of admission. Credit in this course will be part of a student's work load but may not count towards a degree.

Variable and repetitive credit

ECO 599 Research in Special Topics

Variable and repetitive credit

ECO 600 Advanced Microeconomic Theory I

Topics will be selected from the following: neoclassical and modern consumer choice theory, optimization theory, general equilibrium theory, stability theory, game theory, etc. Necessary mathematical concepts will be developed as needed.

Prerequisites: ECO 501 and ECO 591, or the equivalent
3 credits

ECO 601 Advanced Microeconomic Theory II

Continuation of ECO 600.
3 credits

ECO 607 Production and Technology

Economic aspects of research, development and technological change. Survey of historical and econometric

literature and their relation to economic theory.

Spring, 3 credits

ECO 608 Development of Economic Analysis

Detailed analytical study of the origin and development of the major schools and theoretical problems and approaches of economics. The Physiocratic, Classical, Marxist, and neo-classical economists and theories are studied, with emphasis on primary source material.

3 credits

ECO 609 Studies in Economic Theory

Variable and repetitive credit

ECO 610 Advanced Macroeconomic Theory I

Topics will be selected from the following: Neoclassical and modern theories of resource allocation over time; concepts of efficiency, Pareto-optimality and optimality in growth models; Austrian, Neoclassical and Cambridge theories on the concept of capital, and the aggregation problem; the microeconomic foundations of macroeconomics; monetary theory and temporary equilibrium analysis. Necessary mathematical concepts will be developed as needed.

Prerequisites: ECO 501 and ECO 511
3 credits

ECO 611 Advanced Macroeconomic Theory II

A continuation of ECO 610.

Prerequisite: ECO 610
3 credits

ECO 613 Business Cycles, Stabilization Policies, and Forecasting

An analysis of modern theories of the business cycle and the use of alternative stabilization policies to reduce the undesirable effects of cycles. Emphasis will be on the selection of optimal policies and the role of forecasting in the implementation of policy.

3 credits

ECO 619 Studies in Macroeconomics

Variable and repetitive credit

ECO 620 Advanced Econometrics I

Foundations of econometric theory, emphasizing the problems of model formation, identification, estimation, hypothesis testing, and model evaluation. Topics will be selected from the following areas: general linear models, non-linear models, multivariate analysis, time series analysis, simultaneous equations systems.

Prerequisite: ECO 521 or permission of instructor
3 credits

ECO 621 Advanced Econometrics II

A continuation of ECO 620.
3 credits

ECO 622 Seminar in Applied Econometrics

A survey of econometric studies with illustrations from the current literature of various econometric techniques and the critical evaluation of numerical results. Topics include: problems of quantification and measurement, the structure and use of explanatory economic models, analyses of consumer behavior, aspects of firm behavior (e.g., investment), econometric models.

Prerequisites: ECO 521; ECO 501 and ECO 511 are recommended, or permission of instructor
3 credits

ECO 623 Data Analysis and Economic Applications

Survey of major sources of data in economics; and theoretical hypotheses and statistical methods for organizing and analyzing such data. Statistical models for quantitative data as well as qualitative choices are presented. Computer usage is expected.

Prerequisite: ECO 521
Fall, 3 credits

ECO 629 Studies in Quantitative Methods

Variable and repetitive credit

ECO 630 Welfare Foundations of Public Sector Economics

This is a one-semester course designed to explore, in a concise manner, the micro basis of public sector economics. Emphasis is placed on the contrast between optimization in the private and public sectors, externalities, "second best" social optima, "public" goods; collective choice, public investment criteria and optimal pricing in the public sector.
3 credits

ECO 631 Seminar in Public Sector Economics

Analytic and econometric approach to selected issues in public sector economics drawn from the areas of urban economics, medical economics, environmental economics, welfare economics and public finance. This course may be taken as a continuation of ECO 630, but 630 is not a prerequisite.
3 credits

ECO 633 Applied Welfare Analysis

Development of selected topics in advanced welfare theory, including intertemporal resource allocation, uncertainty, preference transformation and collective choice. Theoretical aspects of income distribution. Efficiency and equity of alternative economic systems. This course may be taken as a continuation of ECO 630, but 630 is not a prerequisite.
3 credits

ECO 635 Public Finance

Analytical and econometric analysis of selected topics in public finance, such as: optimal taxation and income distribution, optimal taxation and resource allocation;

social security, retirement and savings behavior; shifting and incidence of corporate, property and payroll taxes. Prerequisite: ECO 631 or permission of instructor
Fall, 3 credits

ECO 640 Advanced Labor Economics Theory I

This is primarily a course in advanced labor economics theory. There will, however, be some attention to empirical work. Topics will include labor contracts, the theory of equalizing differentials, human capital, labor supply, life cycle behavior and income distribution. Prerequisite: ECO 501
3 credits

ECO 641 Advanced Labor Economics Theory II

This is a continuation of Economics 640. There will, however, be more emphasis on empirical application. Topics to be covered are: economic demography, unemployment and job turnover, labor demand, unionism, and signalling and screening. Prerequisite: ECO 640
3 credits

ECO 646 Economics of Health

Theoretical and econometric analysis of selected aspects of the health care delivery system, such as: the demand for medical services, the supply and distribution of physician services, the utilization of non-physician medical personnel, alternative models of hospital behavior, third-party insurance reimbursement and national health insurance, cost and price inflation in the hospital and long term care sectors.
3 credits

ECO 649 Studies in Public Sector Economics

Variable and repetitive credit

ECO 650 International Trade

Contemporary international trade history including comparative advantage models, trade and growth, welfare aspects of international trade, tariff theory, and the theory of customs unions. Relevant empirical studies are surveyed to show how trade theory is tested and expanded.
3 credits

ECO 651 International Finance

Contemporary balance of payments and exchange rate theory, including monetarist, Keynesian and elasticity theories, policy models, international liquidity and capital flows. Relevant empirical work is included.
3 credits

ECO 654 Foundations of Urban Economics

Analysis of the nature and functioning of urban areas. The theoretical foundations of urban economics are developed: theories of the consumer and housing producer in economic space, land rent and use, urban structure, and the size

distribution and growth of urban areas are developed. Emphasis is placed on methodology and hypotheses generated by the theories.

Prerequisite: ECO 501
3 credits

ECO 655 Problems in Urban Economics

The theories developed in Economics 542 are applied to specific urban problems. Urban problems such as poverty, housing, slums and urban renewal, urban transportation, financing local government and environmental quality are analyzed. A great deal of emphasis is also placed on methodology. Economics 654 is recommended though not a prerequisite.
3 credits

ECO 660 Comparative Economic Systems

A systematic treatment of systems analysis, stressing decision-making, information, and motivation. A conceptual framework is developed for analyzing (1) market, centrally planned and planned market models, (2) the model and the reality of Soviet-type centrally planned economies and the reforms in these economies, (3) the model and reality of worker management, and (4) measurement of quality of system performance.
Fall, 3 credits

ECO 661 Theory of Economic Systems

Introduction to the theory of social preference and choice functions. Voting systems. Informationally decentralized systems. Centralized and coercive systems. Team theory. Prerequisite: ECO 501 or consent of instructor
3 credits

ECO 669 Studies in Economic Systems

Variable and repetitive credit

ECO 690 Research Workshop in Applied Economics

Preparation, presentation and discussion of student and faculty research in applied economics. Topics covered by student papers will usually be related to students' long-term research interests. Open to second- and third-year students in Ph.D. program and interested faculty.
3 credits

ECO 691 Research Workshop in Economic Theory

Preparation, presentation and discussion of student and faculty research in economic theory. Topics covered by student papers will usually be related to students' long-term research interests. Open to second- and third-year students in Ph.D. program and interested faculty.
3 credits

ECO 692 Research Workshop in Systems and Development

Preparation, presentation and discussion of student and faculty research on theoretical and applied topics in the fields of comparative systems and economic

development. Topics covered by student papers will usually be related to students' long-term research interests. Open to second- and third-year students in Ph.D. program and interested faculty.
3 credits

ECO 698 Practicum in Teaching

Variable and repetitive credit

ECO 699 Dissertation Research

Variable and repetitive credit

M.A. PROGRAM IN ECONOMICS

ECO 552 Economics of Money and Banking

An analysis of the structure and operations of the U.S. monetary and banking systems, of their influence on domestic and foreign economic policy formation, and of the theoretical foundations of monetary policies.
3 credits

ECO 553 Financial Markets and Institutions

The nature of financial decisions; interest rate fluctuations, uncertainty and risk, cash management and liquidity preference and the demand and supply of funds. The behavior and structure of financial institutions and of financial markets. Money flows and the level of economic activity. Importance and relation of financial decision making and financial market movements to public and private sectors of the economy. Prerequisite: ECO 552 or permission of instructor
3 credits

ECO 554 Work, Education and Health

Selected topics of current interest in unemployment, employment expansion, and the financing of education, training, and health programs will be analyzed in depth. National and state legislation — and the programs financed thereunder — will be analyzed through a series of case studies. The effect of public programs in these areas as they affect private enterprise and various segments of society will be given particular attention. Prerequisite: ECO 579 or permission of instructor
3 credits

ECO 556 Managerial Decision Making

Theoretical, empirical and case study approaches to managerial decision making in private enterprise and the public sector. Cost and price determination; behavior of factor markets; use of production and marketing models; the nature of conflicts between owners, managers, and the public; and how to deal with risk and uncertainty will be among topics covered. Prerequisite: ECO 573 or permission of instructor
3 credits

ECO 557 Comparative Studies in Economic Systems

A survey of various types of economic systems, including market and centrally planned economies. The course begins with a theoretical framework for comparing economic systems and then analyzes specific models and countries in detail.

3 credits

ECO 559 International Trade and Finance

An introduction to the major theoretical and policy aspects of international trade, protection, customs unions, exchange rates, capital movements, and the balance of payments.

3 credits

ECO 573 Prices and Markets

Price determination and the laws of supply and demand. The response of private enterprise to market conditions. The relation of labor and financial markets to the production process. Introduction to the concept of general economic equilibrium.

Prerequisite: CET 511 or equivalent

3 credits

ECO 574 Applied Econometrics

An introduction to estimation and hypothesis testing for economic and public policy models. A review of basic statistical topics is followed by an introduction to regression analysis, econometric models and economic forecasting.

Prerequisite: An introductory statistics course or permission of instructor

3 credits

ECO 576 Public Finance and Taxation

Major elements of taxation and public

expenditures, including theories of public goods and the satisfaction of public wants. The effects of taxation on efficiency of resource allocation, general welfare, income redistribution, and economic growth. The U.S. tax structure, including federal, state and local levels and intergovernmental fiscal relations.

Prerequisites: ECO 573 or permission of instructor

3 credits

ECO 579 Labor Economics

The course surveys the composition and functioning of the labor market; wage determination and wage differentials; wages, productivity and inflation; unionism and its economic impact, governmental intervention; unemployment and poverty in the modern economy.

3 credits

ECO 580 National Income, Employment and Inflation

The determination of national output and income; factors affecting employment and price levels and the rate of economic growth. The role of government in a market economy, specifically the function of fiscal and monetary policies in attaining the objective of full employment, price stability and economic growth.

Prerequisite: CET 511 or equivalent

3 credits

ECO 581 Economic Aspects of Public Policy

Selected problems of current economic policies at the international, federal, state and local levels will be studied so as to determine whether they arise from failure of the market mechanism, from inadequate public sector financing or from inadequate understanding of non-

economic processes.

Prerequisite: At least 6 credits in the program or equivalent

3 credits

ECO 585 Urban Economics

In the first part of the course, theoretical foundations and historical trends will be investigated, including the nature of urban areas, urbanization and suburbanization in the U.S., and the theory of land rent, land use, and urban structure. This will provide the background for understanding and dealing with the problems of poverty, housing and urban renewal, urban transportation, financing local government and environmental quality.

3 credits

ECO 588 The Economics of Developing Countries

An introduction to the processes and problems of economic development in less developed countries with mixed economic systems. Models of economic development are examined with a view to isolating key factors involved in the development process. The merits of alternative strategies of economic development in raising the levels of production and welfare in less developed countries are evaluated.

3 credits

ECO 599 Research in Special Topics

Research in special topics in economic theory or applied economics, either individually or in a seminar setting.

Prerequisite: 12 credits in the program or equivalent, and permission of the program director and a supervising faculty member.

Variable and repetitive credit

Electrical Engineering

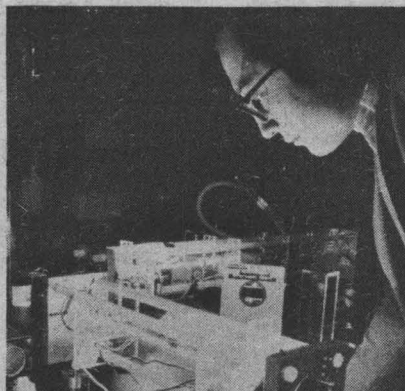
ESE 501 Graduate Laboratory in Electrical Sciences

Intended to familiarize the student with the use of research laboratory equipment, basic measurement techniques and integration into an overall experimental project. Each student will select at least three experimental projects from the following areas to be supervised by the faculty: applied optics, microwave electronics, wave propagation, and solid state electronics. The student must set up the experimental system, measure the necessary parameters and perform the required experiments in order to complete the project.

3 credits

ESE 502 Linear Systems

Mathematical descriptions and correspondences between continuous-time



and discrete-time linear systems. State variable and input-output formulation and the use of laplace and z-transforms in analysis. Controllability, observability, minimal realization, and structural canonical forms. Assignment of system nodes, Rx state variable feedback, and the design of observers. Stability criteria and the Routh-Hurwitz test for

asymptotic stability.

3 credits

ESE 503 Stochastic Systems

Basic probability concepts and application. Probabilistic bounds, characteristic functions, and multivariate distributions. Central limit theorem, normal random variables. Stochastic processes in communication, control and other signal processing systems. Stationarity, ergodicity, correlation functions, spectral densities, and transmission properties. Optimum linear filtering, estimation and prediction. The concept of entropy and physical systems and information transfer. Basic detection theory.

3 credits

ESE 504 Congestion and Delay in Communications Systems

Applications of random process representations to further problems in communications. Traffic congestions, queuing and delay in communications systems. Important channel and queuing

models. Message and circuit switching. Alternative communication structures and protocols. Multiple access techniques. Blocking and rescheduling. Pocket radio and broadcast schemes. Prerequisite: ESE 503 or permission of the instructor
3 credits

ESE 506, 507 Electronic Circuits, Devices and Systems I and II

An intensive coverage of the concepts fundamental to the analysis and synthesis of electronic circuits and systems, both analog and digital. This course is not open to students with an undergraduate degree in electrical engineering. Prerequisite: Permission of Graduate Program Chairman
3 credits each semester

ESE 510 Fundamentals of Physical Electronics

Lagrangian and Hamiltonian formulation of mechanics. Classical and quantum statistics. Schrodinger's and Heisenberg's representation of quantum mechanics; perturbation theory. Solid state theory, crystal structure, simple band structure, effective mass theorem, properties of semiconductors. Transport theory, derivation and application of Boltzman transport theory. Semiconductor devices.
3 credits

ESE 511 Solid State Electronics I

A study of the electron transport processes in solids leading to the analysis and design of solid state devices. Electrical and thermal conductivities; scattering mechanism; diffusion, galvanomagnetic, thermomagnetic, and thermoelectric effects. Hall effect and magnetoresistive devices. Conductivity in thin films. Ferroelectrics, piezoelectrics, theory of magnetism and of magnetic devices.
3 credits

ESE 512 Solid State Electronics II

Resonance phenomena in solids; applications to microwave devices and to measurements of electronic parameters, optical properties of solids, direct and indirect transitions, luminescence, photoelectric devices, photomagnetic effects. Elements of superconductivity, the macroscopic and the microscopic theories, tunneling effects.
3 credits

ESE 514 Semiconductor Electronics

The theory of semiconductor electronics and related devices. Conduction mechanisms in semiconductors; trapping centers, recombination centers, surface states. The continuity equation, p-n junction theory of the junction transistor, transistor characterization. Metal to semiconductor contacts, theory of metal-oxide-semiconductor transistors. Prerequisite: ESE 511
3 credits

ESE 515 Quantum Electronics I

Physics of microwave and optical lasers.

Topics include: introduction to laser concepts; quantum theory, classical radiation theory; resonance phenomena in two-level systems. Block equations, Kramers Kronig relation, density matrix; rate equation approach to laser oscillation and amplification; CO₂ lasers; discharge lasers; semiconductor lasers.
3 credits

ESE 516, 517 Integrated Electronic Devices and Circuits I and II

Theory and applications; elements of semiconductor electronics, basis of the methods of fabrication, bipolar junction transistors, FET, MOS transistors, diodes, capacitors and resistors. Design techniques for linear and digital integral circuitry. Temperature effects and fundamental limitation of integrated electronic components and circuits. Discussion of computer-aided design; (MSI) (LSI).
3 credits each semester

ESE 518 Quantum Electronics II

Interaction of simple quantum systems with complex systems; semiclassical laser oscillation theory, stochastic theory of fluctuations. Brillouin scattering, Raman effect; spontaneous emission, interaction theory; quantum theory of laser oscillation, coupled Green's function relations. Quantized non-linear optics, quantum noise, photon scattering.
3 credits

ESE 520 Electronics II - Fundamentals of Electromagnetics

Electro- and magneto-statics; Maxwell's equations; vector and scalar potentials, vector and tensor transformation properties, Lorentz transformation; derivation of Maxwell's equations from Coulomb's Law and Lorentz transformation. Boundary value problems; Green's function, guided waves, travelling wave and charged particle interactions. Radiation.
3 credits

ESE 521 Applied Electromagnetic Theory

Advanced boundary value problems in electromagnetic and microacoustic wave propagation, guided wave and radiation. Topics include: variation and perturbation methods applied to cavity, wave guide discontinuity radiation from wave guide aperture and equivalent source theorem, mode theory of guided wave around the earth, microwave acoustic wave guide and transducers.
3 credits

ESE 522 Wave Propagation in Plasma

The course includes the following topics: Introduction to magnetic theory and plasma kinetic theory, wave propagation in unbounded plasma, guided waves at a plane plasma interface and its application to terrestrial propagation, radiation from antennas in plasma.
3 credits

ESE 523 Integrated and Fiber Optics

The course includes the following topics:

thin film dielectric optical waveguides and modes, dielectric fibers, semiconductor planar waveguides, input and output couplers, groove reflectors, resonators and filters, modulators and detectors, semiconductor junction lasers and thin film feedback lasers, fabrication techniques of thin film guides and devices; optical communication system consideration and requirements.
3 credits

ESE 529 Network Theory

An exposition of a variety of topics that lead to selected areas of current research in network theory. Graphs and digraphs. Minimum-cost problems. Network flows, the max-flow min-cut theorem, matching theory, propositioning networks. Kirchhoff's laws, linear and non-linear electrical networks, state-space representation, n-ports and Hilbert ports, the scattering and imittance formalisms, realizability theory. Operator networks and infinite networks.
3 credits

ESE 531 Theory of Digital Communication I

Multivariate (vector) random variables and random processes, digital signal alphabets as vector configurations, optimum receiver principles, efficient signalling, comparison of classes of signalling schemes. Prerequisite: ESE 503 or permission of instructor
3 credits

ESE 532 Theory of Digital Communication II

The channel capacity theorem, bounds on optimum system performance, encoding for error reduction, the fading channel, communications with feedback, telemetry, factors in design of multiplexed and repeated transmission systems. Prerequisite: ESE 531
3 credits

ESE 533 Satellite Communication Engineering

Historical perspective, economics, orbital mechanics, synchronous satellites, transponders, multi-access earth terminals, frequency division multiple access, time division multiplexing, time division multiple access, PSK, carrier-phase tracking, filter distortion, bit sync, timing systems, delay-lock tracking.
3 credits

ESE 535 Information Theory and Reliable Communications

Source and channel models. Measure of information and Source Coding Theorems. Mutual information, channel capacity and channel coding theorems. Block codes. Convolutional codes. Research topics.
3 credits

ESE 539 Communications, Transportation and Power Nets

A problem-oriented lecture and seminar course in deterministic and probabilistic

large-scale systems, and techniques for the solution of problems arising therein.
3 credits

ESE 541 Discrete Time Systems

Analysis and synthesis of discrete time systems and discrete time controlled continuous systems. Topics include: Z-transform and state variable representations of discrete time systems, controllability and observability. Stability criterion. Synthesis methods. Dynamite programming and optimum control. Sampled spectral densities and correlation sequence. Optimum filtering and control of random processes.
Prerequisite: ESE 502
3 credits

ESE 542 Stability Theory and Application

Definition and application of stability criteria in both linear and non-linear systems. Topics include equilibrium points, limit cycles, describing function analysis, construction of Lyapunov functions, the Popov circle criterion and perturbation methods. Application of stability theory to design of non-linear control systems.
3 credits

ESE 543 Optimal Control

Topics include parameter optimization, La Grange multipliers, numerical techniques such as steepest descent, Newton's Method and conjugate gradients. In the area of trajectory optimization the Hamilton-Jacobi Equations, Pontryagin Maximum Principle and Dynamic Programming are applied to the quadratic regulator, minimum time, minimum fuel, and other linear and non-linear control problems. Control in restricted phase space.
3 credits

ESE 544 Optimal Filtering and Data Reconstruction

Effects of stochastic noise and inexact measurement on the performance of control and communication systems. Topics include matching filter, coherent detection, optimal estimation, prediction, and smoothing of data using the Wiener-Hopf and Kalman-Bucy methods. The separation principle in optimal control of stochastic systems.
3 credits

ESE 545 Computer Architecture

Covers multiprocessors, stack-organized computers, pipeline computers, microprocessors and computer networks. Topics including microprogramming, computer design language, hierarchical memory management systems, machine algorithm for high-speed arithmetic, hardware dynamic loader, micro-programmed control. Input/Output organization, virtual memory and virtual machine are discussed. May not be taken in addition to MSC 502 for credit.
Prerequisite: ESE 318
4 credits

ESE 546 Analysis and Synthesis of Computer Communication Networks

Mathematical analysis of message queuing and buffering processes for various signal statistics. Analytical and algorithmic methods for networked optimization. Topological design for network reliability. Wave-form optimization, encoding. Error analysis of coded and feedback systems. Optimum features and software requirements of communication processors.
3 credits

ESE 547 Digital Signal Processing

The course covers three aspects of digital signal processing: digital filter, fast Fourier transform (FFT) and error analysis. Topics include: review of analog filters and design of infinite impulse filters. Algorithm and implementation of FFT application of FFT. Effects and analysis of quantization errors.
3 credits

ESE 549 Fault Diagnosis of Digital Systems

This course is designed to acquaint students with fault diagnosis of logic circuits. Both combinatorial and sequential circuits are considered. Concepts of faults and fault models are presented. Emphasis is given to test generation, test selection, fault detection, fault location, fault location within a module and fault correction.
Prerequisites: ESE 318 or equivalent
3 credits

ESE 551 Switching Theory and Sequential Machines

Survey of classical analysis and synthesis of combination and sequential switching circuits, followed by related topics of current interest such as error diagnosis and fail soft circuits, use of large scale integration, logic arrays, automated local design.
Prerequisite: ESE 318 or equivalent
3 credits

ESE 552 LSI and Microprocessor Design and Application

Architecture of microprocessors and associated LSI components. Micro-processor software, and applications types. Demonstrations and use of cross assembler, simulator, and cross compiler via computer terminals.
Prerequisites: MSC 101, 102, ESE 318 or equivalent
4 credits

ESE 557 Digital Signal Processing II; Design, Implementation and Applications

This course emphasizes the implementation aspect of digital signal processors. Topics include the design of IIR, FIR, and multirate digital filters, the FFT processor, the architectural considerations for general purpose digital signal processors, the DSP computer, the implementation of some special purpose processors, and some other practical considerations. Some applications will also be presented.

Prerequisite: ESE 547 or permission of instructor
3 credits

ESE 560, 561 Optical Information Processing

A course introducing the field of modern image processing and optical computing. Particular emphasis is placed on generally applicable fundamentals and on the principles of experimental implementations. The theory is developed and illustrated with examples drawn from the most recent applications, including holography, pattern recognition and image restoration, optical and digital computers, optical memories, information storage and retrieval, holographic laser generation of new types of optical elements, aperture synthesis and holographic interferometry as used in non-destructive testing. Electron microscopy, microwave, radar, x-ray and ultrasonic imaging including medical applications are discussed. All the necessary special mathematics, such as Fourier transform theory, are introduced at appropriate times throughout the course.

Prerequisites: Bachelors degree or equivalent in the physical sciences or biological sciences; mathematics training through calculus
3 credits each semester

ESE 570 Bioelectronics

Origin of bioelectric events; ion transport in cells, membrane potentials; neural action potentials and muscular activity, cortical and cardiac potentials. Detection and measurement of bioelectric signals; impedance measurements used to detect endocrine activity, perspiration and blood flow; impedance cardiography, vector cardiography; characteristics of transducers and tissue interface; special requirements for the amplification of transducer signals.
3 credits

ESE 572 Electronic Instrumentation and Operational Amplifier

Design specification for electronic instruments; signal domains, bioelectric signals, modelling, measurement of pollution in air and in water; media-electrode interfaces, electrodes, sensors/transducers. Signal conditioning, instrument amplifiers, pre-amplifiers, operational amplifiers. Data processing, conversion, microprocessors, signal transmission; output systems, storage, display recording. Instrument packages for measurement monitoring, analyzing.
3 credits

ESE 574 The Design of Artificial Organs

The physiology, anatomy, and pathology of the heart, lungs, and kidneys is presented to enable the student to determine the technical constraint on the design of counterparts. The role of the engineer in the conceptual process is described and constraint imposed by surgical, material, and other technical aspects on the design is discussed. The

student presents a proposed design of the organ which he selects using the standard form of NIH grant proposal.

3 credits

ESE 575 Cardiovascular Dynamics and Assisted Circulation Techniques

The physiology and anatomy of the cardiovascular system is presented and techniques for assisting the system in acute heart failure are described. The instrumentation and techniques which are utilized in animal research are described and used in the operating room; the research projects are offered for the selection of the student as a subject for a feasibility study.

3 credits

ESE 576, 577 Physiology for Engineers and Physical Scientists

Study of human physiology with emphasis on quantitative engineering interpretation. Among the physiological systems considered are: neural; cardiovascular; respiratory; renal; gastrointestinal; and endocrine systems.

3 credits

ESE 596 Internship in Bioengineering

Student will work with physicians in hospital or other clinical facility, and will gain experience in clinical instrumentation diagnosis, and treatment of diseases.

Prerequisite: Physiology background
3 credits, repetitive

ESE 597 Practicum in Engineering

Discussion, case studies of practical problems in engineering designed specially for part-time graduate students, relating to their current professional activity. Registrants must have the prior approval of the Graduate Program Chairman. The grade will be assigned,

and credit granted, upon submission of a written report of seminar presentation of the work performed.

Variable and repetitive credit

ESE 599 Research

Variable and repetitive credit

ESE 610 Seminar in Solid State Electronics

Current research in solid-state devices and circuits and computer-aided network design.

3 credits

ESE 630 Seminar in Communication Theory

3 credits

ESE 640 Seminar in Systems Theory

Recent and current research work in systems theory.

3 credits

ESE 650 Advanced Topics in Digital Systems

Topics of special interest in the area of digital systems.

3 credits

ESE 660 Seminar in Biomedical Systems Engineering

This seminar will treat topics of current interest in bioengineering. Modeling and simulations of physiological systems, such as cardiovascular, respiratory, renal, and endocrine systems. Instrumentation systems including automatic chemical assaying, electric probes, ultrasonic tracer methods, and radiation techniques. Application of computers in biomedicine in the subject of diagnosis, emergency services, and hospital management.

Prerequisites: ESE 310, ESE 370 or equivalent
3 credits

ESE 670 Topics in Electrical Sciences

Varying topics selected from current research topics. This course is designed to give the necessary flexibility to students and faculty to introduce new material into the curriculum before it has attracted sufficient interest to be made part of the regular course material. A. Biomedical Engineering; B. Circuit Theory; C. Controls; D. Electronics Circuits; E. Digital Systems and Electronics; F. Switching Theory and Sequential Machines; G. Digital Signal Processing; H. Digital Communications; I. Computer Architecture; J. Networks; K. Systems Theory; L. Solid State Electronics; M. Integrated Electronics; N. Quantum Electronics & Lasers; O. Communication Theory; P. Wave Propagation; Q. Integrated Optics; R. Optical Communications and Information Processing; S. Instrumentation. Variable, repetitive credit

ESE 691 Seminar in Electrical Engineering

This course is designed to expose students to the broadest possible range of the current activities in electrical engineering. Speakers, from both on and off campus, discuss topics of current interest in electrical engineering. All full-time Ph.D. candidates are required to register for this course and all Ph.D. candidates are required to present their thesis finding to the department as a whole.

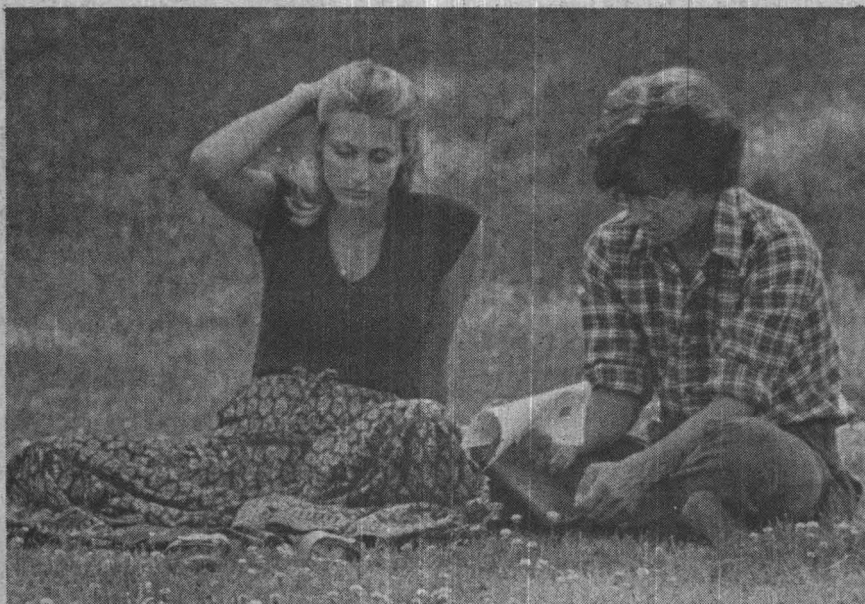
1 credit, repetitive

ESE 698 Practicum in Teaching

Variable and repetitive credit

ESE 699 Dissertation Research

Variable and repetitive credit



English



EGL 501 Studies in Chaucer

A close reading of Chaucer's major poetry, with special emphasis on the *Canterbury Tales*. No previous acquaintance with Middle English is necessary.

Instructor: S. Spector
Fall, 3 credits

EGL 502 Studies in Shakespeare

An in-depth study of Shakespeare's major works and major traditions of literary criticism that have concentrated on them.

Instructor: R. Levin
Fall, 3 credits

EGL 503 Studies in Milton

A study of Milton's major poetry and prose in the context of the political and religious controversies of the period.

Instructor: T. Kranidas
Fall, 3 credits

EGL 505 Studies in Genres

(section 1) The Tragic Vision: Study in Tragedy. Readings from the Greeks to the Renaissance and Aristotle, Kierkegaard, Nietzsche.

Instructor: A. Wilson
Spring, 3 credits

(section 2) Prose Theory

This course is intended as an introduction to the complex study of English prose style as a means of expression from the Renaissance to the present.

Instructor: J. Bennett
Spring, 3 credits

(section 3) Modern Drama

This course will test the validity of the conceptions we have of the major movements in modern drama: "naturalism," "expressionism," "relativism," "peasant drama," "epic theatre," and "absurdism." Emphasis will be upon examination of the plays themselves.

Instructor: R. Zimbaro
Spring, 3 credits

EGL 508 Literature in Relation to Other Disciplines

Children's Literature:

The course description will be available at a later date.

Instructor: J. Jordan
Spring, 3 credits

EGL 510 Studies in Old English Language and Literature

Old English: Beginning course in Old English literature, language, and culture. After a brief introduction to grammar, we shall translate and discuss seven Old English poems: *Caedmon's Hymn*, *Brunanburh*, *Dream of the Rood*, *Maldon*, *Deor*, *Seafarer*, *Wanderer*, and perhaps one more. No prerequisites, no papers. One mid-term and a final exam.

Instructor: D. Fry
Fall, 3 credits

Beowulf: Reading course in *Beowulf* and the *Finnsburh Fragment*. Daily translation and discussion. Some attention to archaeological background. No papers, no mid-term, one final exam.

Prerequisite: one semester of Old English or equivalent.

Instructor: D. Fry
Spring, 3 credits

EGL 515 Studies in Middle English Language and Literature

Middle English Survey: Introductory survey of Middle English (ca. 1154-1500) literature by genres, including *Gawain and the Green Knight*, *Piers Plowman*, *Pearl*, and lyrics. Broad and rapid reading of representative texts with literary discussion. Some attention to history, manuscripts, and culture. No pre-requisites. One paper, one mid-term, one final exam.

Instructor: D. Fry
Spring, 3 credits

EGL 520 Studies in the Renaissance

An introduction to representative literary and dramatic works of the 16th century in England. Readings in the anthologies will be supplemented by library assignments, which will include some attention to 20th

century criticism on this period. Two papers and occasional oral reports.

Instructor: C. Huffman
Fall, 3 credits

EGL 525 Seventeenth Century Literature

Seventeenth Century Poetry: The religious verse of the period will be studied, with emphasis on Donne (especially *The Divine Poems* and *The Anniversaries*), Herbert (*The Temple*), and Vaughan (*Silex Scintillans*), and with Crashaw, Marvell, and others also to be considered. The poetry will be viewed against the relevant doctrinal, denominational, and biographical backgrounds as well as those of literary history and theory.

Instructor: J. Pequigney

EGL 535 Studies in Neoclassicism

Intellectual Texts of the Eighteenth Century: Analysis and comparison in class of texts by Locke, Berkeley, Hume, Johnson, Burke, Gibbon and perhaps others; at least three papers of different kinds.

Instructor: T. Rogers
Fall, 3 credits

The Sentimental and The Sublime: A study of two related trends--the sentimental and the sublime--in mid- and late-eighteenth century British literature. We will establish some of the philosophical and aesthetic contexts for this literature by reading selections from Longinus, Addison, Mandeville, Burke, and others. The literary texts will include the poems of Gray, Collins, Smart, and the early Blake; the prose of Richardson, Sterne, Mackenzie, Radcliffe, and "Monk" Lewis; and some sentimental drama.

Instructor: D. Sheehan
Spring, 3 credits

EGL 540 Studies in Romanticism

Prose Works of the Imagination, Godwin's *Political Justice* and *Caléb Williams*; treatises and inventions of Wollstonecraft, Hazlitt, Landor, Peacock, DeQuincey, Mary Shelley, Carlyle.

Instructor: D. Erdman
Spring, 3 credits

EGL 545 Studies in Victorian Literature

A critical view of the major 19th century British works.

Instructor: N. Arkans
Fall, 3 credits

EGL 550 Studies in 20th Century British Literature

An intensive survey of the major writers of modern British literature.

Instructor: S. Sears
Spring, 3 credits

EGL 560 Studies in Early American Literature

Colonial: A study of the forging of American culture in the furnace called Puritanism. The course asks the student to set aside stereotypical notions about Puritanism and to enter imaginatively into its way of understanding man and nature. We will be looking at Puritan writing in a historical way, as offering a view of some of the processes by which a variety of 17th Century European Protestantism evolved into a peculiarly American 19th Century ro-

manticism. Among the authors to be looked at: William Bradford, John Winthrop, Thomas Hooker, Thomas Shepard, Ann Bradstreet, Edward Taylor, Michael Wigglesworth, Cotton Mather, Jonathan Edwards, Benjamin Franklin, Charles Brockden Brown, and Washington Irving.

Instructor: D. Laurence
Fall, 3 credits

EGL 565 Studies in 19th Century American Literature

The course will concentrate on the work of Emerson, Thoreau, Hawthorne, Melville, and Whitman in the cultural context of America's literary coming of age.

Instructor: E. Fiess
Fall, 3 credits

EGL 570 Studies in 20th Century American Literature

An examination of the major works of Hemingway, Faulkner, Fitzgerald, Cummings, Stevens, Ransom, and of contemporary periodicals.

Instructor: J. Thompson
Fall, 3 credits

Modern American Literature: American fiction and poetry since 1945. The writers will be representative of various post-war literary trends. The novelists include Ellison, Pynchon, Mailer, Bellow, Kerouac, Walker Percy and Toni Morrison. Some of the poets include Olson, Creeley, Baraka, Ginsberg, and Adrienne Rich, and in the closing weeks we will also take a glance at several of the younger poets like Ted Kooser and Ai. The readings will be evenly divided between prose and poetry.

Instructor: W. Harris
Spring, 3 credits

EGL 592 Problems in Teaching Writing or Composition

Primarily for teachers of English, this course will deal with the adaptation of classical rhetoric for modern use. Participants will be expected to do the reading and writing that they ask of their students as well as to design writing exercises based upon rhetorical principles.

Instructor: D. Fortuna
Fall, 3 credits

EGL 593 Problems in Teaching Literature

Analytical class discussion of stories, poems and other genres and their classroom use; sample student papers on literature; at least three assigned papers.

Instructor: T. Rogers
Spring, 3 credits

EGL 596 Problems in Teaching Reading in the Secondary School

An examination and evaluation of the psycholinguistic model of the reading process. Some comparisons are offered between psycholinguistic and word perception models. Also examined are diagnostic factors related to the reading process from a systems framework. Several links are provided between theory and practice for the classroom teacher. Reading in the content areas is explored and evaluated with insights gained from psycholinguistic theory, field theory, information processing theory, and knowledge of affective mobilizers. Also explored are issues related to

speed in reading; dialectal variants; materials for students; and organization for improving reading effectiveness in the secondary classroom.
Instructor: A. Lipton
Spring, 3 credits

EGL 599 Independent Studies

Fall and spring, 3 credits each semester
Staff

EGL 600 Pro-Seminar I

Classical Backgrounds: the development of the major genres. Reading (in translation) and analysis of representative Greek and Latin pastoral, georgic, epic, drama, and satire as background to the study of English literature. Concepts of genres, development of forms, structures, techniques.

Instructor: T. Maresca
Fall, 3 credits

EGL 602 Problems in Bibliography, Editing and Textual Criticism

Paleography: A general introduction to editing and manuscript-study. We will practice reading handwriting in the Old English, Middle English, and Early Modern periods, and will discuss bibliographical issues that relate to editing. We will also consider recent theoretical and scientific approaches to manuscript-study. Each student will deliver an oral report and submit a short edition of a text from any period in the history of English literature.

Instructor: S. Spector
Spring, 3 credits

EGL 603 Problems in Literary Theory and Criticism

Perspectives on Literature: I wish to take the students through an inquiry that will introduce them to the idea that there are many points of view from which we may approach a work of literature. We will examine a single text, *Dangling Man* by Saul Bellow, from the biographical, psychological, historical, social, philosophical, religious and mythic, as well as formal point of view. We will discover that there are different kinds of questions that we must ask and that there are different kinds of answers we may derive as we move from one context to another. The students will decide for themselves which of the various modes of inquiry best suit their personal taste but their choice will be based on informed judgment.

Instructor: R. Miller
Fall, 3 credits

Literary Method: Critical analysis of the major approaches to the understanding of literature, e.g., source study, textual, biographical, literature and the other arts, sociological, history of ideas.

Instructor: H. Weisinger
Spring, 3 credits

EGL 604 Problems in Literary Analysis

Twentieth Century American Poetry: Theory and Practice. An in-depth examination of works by Pound, Eliot, Williams, C. Olson, et al.

Instructor: L. Simpson
Spring, 3 credits

EGL 605 Problems in Convention and Genre

(section 1) Old English Poetry: Seminar in Old English poetry and literary technique. Some attention to cultural backgrounds and paleography. We shall translate and discuss either the Exeter Book or the Vercelli Book. Oral reports and one research paper.

Prerequisite: one semester of Old English or equivalent
Instructor: D. Fry
Fall, 3 credits

(section 2) Spenser, Milton & Epic: Close readings of *The Faerie Queene* and *Paradise Lost* in the light of epic tradition and allegories. Reading acquaintance with Homer and Virgil will be useful, but is not a prerequisite.

Instructor: T. Maresca
Fall, 3 credits

EGL 606 Problems in Period and Tradition

(section 1) Victorianism: The 1850's. The course will focus on the 1850's decade of High Victorianism, a ten-year span which begins with the publication of Tennyson's *In Memoriam* and Wordsworth's *Prelude* and ends with the publication of Darwin's *Origin of Species* and Mill's *On Liberty*. After a preliminary investigation of the period, we will examine the decade year-by-year during which major works by Tennyson, Browning, Dickens, Thackeray, Charlotte Bronte, Trollope, Arnold, and George Eliot were published.

Instructor: J. Bennett
Fall, 3 credits

(section 2) Problems in the Interpretation of American Literature: This seminar is designed as an introduction to the influential and essential interpretations of classic American literature since its rediscovery in the 1920's. The class will choose a number of works and authors which have given rise to one or another major approach to American literature.

Instructor: P. Shaw
Fall, 3 credits

(section 1) Representation of the Individual and Society in the 19th Century Novel: The seminar will examine the social analysis of fiction through an investigation of several critical methods and their practical application. Among the critics to be read: Ian Watt, Lucien Goldmann, George Lukacs, Leo Lowenthal, Lewis Coser, John Henry Raleigh, Raymond Williams, Lionel Trilling. The novels to be discussed: *Emma*, *Bleak House*, *Vanity Fair*, *Middlemarch*, *The Way We Live Now*, *Beauchamp's Career*, *Jude the Obscure*. Students should be familiar with these novels before the start of the seminar.

Instructor: R. Levine
Spring, 3 credits

(section 2) 19th Century American Literature: An intensive survey of the major writers of 19th Century American Literature.
Instructor: P. Newlin
Spring, 3 credits

(section 3) Studies in the Irish Literary Renaissance, 1886-1916: An intensive stu-

dy in the early years of the Irish literary movement, centering on Yeats, but addressing also Lady Gregory, Synge, Douglas Hyde and others.

Instructor: T. Flanagan
Spring, 3 credits

EGL 607 Problems in Individual Authors

(section 1) Herbert & Vaughan: Herbert's poetry and prose will be studied, and in Vaughan the stress will be on *Silex Scintillans* and its affinities with *The Temple*.

Instructor: J. Pequigney
Fall, 3 credits

(section 2) Fielding & Austen: Fielding and Austen invite comparative study as comic novelists who combine great formal ingenuity with strong ethical concerns. The seminar will focus on problems of formal analysis and the relation of ideas and values to narrative structure and technique, identifying the distinguishing features of each author's characteristic comic mode and tracing its evolution or modification, defining their particular ethical concerns and values, and comparing their masculine and feminine sensibilities or outlooks. Works to be discussed will include *Shamela*, *Joseph Andrews*, *Tom Jones*, *Northanger Abbey*, *Pride and Prejudice*, *Emma*, and *Persuasion*.

Instructor: H. Goldberg
Fall, 3 credits

(section 3) Romanticism: Coleridge Entire (poetry, criticism, philosophy, journalism, diaries, marginalia...)

Instructor: D. Erdman
Fall, 3 credits

(section 4) James Joyce: Focus will be on *Ulysses*, and much of the class time will go into a chapter by chapter anatomy of the novel. *Dubliners*, *Portrait*, *Finnegans Wake*, Joyce's poetry, play, criticism, will be read too, with shifts in critical and scholarly approaches to Joyce related to changes in artistic and critical styles during the first seventy years of this century. As usual, the emphasis will be determined by the interests of those who make up the course community.

Instructor: J. Ludwig
Fall, 3 credits

(section 1) Donne: A close study of selected poems in several genres as well as the *Devotions* and several sermons. Papers will focus on the relationship of literary tradition to contemporary theme in the individual pieces.

Instructor: T. Kranidas
Spring, 3 credits

(section 2) Pope: An intensive study of the major works.

Instructor: T. Maresca
Spring, 3 credits

(section 3) Hemingway & Fitzgerald: An intensive study of the major works.

Instructor: J. Thompson
Spring, 3 credits

EGL 609 Problems in Comparative Literature

Form, Time, Space and Change in Modern Literature: Readings in Woolf and selected other major modern figures. Also, Bergson

Jung, Werner, Heisenberg and others.
Instructor: S. Sears
Fall, 3 credits

EGL 611 Pro-Seminar II

This course will examine the nature of literary interpretation. The questions to be raised are: Is there a single correct reading for a literary work? If one believes that such a reading exists in principle, how does one know that one has found it in any given case? Is it actually the main business of practical criticism to formulate correct readings? We shall also consider how a

critic's views on the nature of interpretation influence his or her views on what makes a literary work valuable and on what the proper concerns of English Departments are. Among the authors read will be E.D. Hirsch, Jr., Monroe Beardsley, and Jonathan Culler.
Instructor: B. Bashford
Spring, 3 credits

EGL 690 Dissertation Research

Staff
Fall and spring, variable credit

EGL 697 Practicum in the Teaching of English Composition

For new Teaching Assistants
Instructor: B. Bashford
Fall, 3 credits

EGL 699 Directed Reading for Doctoral Candidates

Staff
Fall and Spring, variable credit

Environmental Engineering

ESC 504 Environmental Pollution

The pollutants in our environment, their sources, effects, and methods for their control. Pollution of the air, water, and land as well as the inter-relationships among these will be discussed.
Fall, 3 credits

ESC 505 Principles of Water Pollution

The basic microbial and chemical processes are examined, especially as they relate to public health and environmental deterioration. The role of micro-organisms as pathogens, pollutants, and in pollution control; the implications for aquatic ecosystems of waste and thermal loading.
Fall, 3 credits

ESC 506 Water Quality Laboratory

An introduction to the field and laboratory techniques used in measuring and predicting water quality. Sampling and monitoring methods, data handling and evaluation.

Co-requisites: MSA 547, ESC 505
Fall, 3 credits

ESC 509 Engineering Hydraulics

Steady and varied flow in open channels; transient flow and water hammer phenomena in closed conduits. Study of the flow of viscous suspensions. Applications to weir, transition and spillway design and the flow of liquids, air, and sludge; pumps and meters.
Spring, 3 credits

ESC 517/518 Waste Water Collection and Treatment Systems I and II

The principles of designing and operating an adequate, efficient, and non-pathogenic waste water collection and treatment system. Municipal and industrial sewage treatment, sedimentation, coagulation, filtration, chemical treatment, aeration, activated sludge, phosphorous and nitrate removal, and other advanced treatment methods. Ultimate disposal and the holding and disposal of solids.

Prerequisites: ESC 505, 509 or equivalent
Fall and spring, 3 credits each semester



ESC 519 Water Supply Design

Water requirements for public, industrial, agricultural, and other usage. The principles of designing an adequate, efficient, and non-pathogenic water supply system. The collection, purification, conditioning, storage and distribution of municipal water supplies.

Prerequisites: ESC 505, 509 or equivalent
Fall, 3 credits

EMP 510 Water Supply Management

Surface and ground water hydrology; the availability of water resources. Strategies for maintaining a continuous safe yield; the water budget, multi-purpose use and reuse, the effects on ground water systems of withdrawal and recharge. Water distribution systems; dams and reservoirs and their ecological impact.
Fall, 3 credits

EMP 511 Environmental Law

The legal aspects of water supply and pollution; national, state, and local laws and codes pertaining to water, air and land pollution, and solid waste disposal. Compliance with these regulations: the statutory responsibilities of private and governmental organizations. Environmental impact statements, their preparations and assessment. The availability of and requirements for obtaining federal and state

funding.

Biennially, 3 credits

EMP 512 Land Use Planning and the Environment

The application of engineering methods to micro- and macro-regional planning and development. Zoning, transportation, resource supply and effluent disposal are considered in the context of resource demand and environmental protection. The use of surveys as a planning tool.

Biennially, 3 credits

MSA 547 Statistical Methods for Environmental Engineering

A one semester survey course in statistical methods. Applications will be to water and air quality programs. Topics: basic concept of sampling and data analysis, and of linear modelling procedures. The techniques of analysis of variance and linear regression will also be discussed.

Fall, 3 credits

MSA 548 Models for Water Resource Management

Introduction to cost benefit analysis and linear and integer programming techniques. Optimal siting applied to water supply and treatment. Multi-dimensional regional optimization.

Spring, 3 credits

French

FRN 500 Techniques of Reading for Graduate Research

Through intensive study of language structures and idiomatic usage, with extensive practice in written translation of scholarly texts, candidates for advanced degrees are able to attain the proficiency level of the graduate French reading requirement. Several departments grant exemption from further examination for successful completion of this course.

Fall, 3 credits

FRN 501 Contemporary French Culture and Institutions

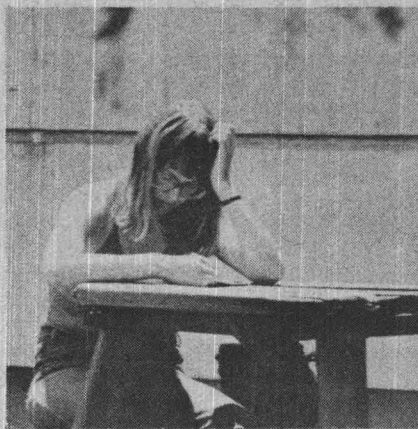
Analysis of contemporary French civilization through the study of the development of its historical, cultural, political, and social characteristics. Designed for potential teachers of French at the college level as well as in secondary schools, this course will emphasize and trace the evolution of the character and institutions of contemporary France. Open to qualified CED students.

Spring, 3 credits

FRN 507 Advanced Stylistics

Designed to deepen the advanced student's knowledge of the finer points of the syntax, structure, and stylistic versatility of the French language, this course, during the first semester, will emphasize three principal exercises: translations from English into French stressing idiomatic turns of phrase and correct structuring, compositions in the French language, and advanced work in major discrepancies between French and English syntax.

Fall, 3 credits



FRN 508 Explication de Texte

Emphasis will be placed upon weekly explication de texte, beginning with Renaissance literature, and proceeding to the modern period, in which analysis will be made of those effects that, taken together, constitute a given author's stylistic pattern.

Spring, 3 credits

FRN 514 Seminar in Medieval Literature

Topic for the 1979 fall semester: The Cult of Woman in Medieval French Literature. This course may be repeated for credit when topic changes.

Fall, 3 credits

FRN 521 Literature of the French Renaissance

A study of major literary and cultural developments characteristic of the civilization of the Renaissance in France. The works of such writers as Rabelais, Ronsard and Montaigne will serve as both focus and starting point for broader inquiry into the

artistic, social and cultural movements accompanying the rebirth of art and letters in France.

Spring, 3 credits

FRN 541 Studies in 18th Century French Literature

Study of the background of the Enlightenment in France and its development throughout the 18th century. Extensive reading of such authors as Rousseau, Diderot, Voltaire, Laclous stressing literary technique, themes, and major trends in prose, poetry, and the theater.

Fall, 3 credits

FRN 552 Studies in 19th Century French Literature

Investigation of special topics and movements in 19th century French prose and poetry based on the study of the works of such authors as Chateaubriand, Benjamin Constant, Balzac, Baudelaire, Flaubert, Zola, and stressing the evolution of genres in the context of such phenomena as realism, symbolism, naturalism.

Spring, 3 credits

FRN 562 Studies in Contemporary Literature

The active pursuit of humanist ideas from Anatole France to Louis Guilloux, from Romain Rolland to Camus, with emphasis on the works of Valery Larbaud, Roger Martin du Gard, Andre Gide, and Andre Malraux.

Fall, 3 credits

FRN 581 Independent Individual Studies

Variable and repetitive credit
Fall and spring

FRN 599 Practicum in Teaching

Variable and repetitive credit
Fall and spring

Germanic Languages and Literatures

GER 500 Intensive Reading German

Intensive introductory German for non-majors. Practice in reading and translation; German prose; use of dictionaries and reference materials; as much attention as possible to special problems of various disciplines.

Instructor: O'Neil

Fall and spring, 3 credits each semester

GER 501 Strategies of Teaching German

Detailed examination of various approaches to teaching German as a foreign language, conventional teaching aids; use of media in instruction. [Given at Goethe House in New York City.]

Instructor: Meyer

Fall, 3 credits

GER 502 Language Practicum

Techniques of classroom instruction; teacher and peer visitation and evaluation.

To be taken in conjunction with initial teaching assignment.

Staff

Fall and spring, 3 credits each semester

GER 503 Literature Practicum

Apprenticeship to a senior professor for work in undergraduate literature course. Preparation and delivery of lectures. Evaluation of students' performance in class and written work.

Staff

Fall and spring, 3 credits each semester

GER 504 German Cultural History

19th Century: The course will examine some of the cultural stages of 19th Century German history and will place special emphasis on the observations on and sometimes participation in contemporary developments by writers, artists and other intellectuals of the time. (Cross-listed with

HIS 508)

Instructor: Werner T. Angress (Guest professor, History Dept.)

Fall, 3 credits

20th Century: Examination of developments in German-speaking countries in the areas of history of political and social systems and the arts during the late 19th and 20th centuries (cross-listed with CED 508).

Instructor: Elling

Spring, 3 credits

GER 506 Advanced Stylistics

Advanced stylistics and textual analysis. Designed to deepen the advanced student's knowledge of the finer points of syntax, structure and stylistic versatility of the German language.

Staff

Spring, 3 credits

GER 525 Contrastive Analysis

The course offers a survey of linguistic typology and examines the ways in which linguistic sub-systems may legitimately be compared across languages, thus providing a basis for devising strategies for teaching one language to speakers of another language.

Instructor: Hall
Spring, 3 credits

GER 526 Analysis of an Uncommonly Taught Language

Working from primary and secondary sources students will construct an outline of the phonology, morphology, and syntax of a language previously unknown to them.

Instructor: Hall
Spring, 3 credits

GER 541 Literature of the Goethe Period

Die Weimarer Klassik: Goethe und Schiller. The major figures considered as poets, philosophers and theoreticians of the arts and literature.

Instructor: Karst
Spring, 3 credits

GER 545 20th Century Poetry

A survey of 20th Century poetry with emphasis on the poetry of Expressionism.

Instructor: Brown
Spring, 3 credits

GER 546 Twentieth Century Drama

Concentration on aspects of modern drama e.g., Brecht's anti-illusionistic theatre, and drama as a vehicle for dissemination of political ideology. Readings will also include works by Ionesco, Beckett, Frisch, and Grass. (Cross-listed with CEL 503)

Instructor: Brown
Fall, 3 credits

GER 547 Special Author Studies

Ernst Barlach: An intensive study of the life and works of Ernst Barlach, stressing the interplay of graphic, verbal, and visual art.

Instructor: O'Neil
Spring, 3 credits

GER 548 Special Period Studies

Das burgerliche Schauspiel. The emergence of the bourgeoisie in the German drama of the Enlightenment.

Instructor: Russell
Spring, 3 credits

GER 549 Theory and Criticism

Problems of Realism. Studies in Georg Lukac's later works: *Wider den miBverstandenn Realismus* and his *Aesthetik*, with reference to the international development of Marxist literary sociology (Benjamin, Brecht, Caudwell). Cross-listed with CLT 601.

Instructor: Schroter
Fall, 3 credits

GER 555 Scandinavian Literature

Mythology: Cross-listed with CLT 508.

Instructor: Sjoberg
Fall, 3 credits

Scandinavian Nobel Prize winners: Bjornson, Undset, Hamsun, Lagerlof, Heidenstam, Lagerkvist, Laxness, Johns. V. Jensen (and Blixen-Denesen).

Instructor: Sjoberg
Spring, 3 credits

GER 557 History of the German Language

The development of the German Language from Indo-European to modern High German: a representative selection of texts from different periods will be examined.

Instructor: Berr
Fall, 3 credits

GER 558 Middle High German

Instructor: Ruplin
Spring, 3 credits

GER 562 Gothic and Indo-European

Instructor: Berr
Spring, 3 credits

GER 563 Old High German

Instructor: Ruplin
Fall, 3 credits

GER 599 Masters Thesis

Variable and repetitive credit

GER 601 Special Author

Tutorial to be arranged with appropriate staff member.

Fall and spring, 3 credits each semester

GER 602 Special Period

Tutorial to be arranged with appropriate staff member.

Fall and spring, 3 credits each semester

GER 603 The Middle Ages

Medieval German Lyric. Middle High German lyric and its antecedents.

Instructor: William T.H. Jackson (Guest professor, Columbia University)
Fall, 3 credits

GER 699 Doctoral Dissertation

Taken after advancement to candidacy. Repetitive, 3 credits each semester

TESOL COURSES**GER 521 Syntax**

A study of the fundamental notion of a grammar and the application of the general method of modern syntax to specific problems.

Instructor: Hall
Fall, 3 credits

GER 522 Phonetics

Articulatory, acoustic and physiological phonetics with some attention paid to speech perception.

Instructor: Welden
Fall, 3 credits

GER 523 Phonology and Morphology

An investigation of the paradigmatic and syntamatic constraints on the sound structure and morphology of English.

Prerequisite: GER 522
Instructor: Welden
Spring, 3 credits

GER 524 Methods of TESOL

An analysis of the differences between first and second language acquisition and relevant learning principles.

Instructor: Chanover
Fall, 3 credits

GER 527 English Grammar and Usage

An analysis of "good" or "correct" usage of English for practical application in the classroom.

Instructor: Anshen
Spring, 3 credits

GER 530 Introduction to General Linguistics

An introduction to modern theoretical and applied linguistics.

Instructor: Staff
Fall, 3 credits

GER 531 Language Testing

How the general principles of measurement can and are applied to the assessment of linguistic functioning.

Instructor: Carton
Spring, 3 credits

GER 532 Selected Topics in Linguistics

Language Acquisition and Creolization: A consideration of how pidgins become creoles and what this process reveals about universals of language acquisition.

Instructor: Bickerton
Fall, 3 credits

GER 528 Practicum in TESOL I

Reading: The teaching of English to non-native speakers. Practical classroom experience.

Instructor: Chanover
Fall and spring, 3 credits each semester

GER 529 Practicum in TESOL II

Speaking: The teaching of English to non-native speakers. Practical classroom experience.

Instructor: Chanover
Fall and spring, 3 credits each semester

Hispanic Languages and Literatures

SPN 501 Seminar in Spanish Linguistics

3 credits each semester, repetitive

SPN 512 Seminar in Medieval Literature

3 credits, repetitive

SPN 515 Seminar in Spanish Composition and Stylistics

Advanced language course for the beginning graduate student. Required by new Doctor of Arts Program; also useful for

M.A. and Ph.D. students.
3 credits, non-repetitive

SPN 523 Seminar in Renaissance and Golden Age Literature

3 credits, repetitive

SPN 528 Seminar in Cervantes

3 credits, repetitive

SPN 531 Seminar in Spanish Enlightenment and Romanticism
3 credits, repetitive

SPN 541 Seminar in 19th Century Spanish Literature until the Generation of 1898
3 credits, repetitive

SPN 543 Seminar in 20th Century Spanish Literature
3 credits each semester, repetitive

SPN 552 Seminar in Colonial Spanish-American Literature
3 credits each semester, repetitive

SPN 562 Seminar in 19th Century Spanish-American Literature
3 credits, repetitive

SPN 569 Seminar in Spanish-American Modernism
3 credits, repetitive

SPN 571 Seminar in 20th Century Spanish-American Literature
3 credits each semester, repetitive

SPN 595, 596 Independent Individual Studies
Not more than nine (9) of these credits are Program must obtain permission from the Director of Graduate Studies or the Chairman before registering in these courses.

SPN 581 Seminar: Cultural Aspects of Hispanic Bilingual-Biculturalism
3 credits, non-repetitive

SPN 583 Spanish and English: Languages in Contact I
3 credits, non-repetitive

SPN 584 Spanish and English: Languages in Contact II
Prerequisite: SPN 583 or permission of instructor
3 credits, non-repetitive

SPN 585 Seminar in Caribbean Literature
3 credits, repetitive

SPN 586 Seminar in the Hispanic Literature in the United States
3 credits, non-repetitive

GRADUATE READING COURSES

SPN 500 Reading Spanish
Not given to graduate Spanish students.
3 credits

POR 500 Reading Portuguese
3 credits

COURSES IN HISPANIC BILINGUAL-BICULTURAL STUDIES

Graduate Spanish students not enrolled in the Hispanic Bilingual-Bicultural Studies acceptable toward the Ph.D., and not more than six (6) toward the M.A.
Variable and repetitive credit

SPN 609 Literary Theory
M.A. students may be admitted only with permission of instructor.
3 credits, non-repetitive

SPN 621 Problems in Comparative Hispanic Literature
M.A. students may be admitted only with permission of instructor.
3 credits, repetitive

SPN 691 Practicum in Lower Division Teaching
3 credits, repetitive

SPN 693 Practicum in the Teaching of Advanced Language and Literature
3 credits, non-repetitive

SPN 695, 696 Directed Doctoral Research
Variable and repetitive credit

History

To prepare students for examinations, research work, and teaching, the Department of History offers the following kinds of graduate courses.
All courses are for 3 credits unless otherwise noted.

HIS 500 Historical Research: An Introduction

HIS 501, 502 Reading Colloquia in Ancient and Medieval History

HIS 503-510 Reading Colloquia in European History Since 1500

HIS 511 Reading Colloquium in Topics in the History of Science

HIS 515-517 Reading Colloquia in European History Since 1500

HIS 521-534 Reading Colloquia in United States History

HIS 541-545 Reading Colloquia in Latin American History

HIS 552-555 Reading Colloquia in English History

HIS 561 Reading Colloquium in East Asian History

HIS 581 Supervised Teaching

HIS 582-586 Directed Readings for M.A. Candidates
Variable and repetitive credit

HIS 590 Reading Colloquium in Quantitative Methods

HIS 593 Reading Colloquium in Psychoanalysis and History

HIS 600 Research in Social History

HIS 601, 602 Research Seminars in Ancient and Medieval History

HIS 603-610, 615-617 Reserach Seminars in European History Since 1500

HIS 621-634 Research Seminars in United States History

HIS 641-645 Research Seminars in Latin American History

HIS 652-655 Research Seminars in English History

HIS 661 Reserach Seminar in East Asian History

HIS 682-686 Directed Readings for Ph.D. Candidates
Variable and repetitive credit

HIS 699 Research for Ph.D. Candidates
Variable and repetitive credit

The research and reading courses offered and the topics they cover depend on student needs and availability of faculty. However, at least one research and reading colloquium in each area, i.e., U.S., European and Latin American History are given each semester. The student should consult the department's courser depend on student needs and availability of faculty. However, at least one research and reading colloquium in each area, i.e., U.S., European and Latin American History are given each semester. The student should consult the department's course list each semester for details on topics and faculty teaching the course.



Industrial Management

REQUIRED COURSES

EMP 500 Management Policy and Planning by Case Study

This course provides the student with experience in analyzing complex, multi-factor management problems in the context of realistic case studies. The cases cover areas such as marketing, finance, labor relations, strategic planning, design of administrative organization, corporate response to social change.

Prerequisite: EMP 502
3 credits

EMP 501 Behavioral and Organizational Aspects of Management

This course provides an understanding of the management process by analyzing organizational behavior. Topics include: behavior in 2-person situations, factors influencing attitudes and changes in organizational behavior, group influence on behavior, formal and informal organizational structures; conflict and conflict resolutions and the dynamics of planned change.

3 credits

EMP 502 Management Accounting and Financial Decision Analysis

Fundamentals of managerial accounting with emphasis on cost accounting terms, concepts; ratio and break even analysis, systems design, cost allocation. Qualitative and quantitative considerations in financial decision analysis; financial structure, cost analysis, opportunity costs and return calculations, replacement of assets, portfolio theory.

3 credits

EMP 503 Legal and Regulatory Aspects of Management

This course provides a survey of business and regulatory law. Topics discussed include contracts, sales and forms of business organizations. An overview is provided of antitrust, environmental and civil rights legislation and their impact on business.

3 credits

EMP 504 Quantitative Methods in Management

A rapid introduction to the application of modern mathematical concepts and techniques in management science. Algebraic operations, mathematical functions and their graphical representation, and matrix operations are reviewed. Topics covered include the following: Breakeven analysis; mathematics of interest, annuity, and mortgage; traffic flow and other systems of linear equations; algebraic and simplex methods of linear programming; probability; statistics of acceptance testing; Markov chain modelling of market transitions; queuing models. Simple management oriented examples are used to introduce mathematical formulations and exten-



sions to more general problems.
Prerequisite: Undergraduate mathematics including differential calculus
3 credits

EMP 505 Investments and Portfolio Management

Provides an introduction to investments in stocks, bonds, options, commodities and the design of portfolios to realize optimal return on investment at least risk. Topics include operations of the securities markets, evaluation of investments, trading strategies, timing, risk vs. return analysis, efficient market theory, capital market theory.

Prerequisite: EMP 502
3 credits

EMP 506 Taxation

This course provides an introduction to the principles of federal taxation emphasizing applications to management planning and strategies. Other topics include estate and gift taxes with particular emphasis on the many and varied tax-saving methods, estate planning, and tax shelters.

Prerequisite: EMP 502
3 credits

EMP 507 Research in Special Topics

Research in special topics on industrial management either individually or in a seminar setting.

Prerequisite: Completion of core program or 18 credits, whichever applies and permission of Program Director and supervising faculty member
3 credits

MSC 534 Data Base Management

The course consists of a short introduction to present and future data base management systems following which the main focus is on the application to which such systems are put. Emphasis is on the institutional impact of data base systems and the management implications of their installation, use and administration.

3 credits

SUGGESTED ELECTIVES

CEN 571 Analysis and Management of Public Policy

CES 565 Personality, Theories and Assessment

ECO 552 Money and Banking

ECO 554 Work, Education and Health

ECO 580 National Income, Employment and Money

MSA 537, 538 Operations Research I, II

MSA 569 Introduction to Applied Probability

MSA 570 Statistics I: Estimation

MSA 572, 573 Data Analysis I, II

EMP 508 Case Studies in Organizational Behavior

Application of behavioral science principles and research to the solution of intra-organizational problems on 3 levels of behavior: inter-personal situations including superior subordinate as well as peer relationships, dynamics of work groups from viewpoints of both leadership and membership roles, problems of larger organizational self-systems and the organization as an entity. Theory and research will be applied through case studies to the solution of day-to-day problems as well as longer-range behavioral issues faced by organizations.

Prerequisites: EMP 501 or permission of instructor
Fall, 3 credits

EMP 509 Management Information Systems

The flow of data in industrial and governmental organizations. How information is stored, analysed, and disseminated for various management tasks. The physical and logical organization of computer data processing systems. Principles of file processing, data base management, and information systems designs. (Cross-listed with MSC 533)

Spring, 3 credits

EMP 513 Social Insurance

The problems involved with modern social insurance, public and private pension systems, unemployment insurance, disability benefits, health insurance, etc., are examined as they affect the covered populations, management, labor, legislators, and government and private administrators of such programs. Included are such topics as cost estimates, solvency, and future trends in population, labor force, and the economy.

Spring, 3 credits

Italian

ITL 500 Reading Italian

Designed to prepare graduate students to read contemporary research in their respective disciplines published in Italian, the course will present systematic instruction in the fundamentals of reading comprehension and in specialized subject-oriented vocabulary.
Fall, 3 credits

ITL 501 Contemporary Italy

Analysis of contemporary Italy and its civilization through the study of the development of its historical, cultural, political, and social characteristics. Designed for potential teachers of Italian at the college level as well as secondary schools, this course will emphasize and trace the evolution of the character and institutions of contemporary Italy.
Fall, 3 credits

ITL 508 Advanced Grammar and Stylistics

This course is designed to analyze and discuss the finer points of Italian grammar and to investigate diverse styles in writing. Students will be expected to develop grammatical drills from elementary through



advanced levels. Literary masterpieces will be translated from English to Italian in order to demonstrate types of style and possible alternatives in writing.
Prerequisite: Intermediate Italian
Spring, 3 credits

ITL 511 History of the Italian Language

A study of the development of the Italian

language beginning with its origins in Latin, through the vulgate (dialects) and finally as an outgrowth of Tuscan.
Spring, 3 credits

ITL 552 Studies in the Modern Novel

A study of the development of the Italian novel from Verga to the latest trends. Stress will be placed on the major shift in sensibility occurring at the beginning of the 19th century and after World War II. This course may be repeated when the topic changes.
Spring, 3 credits

ITL 562 Studies in Contemporary Literature

Contemporary Italian literature oscillates between political commitment and disavowal of any form of engagement. The works of Pirandello, Moravia, Pavese, Ungaretti, Quasimodo, Montale, Vittorini, Betti, De Filippo will be studied in the context of such phenomena as Existentialism, Psychoanalysis, Fascism and Marxism. Topics will vary from semester to semester.
Fall, 3 credits

ITL 581 Independent Individual Studies

Variable and repetitive credit
Fall, spring

Marine Environmental Sciences

MAR 501 Physical Oceanography I

Seawater properties, T/S diagrams, turbulence, mixing, diffusion and advection, air-sea interaction, thermohaline and wind driven circulation, pressure gradient, Coriolis, buoyancy and frictional forces, geostrophic and Ekman transports, waves and tides, estuaries, modeling.
Fall, 3 credits

MAR 502 Biological Oceanography

A treatment of the dependencies of biological communities on the physical and chemical properties of the marine environment with emphasis on the planktonic communities of coastal and estuarine environments. Includes laboratory experience directed towards imparting analytical skills.
Spring, 4 credits

MAR 503 Chemical Oceanography

Introduction to chemical oceanography. Topics include: origin and history of seawater, physical properties of seawater, major and minor constituents, dissolved gases, the carbon dioxide system, distribution of properties in the World Ocean, chemical equilibria. Also includes laboratory exercises.
Fall, 4 credits

MAR 504 Physical Oceanography II

The course examines the fundamental principles of hydrodynamics and the relationship between these principles and the

methods and results in physical oceanography. It discusses the equation of state and the conservation of mass, momentum, and energy.

Prerequisite: MAR 501
Spring, 3 credits

MAR 506 Geological Oceanography

An introduction to the geological oceanography of the World Ocean with emphasis on the coastal environment; discussions of the physical processes controlling the structure and evolution of the ocean basins and continental margins, the distribution of marine sediment and the development of coastal features. Field trip required.
Spring, 3 credits

MAR 521 General Problems of the Marine Environment

The course examines the multiple utilization of the marine environment. Ecological and economic problems that result from conflicting uses are investigated and methods for the management of marine resources are discussed.
Fall, 3 credits

MAR 522 Case Studies in Environmental Problems

Several current environmental issues will be examined in depth from a multidisciplinary viewpoint. These will include such topics as pesticide contamination, energy utilization, and water resource management.
Spring, 3 credits

MAR 523 Marine Botany

Lectures will stress ecology, morphology, physiology, reproduction and systematics of phytoplankton, macroalgae and seagrasses. Laboratory will consist of isolation techniques, physiology experiments and productivity assessment. Several field trips will be undertaken. 2 hr. lecture, 2 hr. laboratory per week.
Spring, 4 credits

MAR 530 Scientists in Organizations

An introduction to marine scientists in public and private organizations including an assessment of the role of the scientist in an organization and in the administration of science.
Fall 1979, 3 credits

MAR 531 Regional Planning Applied to Marine Sciences

This course will introduce the theories, techniques and literature of regional planning with special emphasis as a decision-making tool related to the marine environment.
Fall, 3 credits

MAR 532 Case Studies in Coastal Planning

This course will address the application of regional planning with the marine sciences input in the development of governmental programs for coastal zone management, water quality control and management. Long Island case studies will be the basis

for this course.
Prerequisite: MAR 531
Spring, 3 credits

MAR 533 Fishery Management

Marine fishery management, successes and failures, and biological, physical-chemical, economic, and socio-political background. Case histories of domestic and international fishery management problems and solutions. The Fishery Conservation and Management Act of 1976, which extended U.S. fishery jurisdiction to 200 miles, is treated in detail.
Fall, 3 credits

MAR 550 Topics in Marine Sciences

This is used to present special interest courses, including intensive short courses by visiting and adjunct faculty and courses requested by students. Those given in recent years include Environmental Law, Nature of Marine Ecosystems, Science and Technology in Public Institutions, Plutonium in the Marine Environment, and Problems in Estuarine Sedimentation.
Section 1: Tutorial
Fall and spring, variable and repetitive credit
Other sections as announced by the Center.

MAR 580 Seminar

A weekly series of research seminars presented by visiting scientists and members of the staff.
Fall and spring, 1 credit each semester, repetitive

MAR 590 Research

Original investigation undertaken with the supervision of the Advisor.
Fall and spring, variable and repetitive credit

Materials Science and Engineering

ESM 502 Techniques of Materials Science

A survey of the important experimental methods employed in the studies of materials. Essentially a laboratory course where the student carries out refined measurements using research grade equipment. The areas covered include X-ray diffraction studies of crystalline and amorphous materials, optical properties of materials. The course also covers the use of radiation counters, determination of phase diagrams, the study of polymers, etc.
Fall, 4 credits

ESM 504 Production Processes

A study of manufacturing processes used in the semiconductor industries. Topics include: Single crystal growth, compound formation, zone refining, epitaxial growth, doping techniques, thin film techniques, thick film techniques, passivations, isolations, lead bonding techniques, cleaning and etching, and failure analysis; discrete devices and integrated circuit devices; various modern concepts in IC processing.
Fall, 3 credits

ESM 505 Diffraction Techniques and the Structure of Solids

The structure of solids can be studied using X-ray, neutron and electron diffraction techniques. Topics covered are: coherent and incoherent scattering of radiation, structure of crystalline and amorphous solids, stereographic projection and crystal orientation determination; concept of reciprocal vector space. Laboratory work in X-ray diffraction is also included.
Fall, 4 credits

ESM 506 Mechanical Properties of Engineering Materials

The deformation of engineering materials under stress is described by classical theories of elasticity and plasticity. Macroscopic mechanical properties are interpreted in terms of thermal dynamics, lattice mechanics, and microstructure of these materials. The course deals with quasi-static and dynamic testing techniques for delineating mechanical properties of materials, considering elasticity, anelasticity, plasticity, cohesive strength, and fracture.

Attention is given to strengthening mechanisms and material reliability.
Fall, 3 credits

ESM 507 Imperfections in Crystals

The characteristics of point defects in metals, semiconductors, and ionic solids are described, and the thermodynamics of point defects is developed. Dislocation theory is introduced and the structures of internal boundaries are described. Finally, interactions between lattice imperfections are discussed, with emphasis on plasticity and fractures.
Spring, 3 credits

ESM 509 Thermodynamics of Solids

Current knowledge regarding the thermodynamic properties of condensed phases is discussed. The thermodynamic treatment of ideal, regular, and real solutions is reviewed. Estimation of reaction free energies and equilibria in condensed phase reaction such as diffusion, oxidation and phase transformations; thermodynamic analysis of phase equilibria diagrams.
Fall, 3 credits

ESM 510 Kinetic Processes in Solids

Diffusion in solids is considered in detail, including solution of the transport equations for volume, grain boundary, and surface diffusion. Kirkendall effect and other diffusion phenomena, atomic mechanisms of diffusion, correlation effects, etc. Next, the theory of processes in which diffusion plays an important role is considered, such as ionic conduction, oxidation of metals, and the sintering of solids.
Spring, 3 credits

ESM 511 Solid State Electronics

A study of the electronic processes in solids leading to the analysis and design of materials and devices. Crystal structures, binding, electrical and thermal conductivities, diffusion, galvanometric, thermomagnetic, and thermoelectric effects. Hall effect and magnetoresistance. Conductivity in thin films.
Fall, 3 credits

ESM 512 Dielectric and Magnetic Properties of Materials

The physical origins of the dielectric and



magnetic properties of materials are treated in this course with respect to the structure of materials. Topics include electric and magnetic susceptibilities; piezoelectricity, ferroelectrics; ferromagnetics, ferrimagnetics and antiferromagnetics; and materials which are used in industrial applications.

Fall or spring, 3 credits each semester

ESM 599 Research

Variable and repetitive credit

ESM 600 Seminar in Surface Science

Discussions and readings on current problems in surface physics, chemistry, and crystallography.
Spring, 3 credits

ESM 602 Seminar in Plasticity and Fracture

Intended for advanced students, especially those doing research in this area. Topics: linear elastic fracture mechanics, quasi-static and dynamic crack growth, fracture surface energy calculations, ductile-brittle transitions, and the effects of plastic deformation on crack propagation. Recent advances in the improvement of fracture toughness in engineering materials will be described.

Prerequisite: ESM 506

Fall, 3 credits

ESM 604 Seminar in Ultrasonic Methods & Internal Friction in Solids

Review of advanced measurement techniques in the field of ultrasonics coupled with quantitative descriptions of experimental variables related to the sample microstructure. Applications to optical,

electrical, and mechanical properties will be discussed. Use of ultrasonics for Non-destructive Evaluation will be considered. Prerequisite: ESM 506
Spring, 3 credits

ESM 606 Seminar In Optical Properties of Material

A survey of modern optical materials and their characterization. The properties of both glasses and crystalline materials are related to physical origin. Electro-optic, elasto-optic, and magneto-optic properties and their interrelations are related to applications in technology including laser systems, displays, and spectroscopy.
Fall, 3 credits

ESM 608 Seminar in Catalysis

Introduction to homogeneous and heterogeneous catalysis. Geometric factors in catalysis. The kinetics of heterogeneous catalysis. Electronic factors in catalysis; metals, semiconductors and surface species. Preparation and properties of metal surfaces. Porosity. Typical industrial processes, e.g., Fischer-Tropsch, Ammonia synthesis, Ammonia oxidation, etc.
Fall, 3 credits

ESM 610 Seminar in Reactions in Inorganic Solids

Crystal growth and the nature of defects in inorganic crystals. Heterogeneous nucleation in decomposing inorganic single crystals. Theories of isothermal decomposition kinetics. Measurement of decomposition rates. Radiation effects and nature of radiation damage in inorganic solids. Photodecomposition of solids and the underlying theories of photolysis.
Fall, 3 credits

ESM 612 Seminar in Advanced Thermodynamics of Solids

The fundamentals of the thermodynamics of irreversible processes are presented and the theory applied to thermal diffusion, thermoelectric transport and other coupled processes in solids. Thermodynamics of multi-component phase equilibria. Diffusion, oxidation and other rate processes in ternary and higher order systems. Prerequisite: ESM 509
Spring, 3 credits

ESM 613 Seminar in Materials and Environment

Interactions between materials and their environments including corrosion, oxidation, absorption and adsorption reactions. The influence of these reactions on the properties of materials, the design of materials resistant to these phenomena, alternative methods of protection and the utilization of these reactions in promoting breakdown and deterioration of materials.
Spring, 3 credits

ESM 615 Seminar in Phase Transformations

The theory of phase transformations in solids is considered. Kinetics and mechanisms of nucleation and growth and martensitic transformations. Melting and solidification, precipitation from solid solution, polymorphic transformations, eutectic and eutectoid reactions; second order transitions, recrystallization and other

transformations in solids.
Fall, 3 credits

ESM 696 Special Problems in Materials Science

Supervised reading and discussion of selected publications in particular fields of materials science. This course is designed primarily for advanced graduate students who are, or expect to be, involved in research in these areas, although other students may enroll with permission of the instructor.
3 credits, repetitive

Mathematics

CORE COURSES FOR TEACHER OPTION

MSM 512 Algebra for Teachers

Linear algebra, the algebra of polynomials, algebraic properties of the complex numbers, number fields, solutions of equations.
Fall, spring or summer, 4 credits each semester

MSM 513 Analysis for Teachers I

Topics in differential calculus, its foundations, and its applications. This course is designed for teachers and prospective teachers of advanced placement calculus.
Fall, 4 credits

MSM 514 Analysis for Teachers II

Topics in calculus, its foundations, and its applications. Emphasis will be on integration. This course is designed for teachers and prospective teachers of advanced placement calculus.
Spring, 4 credits

MSM 515 Geometry for Teachers

A re-examination of elementary geometry using concepts from analysis and algebra.
Fall, spring or summer, 4 credits each semester

MSM 516 Probability and Statistics for Teachers

A priori and empirical probabilities, conditional probability; mean and standard deviation; random variables; financial distributions; continuous distributions; sampling; estimation; decision making.
Fall, spring or summer, 4 credits each semester

MSM 519 Seminar in Mathematics Teaching

Study of recent curricular and pedagogical developments in secondary school mathematics.
Fall, spring or summer, 4 credits each semester

ESM 697 Materials Science

A weekly series of lectures and discussions by visitors, local faculty and students presenting current research results.
1 credit, repetitive

ESM 698 Practicum in Teaching

3 credits, repetitive

ESM 699 Dissertation Research

Variable and repetitive credit

CORE COURSES FOR PROFESSIONAL OPTION

MSM 530 Topology/Geometry I

Basic point set topology: connectedness, compactness, continuity, etc. Metric spaces; function spaces, and topological manifolds. Introduction to algebraic topology: fundamental group and covering spaces, homology, applications.
Fall, 4 credits

MSM 531 Topology/Geometry II

Foundations of differentiable manifolds: differentiable maps, vector fields and flows, differential forms and integration on manifolds. Stokes' Theorem. Frobenius Theorem. Lie derivatives. Immersions and submersions. Introduction to Lie groups and to the classical groups.
Spring, 4 credits

MSM 534 Algebra I

Linear Algebra: fields, vector spaces, dimension, bases, matrices, linear maps, determinants, canonical form. Multilinear algebra: bilinear forms, Hermitian forms, spectral theorem, symmetric and tensor products, exterior products.
Fall, 4 credits

MSM 535 Algebra II

Groups: normal subgroups, Jordan-Hölder theorem, fundamental theorem of Abelian groups. Rings: ideals and homomorphisms, Euclidean rings, polynomial rings, unique factorization. Fields: transcendence, algebraic extensions, primitive elements, fundamental theorem of Galois theory, applications.
Fall, 4 credits

MSM 539 Algebraic Topology

Homology and cohomology groups. Homotopy groups and the Hurewicz theorem, the universal coefficient theorem, cup and cap products. Poincaré duality and introduction to special sequences.
Fall, 4 credits

MSM 542 Complex Analysis I

Elementary functions, holomorphic functions, Cauchy theory, power series, classification of isolated singularities, calculus

of residues, open mapping theorem, Riemann mapping theorem.
Spring, 4 credits

MSM 543 Complex Analysis II

Monodromy theorem and analytic continuation. Elliptic functions. Dirichlet problem and Green's function. Conformal mappings. Introduction to Riemann's surfaces and/or several complex variables.
Fall, 4 credits

MSM 544 Analysis

Elementary ordinary differential equations, existence theory, power series methods, characteristic functions, orthogonal polynomials, Fourier series.
Fall, 4 credits

MSM 546 Differential Equations

Basic concepts in ordinary and partial differential equations. Existence, uniqueness, and stability theorems. Geometric theory of characteristics and the Frobenius theorem. Typical features of elliptic, hyperbolic, and parabolic equations.
Spring, 4 credits

MSM 550 Real Analysis I

Lebesgue measure and integration, Radon-Nikodym theorem, Lebesgue-Stieltjes measures, Fubini and Tonelli theorems, classical Banach spaces.
Spring, 4 credits

MSM 551 Real Analysis II

Banach space, Hilbert space, Hahn-Banach and uniform boundedness theorems, topics in topological vector spaces, distribution theory.
Fall, 4 credits

MSM 566 Differential Topology

Vector bundles, transversality, and characteristic classes. Further topics such as embeddings and immersions, intersection theory, surgery, and foliations.
Prerequisite: MSM 531
Fall, 4 credits

MSM 568, 569 Differential Geometry

Connections, curvature, geodesics, parallelism, and completeness, Riemannian manifolds, geometry of sub-manifolds of R^n , method of integral formulas, applications to global extrinsic theorems. Riemannian curvature, Gauss-Bonnet theorem, Gopf-Rinow theorem, first and second variation formulas, conjugate points and Jacobi fields, comparison theory. Curvature and fundamental group: spaces of positive and of negative curvature, space forms, Lie groups, homogeneous spaces, and symmetric spaces.
Prerequisite: MSM 531
Fall and spring, 4 credits each semester

MSM 590, 591, 592 Problem Seminar I, II, III
Analyze problems and explore supplementary topics related to the other courses. Focus preparation for the preliminary exam. Teaching practicum.
Fall and spring, 3 credits each semester

INTERMEDIATE COURSES

These courses are designed for second and third year graduate students who are preparing for the Doctoral Preliminary Examination or are starting work toward a dissertation. The only prerequisites are consultation with the teacher. Topics covered will be chosen to reflect interest of teachers and students. All of these courses may be taken for repeated credit.

MSM 602, 603 Topics in Algebra

Typical topics will be drawn from group theory, ring theory, representation theory of groups and algebras, fields and commutative algebra, homological algebra.
Fall and spring, 4 credits each semester, repetitive

MSM 608, 609 Topics in Number Theory

Typical topics will be drawn from analytic number theory, algebraic number theory, diophantine equations, transcendental number theory, with indications of methods from algebra, geometry, analysis, and logic.
Fall and spring, 4 credits each semester, repetitive

MSM 614, 615 Topics in Algebraic Geometry

Typical topics will be drawn from varieties and schemes, algebraic curves, and their arithmetics.
Fall and spring, 4 credits each semester, repetitive

MSM 620, 621 Topics in Algebraic Topology

Topics will be of current interest such as foliations, surgery, singularities, group actions on manifolds, and homotopy theory.
Fall and spring, 4 credits each semester, repetitive

MSM 626, 627 Topics in Complex Analysis

Topics selected from: Riemann surfaces, quasiconformal mappings, several complex variables, Fuchsian Groups, Kleinian groups, moduli of Riemann surfaces and Kleinian groups, analytic spaces, singularities.
Fall and spring, 4 credits each semester, repetitive

MSM 632, 633 Topics in Differential Equations

Typical topics are: Hyperbolic or elliptic systems, parabolic equations, spectral theory, finite difference equations, Cauchy-Riemann equations and complex vector fields, equations with constant coefficients, solvability of linear equations, Fourier integral operators, non-linear equations.
Fall and spring, 4 credits each semester, repetitive

MSM 638, 639 Topics in Real Analysis

Topics selected from: functional analysis,

harmonic analysis, Banach algebras, operator theory.
Fall and spring, 4 credits each semester, repetitive

Laplacian, geometry of general relativity.

Fall and spring, 4 credits each semester, repetitive

ADVANCED COURSES

These courses are designed for students doing advanced work, especially in connection with doctoral dissertations. The only prerequisites are consultation with the teachers. The topics will be selected from the area listed under the corresponding intermediate course, and will generally be on a more advanced level. A course will normally begin in the Fall and may continue in the Spring. Course offerings will depend on student demand and availability of faculty to supervise advanced work in the area. These courses may be taken for repeated credit. Each of these courses carries 4 credits.

MSM 662, 663 Advanced Topics in Algebra

MSM 666, 667 Advanced Topics in Algebraic Topology

MSM 670, 671 Advanced Topics in Complex Analysis

MSM 674, 675 Advanced Topics in Differential Equations

MSM 678, 679 Advanced Topics in Real Analysis

MSM 682, 683 Advanced Topics in Differential Geometry

OTHER COURSES

MSM 696 Mathematics Seminar

MSM 697 Mathematics Colloquium

MSM 698 Independent Study

MSM 699 Dissertation Research

Each of the above courses may be taken only with the approval of the Director of the Graduate Program.
Variable and repetitive credit



Mechanical Engineering

ESC 501 Convective Heat Transfer and Heat Exchangers

An examination of the heat transfer characteristics of both external and internal flows (laminar and turbulent) with free and forced convection. Study of the operation and design of a variety of heat exchanger types including shell and tube, regenerator, finned plate, etc.

Prerequisite: Graduate student standing in the department
Spring, 3 credits

ESC 502 Conduction and Radiation Heat Transfer

Heat conduction and conservation law; intensity of radiation, black body radiation, and Kirchoff's law; analysis of heat conduction problems; analysis of radiative exchange between surfaces and radiative transport through absorbing, emitting and scattering media.

Prerequisite: Graduate student standing in the department
Fall, 3 credits

ESC 504 Environmental Pollution

The pollutants in our environment, their sources, effects, and methods for their control. Pollution of the air, water, and land as well as the inter-relationships among these will be discussed.

Fall, 3 credits

ESC 505 Principles of Water Pollution

The basic microbial and chemical processes are examined, especially as they relate to public health and environmental deterioration. The role of micro-organisms as pathogens, pollutants, and in pollution control; the implications for aquatic ecosystems of waste and thermal loading.

Fall, 3 credits

ESC 506 Water Quality Laboratory

An introduction to the field and laboratory techniques used in measuring and predicting water quality. Sampling and monitoring methods, data handling and evaluation.

Co-requisites: MSA 547, ESC 505
Fall, 3 credits

ESC 507 Reactive Media

Thermodynamics, rate processes, flow, and stability of reactive media. Thermokinetic and thermophysical properties of nonequilibrium systems. Energy storage and energy transfer in reactive systems. Non-adiabatic theory of reaction wave structure, initiation, propagation and extinction. Application of fundamentals to lasers, combustion, condensation, crystallization, population dynamics and nonequilibrium systems.

Instructor: A. Berlad
3 credits



ESC 508 Reactive Media—Current Problems

Continuation of ESC 507. Detailed discussion of selected journal articles.

Instructor: A. Berlad
3 credits

ESC 509 Engineering Hydraulics

Steady and varied flow in open channels; transient flow and water hammer phenomena in closed conduits. Study of the flow of viscous suspensions. Applications to weir, transition and spillway design and the flow of liquids, air, and sludge; pumps and meters.

Spring, 3 credits

ESC 511 Advanced Fluid Mechanics I: Perfect Fluids

Lagrangian and Eulerian frames. Dynamical equations of momentum and energy transfer. Two-dimensional dynamics of incompressible and basotropic perfect fluids and of the compressible perfect gas. Conformal mapping applied to two dimensional fluid dynamics. Jets and cavities. Surface waves, internal waves. Perfect shear flows.

Instructor: E. O'Brien
3 credits

ESC 512 Advanced Fluid Mechanics II: Viscous Fluids

The role of viscosity in the dynamics of fluid flow. The Navier-Stokes equations. Low Reynolds number behavior including lubrication theory, percolation through porous media and flow due to moving bodies. High Reynolds number behavior including steady, unsteady and detached boundary layers, jets, free shear layers, and wakes. Phenomenological theories of turbulent shear flows are introduced.

Instructor: S. Bradfield
3 credits

ESC 513 Advanced Fluid Mechanics III: Compressible Fluids

One-dimensional gas dynamics and wave propagation. Shock waves in supersonic flow. The method of characteristics. Effects of viscosity and conductivity, and concepts from gas kinetics.

Instructor: P. Varanasi
3 credits

ESC 514 Advanced Fluid Mechanics IV: Introduction to Turbulence

Introductory concepts and statistical description. Kinematics of random velocity fields. Equations of motion and their interpretation. Experimental techniques: isotropic turbulence and the closure problem. Transport processes in a turbulent medium. Turbulent jets, wakes and boundary layers.

Instructor: R. Chevray
3 credits

ESC 515 Dynamic Meteorology

Rotation of the Earth and the Coriolis force. Physical properties of atmospheric air. Large-scale atmospheric motion—Rossby waves; turbulent nature of the atmospheric motion; baroclinic effects. General circulation of the atmosphere.

Instructor: L. Wang
3 credits

ESC 516 Climatology

General circulation of the atmosphere. Solar constant; nature of clouds; global albedo. Terrestrial outgoing radiation. Interactions of the atmosphere and the oceans. Climatic pattern and possible causes of the changes in climatic pattern. Orbital parameters of a planet. Climate in the Quaternary period—glacial-interglacial oscillation; theories of the "ice ages." Drifting of the continents; deep ocean circulation; and the initiation of the Quaternary period. Climates of Mars.

Instructor: L. Wang
3 credits

ESC 517/518 Waste Water Collection and Treatment Systems I and II

The principles of designing and operating an adequate, efficient, and non-pathogenic waste water collection and treatment system. Municipal and industrial sewage treatment, sedimentation, coagulation, filtration, chemical treatment, aeration, activated sludge, phosphorous and nitrate removal and other advanced treatment methods. Ultimate disposal and the holding and disposal of solids.

Prerequisites: ESC 505, 509 or equivalent
Fall and spring, 3 credits each semester

ESC 519 Water Supply Design

Water requirements for public, industrial,

agricultural, and other usage. The principles of designing an adequate, efficient, and non-pathogenic water supply system.

ESC 521 Energy Transfer in Gases

Fundamental concepts in quantum mechanics, statistical thermodynamics, and electro-magnetic theory from an engineer's point of view. Thermodynamic properties of gases at high temperatures. Absorption and emission of radiation in high temperature gaseous environments. Rates of relaxation processes in gases and plasmas. Current experimental techniques for measuring temperature, rate constants and radioactive properties of gases.

Instructor: P. Varanasi
3 credits

ESC 522 Experimental Methods in Energy Transfer

Introduction to experimental techniques in convective and radiative heat transfer, combustion processes and air pollutant detection. Quantitative spectroscopy as a research tool in above mentioned areas as well as planetary atmospheric research.

Instructor: P. Varanasi
3 credits

ESC 523 Atmospheric Molecular Processes

Review of electromagnetic theory of scattering and spectroscopy in a manner appropriate for studies of planetary atmospheric phenomena involving gaseous molecules. A major portion is devoted to quantitative spectroscopic aspects of absorption of infra-red radiation by planetary atmospheric gases. Spectral line shaped and band models.

Instructor: P. Varanasi
3 credits

ESC 524 Statistical Mechanics: The Molecular Basis of Continua Mechanics

The course develops the basic tools necessary for an understanding of the relation between the properties of matter in the bulk (e.g., thermodynamic and transport properties) and the underlying interparticle forces responsible for them.

Instructor: G. Stell
3 credits

ESC 526 Introduction to Experimental Stress Analysis

Elementary theory of elasticity, electrical and mechanical strain gauges, introduction to photoelasticity and moiré method. Brittle coating and analog methods. Application of different methods to the study of static and dynamic problems. Laboratory participation is an integral part of the course. Instructor: F. Chiang
3 credits

ESC 529 Vehicular Dynamics

Applications of fluid dynamics theory to practical devices. Elements of airfoil and hydrofoil design; Structural analysis from hydrodynamic loads prediction; Performance prediction for a full scale vehicle based on a theoretical loads prediction. Elements of static and dynamic stability. Where possible, full scale structural and vehicle performance tests are carried out. Instructor: S. Bradfield
3 credits, alternate years

ESC 532 Structural Dynamics

The mechanical behavior of engineering structures is studied by choosing topics from the quasi-static and dynamic response of elastic and inelastic beams, bars, columns and shells subjected to mechanical and thermal loading.

Instructor: J. Tasi
3 credits

ESC 533 Molecular Theory of Fluids

The course will have three main aspects. One will be the molecular basis of the results of fluid mechanics. The second will be those techniques and viewpoints common to the statistical theory of turbulence and the molecular theory of fluids. The third will be selected applications to problems of current engineering interest (e.g., flow through porous media and fluidized beds, coagulation theory, transport properties of fluid mixtures).

Instructor: G. Stell
Spring, 3 credits, alternate years

ESC 534 Systems Engineering I

Introduction to systems engineering as a technical area of activity. Topics will include "need" analysis; concepts of the engineering system; optimization with respect to cost, performance, and weight; the design definition, system verification requirements; and system performance demonstration techniques. The course material will be illustrated by case studies of current engineering systems in development.

3 credits, alternate years

ESC 535 Systems Engineering II

A detailed look at the considerations and techniques involved in bringing an engineering system into existence. Topics will include acceptance criteria; program planning; technical planning; product assurance; systems safety including fault tree analysis and product liability; and a testing philosophy overview (or when to test and why). A term paper will be required concerning an industrial problem of current interest.

Prerequisite: ESC 534
3 credits, alternate years

ESC 537 Experimental Fluid Mechanics

Fundamentals of measurements and instrumentation. Operating principles and performance characteristics of instruments for measurements of physical quantities such as velocity, pressure, and temperature. Flow visualization and liquid and gases. Optical methods in compressible flow: interferometry, schlieren, shadow. Fundamentals of acoustics. Introduction to analysis and measurement of random variables. Laboratory demonstrations.

Instructor: R. Chevray
3 credits

ESC 539 Finite Element Methods in Mechanical Engineering Design

Finite element methods for solving structural mechanics, heat transfer, and fluid flow problems in the design area. General formulations and computational schemes.

Structural analysis. Thermal and momentum boundary layer flow formulations. Numerical solutions. Error estimates.

Prerequisite: MSA 361
Fall, 3 credits

ESC 540 Geophysical Fluid Dynamics

Inertia and gravity effects of entropy or density variations in fluids. Small amplitude waves, gravitational and Helmholtz instabilities, internal waves and turbulence. Coriolis effects of the earth's rotation. Comparison of gravity and rotation effects on the behavior of non-homogeneous fluids. Applications to natural phenomena.

Instructor: R. Chevray
3 credits

ESC 541/542 Elasticity I and II

Derivation of linear equations of elasticity. Stress equations of motion. Displacement and strain. Stress-strain relations for crystalline solids. Compatibility equations. Uniqueness theorem. Reciprocity theorem. Applications to static three-dimensional problems. Wave propagation in infinite and bounded media. Elastic lattice vibrations and theories of microstructure.

Instructor: J. Tasi
3 credits each semester, alternate years

ESC 543 Plasticity

Stress and deformation of solids: Yield criteria and flow rules for plastically deforming solids; The notion of a stable inelastic material; Static and dynamic analysis of plastic bodies under mechanical and thermal loadings; Use of load bounding theorems and the calculation of collapse loads of structures; The theory of the slip-line field.

Instructor: F. Chiang
3 credits

ESC 544 Atmospheric Radiation

Discussion of the compositions and radiative components of planetary atmospheres. Blackbody and gaseous radiation with emphasis upon the respective roles of electromagnetic theory and quantum statistics. Derivation of the equation of transfer and radiative exchange integrals, with application to energy transfer processes within the atmospheres of earth and other planets.

Instructor: R. Cess
3 credits

ESC 545, 546 Theoretical Meteorology I and II

Introduction to the quantitative interpretation of the thermal and dynamical structure of the planetary atmospheres. Topics to be covered include: atmospheric thermodynamics, hydrostatic equilibrium, hydrostatic equilibrium and convection, solar and terrestrial radiations, equations of motion on a rotating planet, atmospheric energetics, general circulation and numerical weather prediction.

Instructor: J. Hogan
3 credits each semester

ESC 547 Aeronomy

An examination of the physical and chemical processes which determine the struc-

ture and composition of the atmosphere. A discussion of the chemical composition of the neutral atmosphere and ionosphere will be followed by the development of the basic equations governing atmospheric structure. The major processes at work in each region of the atmosphere will be delineated. The origin and history of our atmosphere will be discussed, and man's impact on its future will be considered. Comparisons will be drawn between our own environment and the atmospheres of other planets.
Spring, 3 credits

ESC 548 Air Pollution Meteorology

A discussion of atmospheric processes which determine air pollution concentration. Theory of diffusion with application to pollution dispersion from point, line and area sources. Practical methods for estimating pollution levels near urban and industrial sources. Chemical interactions of air pollutants. Production of ozone in urban smog. Urban heat-island. Modification of local weather by pollution.
Instructor: S. Hameed
3 credits

ESC 549 The Changing Global Environment

An introduction to the global aspects of environmental pollution and its long and short term consequences. Chemical balance of gases in the earth's atmosphere. Origin and fate of major air pollutants. Global circulation of atmospheric pollution. Impact of land and sea pollution on the chemical stability of the atmosphere. Effects of atmospheric pollution on climate. Environmental effects of energy production. Ocean pollution by toxic wastes. Environmental monitoring and control. Air quality standards versus emission standards. Systems analysis of pollution abatement.
Instructor: S. Hameed
3 credits

ESC 552 Analysis of Composite Solids

The main emphasis of the course is on the analysis of layered composite materials. The cartesian tensor calculus is used. Homogeneous anisotropic media are studied first. The effect of layering is then analyzed. Applications to plates and shells are considered. Current theories of inelastic mechanical behavior of composite solids are introduced.
Instructor: J. Tasi
3 credits, alternate years

ESC 557 Kinetic Theory

Theory of the Boltzmann equations. The Hilbert, Chapman-Enskog and Grad solutions, and the transition to fluid dynamics, determination of transport coefficients. Relationship of normal solutions to actual solutions of the Boltzmann equation.
Instructor: S. Harris
3 credits

ESC 561 Photoelasticity

Theory of two- and three- dimensional photoelasticity for experimental stress analysis. Lectures include the necessary optics background and such topics as frozen-stress method, scattered light technique, birefringent coating and absorption

retardation methods. Special techniques such as fringe multiplication and sharpening, oblique incidence. Students will be involved in a complete project.
Instructor: F. Chiang
3 credits

ESC 591 Thermodynamics

The course will begin with a review of elementary thermodynamics and go on to consider more advanced areas of thermodynamic theory that are fundamental to various engineering applications, such as irreversible thermodynamics. Special topics will include thermophysical properties of fluids and the form of thermodynamic perturbation theory that has proven to be of enormous utility to chemical engineers.
Instructor: G. Stell
3 credits

ESC 592 Classical Thermodynamics

A rigorous presentation of classical thermodynamics. Applications to flow systems and heat engines. Applications to systems involving intensive variables besides pressure and temperature.
Instructor: L. Wang
Spring, 3 credits

ESC 599 Research

Variable and repetitive credit

ESC 601 Nonlinear Mechanics

Stability theory and Liapunov functions. Phase plane analysis, limit cycles, and bifurcation theory. Generalized Volterra and Van der Pol equations. Isocline and Liénard methods of graphic construction. Poincaré and Lindstedt's method of small perturbations. Asymptotic process of Krylov and Bogoliubov for autonomous and non-autonomous systems. Problems in chemical kinetics and population dynamics.
Instructor: C. Yang
3 credits

ESC 613 Phase Transitions and Critical Phenomena

Traditional approaches (Weiss mean field, Bragg-Williams and van der Waalslike theories) as well as more recent work (scaling laws of Kadanoff and Widom functional expansions, "semi-invariant" expansions) are examined. Various useful models such as the Ising model are discussed. In addition to liquid-gas and order-disorder transitions, the nature of the solid-liquid transition is also considered.
Instructor: G. Stell
3 credits

ESC 614 Applications of Statistical Mechanics

The relation between the thermodynamic properties of a system at equilibrium and its Hamiltonian. The emphasis is in developing a set of techniques that enables one to assess the properties of fluids and certain solids over a wide range of thermodynamic conditions (critical or curie point). The use of cluster expansions and functional Taylor series are among the techniques stressed.
Instructor: G. Stell
3 credits

ESC 615 Seminar in Radiative Transfer

Topics of current interest concerning radiative energy transfer in gases are discussed.
3 credits

ESC 620 Chemical Kinetics of Combustion and Atmospheric Reactions

Introduction to collision and transition state theory of kinetics. Chain reaction and unified theories of explosion. Kinetic and thermokinetic theory of chemical oscillations. Oxidation of hydrocarbon and gasification of coal. Photochemical smog and kinetic processes in stratosphere.
Instructor: C. Yang
3 credits

ESC 621 Combustion Theory

Theory of laminar flame propagation. Combustion of droplet and particle cloud sprays. Engine knocking and autoignition. Source ignition, extinction limits and environmental fire hazards. Detonation theory of gases and condensed phase explosives; initiation mechanism, detonability limits and spinning detonation.
Instructor: C. Yang
3 credits

ESC 624 Baroclinic-Fluid Flow

The role of baroclinicity in the dynamics of fluid flow: Wave propagation in a solenoidal nonhomogeneous fluid. Natural convection flow and the Bernard-Rayleigh problem. Quasi-geostrophic theory of rotating baroclinic stratified fluids. Intense vortices in a conditionally-stable stratified fluid.
Instructor: L. Wang
3 credits

ESC 625 Turbulent Diffusion

Eulerian description of passive contaminants in homogeneous turbulence. Closure techniques and their flaws. Lagrangian description of single particle and relative diffusion. Similarity in shear flows. The role of buoyancy forces in atmospheric transport. An introduction to turbulent reactive flows.
Instructor: E. O'Brien
3 credits

ESC 642 Advanced Mechanics of Continua

The curvilinear tensor calculus is reviewed. Basic equations which govern the behavior of continuous media are derived in which finite deformations are permitted. Coupling between mechanical, thermal and other effects is considered. The thermodynamics of continuous media are studied. Singular surfaces and waves are examined.
Instructor: J. Tasi
3 credits

ESC 661 Measurements System Design

Design of research instrumentation in the context of the research problem. Selection of appropriate transducers for response to a given phenomenon and design of appropriate intermediate and readout components. Specific problems may be selected, depending upon the students' interest.
Instructor: W. Bradfield
3 credits

ESC 671 Optical Methods for Experimental Stress Analysis

Theory and applications of moire methods (inplane, shadow, reflection, projection and refraction moire techniques) for measuring static and dynamic deformation of 2-D and 3-D models, bending of plates and shells, and temperature distribution or refraction index change in fluids. Other topics: holographic interferometry, laser speckle interferometry, and current research activities of the field.

Instructor: F. Chiang
3 credits

ESC 681 Planetary Atmospheres

A survey of current knowledge about the compositions, structures, and dynamics of the atmospheres of planets in our solar system. Models for upper and lower regions and probable evolutionary histories will be discussed. Emphasis will be placed on the most recent results obtained from space craft and ground-based observations. Student participation is encouraged. This course is identical to ESS 611.

Instructor: R. Cess
3 credits

ESC 696 Special Problems in Mechanics

Conducted jointly by graduate students and one or more members of the faculty. 3 credits, repetitive

ESC 698 Practicum in Teaching

3 credits, repetitive

ESC 699 Dissertation Research

Variable and repetitive credit



Microbiology

HBM 503 Microbial Genetics

Microbial genetic systems are used to test and to prove theories of classical genetics and are also at the forefront with the newest ideas and facts of modern genetics. In this course, systems of genetic analysis will be considered in lectures, discussions, and readings. These will include bacteriophage recombination and mapping, and bacterial conjugation, transformation, and transduction. A detailed consideration of bacteriophage will illustrate current experiments and notions about the functioning of regulatory genes. Application of physical mapping techniques, especially heteroduplex mapping of both prokaryotic and eukaryotic DNA molecules, will be emphasized.

Corequisite: HBM 501 or equivalent prior training

Instructor: Drs. Ohtsubo, Setlow and Bukhari
Fall, 3 credits

HBM 509, 510 Experimental Microbiology

An introduction to modern microbiological research. During this course, the student rotates through two professors' laboratories spending approximately one-half semester in each. The selection of laboratories is made by the student in consultation with his advisory committee. By taking part in ongoing projects the student will learn experimental procedures and techniques and become acquainted with research opportunities in the departments.

Prerequisites: Matriculation in a graduate program and permission of the departmental faculty

Instructor: Staff

Fall and spring, variable, 3-8 credits each semester

HBM 531 Medical Microbiology

Information derived from molecular and experimental cellular biology will be presented to provide a foundation for understanding the basic aspects of the growth regulation, structure, and function of viruses, prokaryotic and eukaryotic cells. Extrapolation and application of basic concepts of microbiology to human disease will be made.

Prerequisite: Permission of instructor

Instructors: Drs. Weitzman, Carter and Wimmer

Spring modules, 4 credits

HBM 599 Graduate Research

Original investigations undertaken with the supervision of a faculty member.

Prerequisite: Permission of instructor

Instructor: Staff

Fall and spring, variable, 3-8 credits each semester

HBM 611/612 Animal Cells and Their Viruses

This two-semester sequence will attempt to bring students up-to-date in the interrelated areas of animal cells and viruses. The Fall semester will emphasize animal virology.

The Spring semester will emphasize animal cells. Students are encouraged to take the two courses as a sequence, however, they can be taken separately. Microbiology students are encouraged to take both. This course is recommended for advanced students and/or first year students with some background in animal virology.

Prerequisite: Permission of instructor

Instructors: Drs. Tegtmeyer, Anderson, Carter, Kates and Wimmer (Animal Virology, HBM 612, Spring); Drs. Pollack and Lucas (Animal Cells, HBM 611, Fall)

3 credits each semester

HBM 620 DNA Sequencing Technique

The laboratory course is designed to teach graduate students how to sequence DNA and RNA according to the Maxam-Gilbert method. This includes the preparation of 5'-32p labelled restriction fragments, single strand separation by gel electrophoresis, base specific modification and cleavage of DNA strands, preparation and cleavage of corresponding RNAs, fractionation of the cleavage products on sequencing gels, autoradiography and interpretation of the autoradiograms.

Prerequisite: Permission of instructor

Instructor: Dr. H. Ohtsubo

Spring, 1 credit

HBM 621, 622 Short Courses in Microbiology

Upon occasion the department will present short courses covering topics in microbiology at an advanced level. Classes will meet one or two periods for three to five weeks. Announcement of the courses will be made by sending notices to university departments.

Prerequisite: Permission of instructor

Instructors: Drs. Setlow, Dunn, Jacobson, Bukhari, Anderson, Botchan and Ohtsubo

Fall and spring, 1 credit

HBM 690 Microbiology Seminar

A weekly meeting devoted to current work in the department and lectures by invited speakers.

Prerequisite: Permission of instructor

Instructor: Dr. Jacobson

Fall and spring, 1 credit each semester, repetitive

HBM 694 Dissertation Research in Microbiology

For the student who has been admitted to candidacy. Original research will be undertaken with the supervision of the thesis advisor and advisory committee.

Prerequisite: Permission of thesis advisor

Instructor: Staff

Fall and spring, variable, 1-12 credits

Molecular Biology

BMO 500 Directed Readings in Molecular Biology

Directed readings in topics of current interest, under supervision of a faculty sponsor culminating in one or more critical review papers.

Prerequisite: Sponsor and approval of Masters Program Executive Committee Staff

1-3 credits
Yearly

BMO 504 DNA, RNA, Protein Synthesis

Special topics in nucleic acid replication, transcription and protein synthesis, both in vivo and in vitro are discussed in detail.

Prerequisites: BMO 520, 521 or permission of instructor

Spring, odd-numbered years, 2 credits
Instructor: Arnheim

BMO 505 Microbial Regulatory Mechanisms

Lectures and discussions devoted to current concepts of regulatory mechanisms involved in intermediary metabolism. Major metabolic pathways and their regulation will be studied in detail.

Instructor: Freundlich

Fall, even-numbered years, 2 credits

BMO 506 Transport

Molecular and ion transport mechanisms will be studied in microorganisms, higher cells, and the cellular organelles. Emphasis will be placed on the molecular basis of transport functions, their genetic and physiological control, and energy coupling mechanisms in active transport. Membrane structure, chemical composition, and biosynthesis will be considered in terms of their role in membrane transport.

Instructors: Cirillo, LeFevre, Simon

Spring, even-numbered years, 2 credits

BMO 507 Neurochemistry

Correlation of chemistry and nerve cell function. Covers classical neurochemistry (chemical composition and metabolism of important constituents of the brain), as well as functional neurochemistry (molecular basis of synaptic transmission, axonal conduction, sensory physiology, inter-neuronal recognition and synapse plasticity). Related topics, such as neuropharmacology and neuroendocrinology will be discussed.

Prerequisites: BMO 520, 521

Instructor: Schmidt

Fall, odd-numbered years, 2 credits

BMO 509, 510 Experimental Biochemistry

An introduction to modern biochemical research techniques. The student spends a half semester in the laboratory of each of four different members of the faculty. In each laboratory the student participates in some aspect of the research being pursued by the faculty member.

Staff

Fall and spring, variable credit, minimum two credits each semester

BMO 513 Enzymes

This course will consider the general study of enzyme structure and function, including chemical catalysis, thermodynamics of rate enhancement, the active site, and the evolution of catalytic efficiency. Specific topics to be covered are the chemical properties of amino acids, peptides, and proteins; protein structure determination; steady-state kinetics; transient phenomena; ligand binding; catalytic mechanisms; and enzyme regulation. Special emphasis will be placed on the application of spectroscopic techniques to enzymology.

Prerequisites: BMO 520, 521 or permission of instructor
Instructor: Uyemura

Fall, 4 credits

BMO 514 Muscle and Contractile Mechanisms

Seminar discussions based primarily on student presentations of published research papers on muscle contraction and other forms of biological motility. Topics will include the physiology and energetics of the contractile processes, the ultrastructure of the contractile machinery, the biochemical and physicochemical properties of the active proteins, and a critical review of current theories.

Prerequisite: BMO 520

Instructor: Moos

Spring, odd-numbered years, 2 credits

BMO 517 Biomembranes

The molecular architecture of membranes: the organization, functions, and assembly of lipids and proteins in biological membranes; and also biophysical phenomena such as diffusion and conductivity, which are amenable to detailed molecular analysis will be examined.

Prerequisite: Permission of instructor

Instructors: Scandella, McLaughlin

Spring, even-numbered years, 3 credits

BMO 520/521 Principles of Biochemistry

A comprehensive survey of modern biochemistry. Materials discussed will include proteins, membranes, the biosynthesis and degradation of carbohydrates, lipids and amino acids, energy transformations, and the structure, function and biosynthesis of nucleic acids.

Staff

Fall and spring, 3 credits each semester

BMO 599 Research

Original investigation undertaken under the supervision of a member of the staff.

Staff

Fall and spring, credit to be arranged

BMO 601, 602 Colloquium in Molecular Biology

A weekly series of talks and discussions by visiting scientists in which current research and thinking in various aspects of molecular and cellular biology will be presented. This course is required of all stu-

dents every semester in which they are registered in the Molecular Biology Program and attendance is mandatory. Visitors are welcome.

Fall and spring, 1 credit each semester

BMO 603, 604 Student Seminar in Molecular Biology

Seminars given by graduate students on recent work taken from the literature in the area of molecular or cellular biology. This course is required of all students every semester in which they are registered in the Molecular Biology Program and attendance is mandatory. Visitors are welcome.

Fall and spring, 1 credit each semester

BMO 605, 606 Molecular Biology Workshop

Progress reports given each week by members of the faculty, post-doctoral fellows, and advanced graduate students on their current research. This course is required of all students every semester in which they are registered in the Molecular Biology Program and attendance is mandatory. Visitors are welcome.

Fall and spring, 1 credit each semester

BMO 685-688 Advanced Seminars

Topics to be arranged.

Fall and spring, variable and repetitive credit

BMO 699 Dissertation Research

Original investigations undertaken as part of the Ph.D. program under supervision of a research committee.

Prerequisite: Advancement to candidacy

Fall and spring, credit to be arranged



Music

MUS 501 Compositional Skills of Tonal Music

An intensive course in chorale harmonization and tonal counterpoint. (Enrollment limited to 12. MUS 501 may not be included in the courses taken in fulfillment of degree requirements.)

Fall, 3 credits

MUS 502 Proseminar in Tonal Analysis

The application of various techniques of analysis to tonal works. Rhythmic, harmonic, linear, thematic and other elements of musical structures will be considered. Preparation equivalent to MUS 501 is assumed.

Spring, 3 credits

MUS 503 Music in the 20th Century

An intensive course in 20th century musical styles, focusing on historical problems of influence, development, and change. Seminar reports and research papers on works of major significance.

Instructor: J. McCalla

Fall, 3 credits

MUS 506 20th Century Notation

Study of various contemporary notational systems with emphasis on problems in standardization and common usage.

3 credits. Not offered 1979-80

MUS 507 Studies in Music History

Concentrated study of the works of a single composer, or of repertoires that comprehend single compositional tendencies in Western music. Various topics are offered each semester.

Fall and spring, variable credit
(see note below MUS 509)

MUS 508 Studies in Composition

Concentrated study of skills and techniques ancillary to musical composition.

Fall and spring, variable credit
(see note below MUS 509)

MUS 509 Performance Studies

This course provides opportunity for a student who is not in a performance degree program, but who can demonstrate graduate-level performance ability, to pursue performance studies without investing the time and credit required of M. Mus./D.M.A. students. The course is not open to M. Mus./D.M.A. students, except for conducting students who can demonstrate graduate-level ability in an instrument or voice.

Fall and spring, variable credit

Note: Not more than 8 credits of MUS 507, 508, and 509 combined may be counted toward the degree.

MUS 511 Compositional Techniques of the 20th Century

A study, by means of practical exercises in writing, of some of the important techniques of the present century in the organization or non-organization of pitch, rhythm, line, motive, and form.

Instructor: B.J. Layton

Fall, 3 credits



MUS 513 Musical Applications of Modern Mathematics

For musicians wishing to acquire mathematical concepts and techniques pertinent to the theory and composition of music in certain important contemporary styles. Mathematical introductions to group theory, lattice theory, probability, and information theory; the pertinence of these subjects to serial, aleatoric, and stochastic music. The course will not touch on calculus or computer programming; music students interested in these topics are directed toward the appropriate courses in other departments. No mathematical prerequisites beyond the high school level are required, but students should have a more than perfunctory acquaintance with and professional interest in at least one of the musical styles cited above.

3 credits. Not offered 1979-80

MUS 515 The Fundamentals of Electronic Music

A short survey of the history and literature of the medium will be followed by study of the pertinent background in theoretical acoustics and practical engineering. Students will then be instructed in the basic techniques of electronic sound production and modification.

Instructor: B. Arel

Fall, 3 credits

MUS 516 Electronic Music Workshop

Individual short experimental works on specific assignments. Uses of electronic music equipment.

Prerequisite: MUS 515 or the equivalent

Instructor: D. Semegen

Spring, 3 credits

MUS 521 Composition in Traditional Styles

A study of one of the established disciplines such as fugue, homophonic forms, or composition in the sacred style of the 16th century. The content of the course will be announced each time it is offered.

3 credits

MUS 523 Advanced Composition

Individual projects for graduate students in composition.

Instructors: B. Arel, B.J. Layton, J. Lesard, D. Lewin, D. Semegen, P. Winkler

Fall and spring, 3 credits each semester

MUS 531 Seminar in Music Theory: Compositional Theory Before 1800

Studies in the writings of theorists from the Middle Ages through the 18th Century in the context of contemporary repertoires. Topics, varying from semester to semester, will include the following areas of investigation: Modal theory as model for melodic composition, and the efforts to adapt modal theory to polyphonic practice; problems of *musica ficta* as symptoms of the confrontation of modality and the melodic dimension with tonality and the harmonic dimension; Discant and counterpoint; Thorough bass, improvisation and ornament; Rameau, Fux and Kirnberger *inter alia*—crises in 18th Century theory.

3 credits

MUS 532 Seminar in Music Theory: Rhythm and its Notation

Investigations, with the aid of theoretical writings ancient and recent, and through musical analyses, into the nature of the

rhythmic impulse; studies in the efforts, throughout musical history, to make rhythm as performance competence and as compositional parameter; studies in the relation of rhythm and meter in theory and practice. The work in any single semester may be confined to a special aspect of such topics.
3 credits

MUS 533 Seminar in Music Theory: Tonality

Examination, using the writings of selected theorists from Rameau and his precursors through Schenker, of various possible means—mathematical, physical, metaphysical, etc.—for developing and/or disputing such concepts as “root,” “root progression,” “key system,” “tonality,” et al. Interrelations among such concepts, both as abstractable from musical time and as immersed within it. The relevance or irrelevance of various notions of “consonance” and “dissonance” in such connections.
3 credits

MUS 534 Seminar in Music Theory: 20th Century Topics

Studies in the formation of systematic theories pertinent to various idioms from C. Debussy to the present. The following would be representative areas: attempts to extend prolongational (Schenkerian) theory beyond “tonality;” attempts, Forte’s in particular, to systematize a theoretical basis for pitch-structure in “atonal” music; classical twelve-tone theory; rhythmic systems in Babbitt, Boulez and Stockhausen.
3 credits. Not offered 1979-80

MUS 535 Lecture-Workshop in the Performance of Baroque Music

An examination of problems confronting the performer of music from the period ca. 1600-1750, from both musicological and practical points of view. The basso continuo, its function and realization; phrasing and articulation; ornaments, notated and improvised; period instruments; aspects of notation; bibliography. The course will meet in lecture for two hours each week with a third hour devoted to the coaching of a rehearsal or performance of music prepared by members of the class.
Instructors: E. Chafe, S. Baron
Spring, 3 credits

MUS 537 Seminar in Analysis and Performance

A study of the relationship of technical aspects of performance, such as tempo, phrasing, articulation and dynamics, to conceptual problems, such as rhythmic and metric levels, tonal structure, and serial organization, based upon the analysis and performance of representative solo and chamber works from the 18th through the 20th century.
3 credits

MUS 539 Contemporary Criticism and Analysis in Music, Literature, and Art

The methodology of contemporary criticism. A discussion of theories of form and style, and the relations and cross-currents among contemporary criticisms in different media. Formalist theories (Schenker in

music, Riegl and Woelfflin in art), statistical analysis, sociological criticism and Marxism (Adorno), structuralism, psychological theory, and traditional psychology.
Instructor: C. Rosen
Fall, 3 credits

MUS 540 Studies in Cultural Historiography

This course is intended to promote the student’s knowledge and reflection about the study of the history of the arts as history. It is organized on the following topics: origins and philosophical foundations of the modern historical consciousness; the nature of historical knowledge and explanation; historiographic models; origins, philosophical foundations, and genres of historical musicology.
Instructor: L. Treitler
Fall or spring, 3 credits

Special Topics Courses

Topics to be chosen each time a course is offered will depend upon the needs of the students and the interests of the instructor.

MUS 543 Topics in Medieval Music

3 credits. Not offered 1979-80

MUS 545 Topics in Renaissance Music

3 credits. Not offered 1979-80

MUS 547 Topics in Baroque Music

Instructor: E. Chafe
Fall, 3 credits

MUS 549 Topics in 18th Century Music

3 credits

MUS 553 Topics in 19th Century Music

3 credits

MUS 555 Topics in 20th Century Music

3 credits

MUS 559 Topics in Analysis

Fall and spring, 3 credits each semester

MUS 561 Orchestral Conducting

Advanced training in the preparation and conducting of orchestral scores from the standard repertory. Students will study the works in a seminar, and then conduct them in regular supervised readings with the Graduate Orchestra.

Instructors: D. Lawton, A. Weisberg
Fall and spring, 3 credits each semester

MUS 563 Choral Conducting

Guidance in the preparation and practice of conducting choral groups. Open only to adequately prepared students with a professional commitment to conducting.

Instructor: M. Brooks
Fall and spring, 3 credits each semester

MUS 565 Graduate Orchestra

Study and performance of orchestral works from the Baroque period to the present. Weekly readings of important works from the standard repertory.

Instructors: D. Lawton, A. Weisberg
Fall and spring, 2 credits each semester

MUS 569 Performance Problems in 20th Century Music

A study of performance skills required in new music, with emphasis on polyrhythms, composite rhythms, control of tone color and dynamics, and on the understanding of new methods of nota-

tion. Exercises, and the study of selected 20th century works.

Instructor: A. Weisberg
Fall, 2 credits

MUS 570 20th Century Conducted Ensemble

Works to be studied will range from 5 to 15 players. Representative composers would be: Boulez, Carter, Stockhausen, Stravinsky, Varese, Webern. Performance of the works will be a normal part of the course. Instrumental students will be conducted by the instructor for one and one-half hours per week, and by the student conductors for one hour per week. Conducting students will meet with the instructor alone for one and one-half hours per week; besides working with the instrumentalists, they will also observe the sessions conducted by the instructor. Enrollment of conducting students will be limited to three.
Prerequisite: MUS 569 or the equivalent
Instructor: A. Weisberg
Spring, 3 credits for conducting students, 2 credits for instrumentalists

MUS 571 Advanced Instruction in Instrument or Voice

Individual guidance in technique and repertory, with 30 practice hours required each week. Each student is required to perform at least one solo piece per semester, unless excused by the instructor in a written note to the department’s Graduate Studies Committee.
Fall and spring, 6 credits each semester

MUS 573 Chamber Music

Chamber ensembles such as the string quartet, wind quintet, solo vocal ensemble, two-piano team and other special groups meet, each under the direction of a member of the performance faculty, for the study of works from the repertoires of the respective groups, with particular attention given to the music of the 20th century. Required: presence at a weekly coaching session, at least three hours per week of uncoached rehearsal, and at least one performance per semester.
Instructor: J. Kreiselman, Co-ordinator
Fall and spring, 2 credits

MUS 575 Master Class in Solo Repertory for Instrument or Voice

Performance techniques and problems in works for instrument or voice, drawn from all historical periods. The instructor will be a teacher of the specific instrument in each case, except that his section may be open to students of certain other instruments with his permission. Not offered each semester in every instrument.
Instructors: A. Addison, M. Canin
Fall and spring, 2 credits each semester

MUS 577 Master Class in Performance Pedagogy

Guidance and supervision in the teaching of an instrument or voice
2 credits

MUS 579 Opera Workshop

Study and performance of scenes or complete operas from the standard and 20th century repertoires. An interdisciplinary approach involving the Departments of

Music and Theatre Arts.

Instructors: D. Lawton, T. Neumiller
Fall and spring, 3 credits each semester

MUS 581 20th Century Repertory for Instrument or Voice

A study of the solo works of the 20th century, with emphasis on performance techniques and problems. The instructor will be a teacher of the specific instrument in each case, except his section may be open to students of certain other instruments with his permission. Not offered each semester in every instrument.

Instructor: G. Kalish, S. Baron
Fall and spring, 2 credits each semester

MUS 585 Renaissance and Baroque Brass Performance Practice

Study and survey of original and transcribed Renaissance works, and of various Baroque works, for brasses. Investigation of styles and techniques of Renaissance ornamentation using mainly Ganassi's Fontegara (1535) as text. Investigation of Baroque ornamentation styles and symbols.

Instructor: R. Anderson
Fall, 2 credits

MUS 591 Practicum in Teaching

Instruction in the department under the supervision of the faculty. (MUS 591 may not be included in the courses taken in fulfillment of degree requirements.)

Fall and spring, 3 credits each semester

MUS 592 Seminar on the Teaching of Music

Discussion of fundamental problems in teaching music. Topics may include the explanation of musical processes, communication to non-professionals, integration of aspects of performance, theory,

history or analysis with one another. Required of all students who teach one of the introductory undergraduate courses in musicianship, theory or literature; to be taken during the first semester of teaching.
Fall, 1 credit

MUS 595 Chamber Players

The Graduate String Quartet, the Graduate Wind Quintet and the Graduate Piano Trio, specially appointed groups, work under the direction of a member of the performance faculty and present concerts and workshops at the University and elsewhere.

Fall and spring, 3 credits each semester

MUS 599 Independent Studies

Individual studies under the guidance of a faculty member. Each student must submit to the Graduate Studies Committee of the department a written prospectus of the work he intends to pursue, with the amount of credit proposed, together with the written endorsement of the prospective instructor. Approval of the Graduate Studies Committee is required; hence this material should be submitted as soon as possible, and in any case within the first two weeks of the semester (or the first week of a summer session).

Fall and spring, variable credit

MUS 611 Workshop in Composition and Performance

Student composers and student performers will be under the joint supervision of the composition faculty and a member of the performance faculty. The composers will write examples, to be performed and discussed in class, that confront specified problems in performance and composition. The course can be repeated once for credit toward the degree.

Instructor: J. Lessard
Spring, 3 credits

MUS 615 Seminar in Electronic Music Composition

Individual compositions, of substantial proportions, in electronic or concrete music media. The course may be repeated. Open only to qualified students in a music degree program.

Prerequisite: MUS 516 or the equivalent
Instructors: B. Arel, D. Semegen

Fall and spring, 3 credits each semester

MUS 623 Directed Study in Composition

Intended for doctoral students in composition.

Fall and spring, variable, 1-12 credits each semester, repetitive

MUS 661 Directed Study in Conducting

Intended for doctoral students in conducting.

Fall and spring, variable, 1-12 credits each semester, repetitive

MUS 671 Directed Study in Instrumental and Vocal Performance

Intended for doctoral students in instrumental and vocal performance.

Fall and spring, variable, 1-12 credits each semester, repetitive

MUS 697 Directed Reading

Intended for preparation for the Preliminary Examinations and related requirements.

Fall and spring, variable, 1-12 credits each semester, repetitive

MUS 698 Directed Dissertation Research

Intended for work in the area of the dissertation.

Fall and spring, variable, 1-12 credits each semester, repetitive

Neurobiology and Behavior

BNB 500 Directed Readings in Behavior and Neurobiology

Directed readings in topics of current interest, under supervision of a faculty sponsor culminating in one or more critical review papers.

Prerequisite: Sponsor and approval of Masters Program Executive Committee Staff

1-3 credits, yearly, repetitive

BNB 541 Topics in Sensory Physiology

In-depth coverage of current knowledge and problems in specified sensory systems. Seminars will integrate anatomical, physiological, and psychological aspects of the selected topic. Topic to change yearly.

Prerequisite: Permission of instructor
Instructor: Yazulla

Spring, 3 credits, repetitive

BNB 547 Readings in Neurophysiology

Discussion and critical evaluation of neurophysiological research published in biological journals. Critical analyses of tech-

niques, methodology and conclusions of these researched will provide the primary focus of this seminar.

Prerequisite: Permission of instructor
Fall and spring, 2 credits each semester

BNB 548 Readings in Animal Behavior

Discussion of published research in the area of animal behavior. Critical analyses of techniques, methodology and conclusions of these researched will be the primary focus of this seminar.

Prerequisite: Permission of instructor
Fall and spring, 2 credits each semester

BNB 583-585 Special Seminars

Topics to be arranged
Fall and spring, variable and repetitive credit

BNB 599 Research

Original investigation undertaken with supervision of a member of the staff.
Fall and spring, credit to be arranged

BNB 693-696 Advanced Seminars

Topics to be arranged



Fall and spring, variable and repetitive credit

BNB 697 Advanced Neurobiology and Behavior Seminar

This seminar for advanced graduate students stresses a synthetic approach, drawing on original publications from diverse areas in the biological sciences.

Prerequisite: Permission of instructor
Fall and spring, 1 credit each semester

BNB 699 Dissertation Research

Original investigations undertaken as part of the Ph.D. program under the supervision of research committee.

Fall and spring, credit to be arranged

Oral Biology and Pathology

HBO 500 Biology of the Oral Mineralized Tissues

This course deals with the basic chemistry, crystallography, ultrastructure and metabolism of the calcium phosphates involved in the formation and physiological and pathological resorption of the various mineralized tissues found in or associated with the oral cavity (enamel, dentin, cementum, bone). Ectopic calcifications and calculus formation will also be examined.

Prerequisites: Oral Biology & Pathology or its equivalent and permission of instructor
Instructor: Dr. Kaufman

Fall and spring, 3 credits each semester

HBO 510 Salivary Metabolism and Secretion

Consideration is given to the normal and abnormal structure and function of the glandular systems found in the oral cavity. The composition, regulations and functions of the secretions from the major and minor salivary glands will receive particular attention.

Prerequisites: Oral Biology & Pathology or its equivalent and permission of instructor.
Instructors: Drs. Kleinberg and Pollock

Fall and spring, 3 credits each semester

HBO 520 Oral Microbial Systems

Consideration is given to the structural composition, metabolism and environmental relationships of the bacterial systems formed on and in association with the oral hard and soft tissues. Specific and mixed bacterial populations and their role in oral disease will be dealt with.

Prerequisites: Oral Biology & Pathology or its equivalent and permission of instructor
Instructor: Dr. McNamara

Fall and spring, 3 credits each semester

HBO 530 Molecular Biology and Pathology of the Periodontium

This course deals with the ultrastructure and biochemical composition of the periodontal tissues, the microbial interrelations with the organic and inorganic components of the periodontal tissues, the biochemical dynamics of gingival inflammation and wound healing, and the metabolic processes responsible for the composition and flow of gingival crevice fluid.

Prerequisites: Oral Biology & Pathology or its equivalent and permission of instructor
Instructor: Dr. Golub

Fall and spring, 3 credits each semester

HBO 535 Differentiation and Pathological Disorders

A consideration of the role of stabilization of gene expression in the development and maturation of mammalian cells and tissues. Differentiation in skin and cartilage will be considered in detail. Alterations in the differentiative process of these tissues which may result in pathological disorders will be discussed.

Prerequisites: Permission of instructor required; suggested—HBP 531; students must have had background in cellular bio-

chemistry

Instructor: Dr. Taichman

Fall and spring, 3 credits each semester

HBO 550 Molecular Basis of the Morphogenesis and Pathogenesis of the Oral and Related Tissues

This course deals with the basic mechanisms involved in differentiation, growth and development, and tumor formation as they relate to the biology and pathology of the oral apparatus.

Prerequisites: Oral Biology & Pathology or its equivalent and permission of instructor
Instructor: Dr. Taichman

Fall and spring, 3 credits each semester

HBO 560 Oral Biology and Pathology I

This course is the first of four comprehensive courses on molecular structure, biochemical and physiological function, developmental anatomy and pathology of the various systems that constitute the oral apparatus. The course consists of the following two units of instruction: (1) The Embryological Development of the Face and Oral Cavity and (2) The Biology and Pathology of the Oral Mineralized Tissues.

Prerequisites: Undergraduate degree in basic science and permission of instructor
Instructor: Dr. Kleinberg

Fall and spring, 3 credits each semester

HBO 561 Oral Biology and Pathology II

This course is the second of four comprehensive courses on molecular structure, biochemical and physiological function, developmental anatomy and pathology of the various systems that constitute the oral apparatus. The course consists of the following two units of instruction: (1) The Biology and Pathology of the Periodontal Structures and (2) The Microbiology of the Oral Cavity.

Prerequisites: Undergraduate degree in basic science and permission of instructor
Instructor: Dr. Kleinberg

Fall and spring, 3 credits each semester

HBO 562 Oral Biology and Pathology III

This course is the third of four comprehensive courses on molecular structure, biochemical and physiological function, developmental anatomy and pathology of the various systems that constitute the oral apparatus. The course consists of the following two units of instruction: (1) The Biology and Pathology of the Salivary Glands and their Products and (2) The Biology and Pathology of the Oral Mucous Membranes.

Prerequisites: Undergraduate degree in basic science and permission of instructor
Instructor: Dr. Kleinberg

Fall and spring, 3 credits each semester

HBO 563 Oral Biology and Pathology IV

This course is the last of four comprehensive courses on molecular structure, biochemical and physiological function, developmental anatomy and pathology of the various systems that constitute the oral



apparatus. The course consists of the following two units of instruction: (1) The Biology and Pathology of the Oral Sensory Systems and (2) The Biology and Pathology of Oral Motor Systems.

Prerequisites: Undergraduate degree in basic science and permission of instructor
Instructor: Dr. Kleinberg

Fall and spring, 3 credits each semester

HBO 590 Research Projects in Oral Biology & Pathology

Individual laboratory projects closely supervised by faculty members to be carried out in their research laboratories.

Prerequisite: Student must be enrolled in a master's or doctoral program.

Instructor: Dr. Pollack

Fall and spring, 3 credits each semester

HBO 599 Graduate Research

Original investigations undertaken with the supervision of a faculty member.

Prerequisite: Permission of instructor
Fall and spring, variable credit, 1-12 each semester

HBO 690 Oral Biology and Pathology Seminars

Research seminars by students, staff and visiting scientists.

Prerequisite: Permission of instructor.

Instructor: Dr. Pollack

Fall and spring, 1 credit each semester, repetitive

HBO 694 Dissertation Research in Oral Biology and Pathology

Original investigation undertaken with the supervision of a member of the staff.

Prerequisite: Permission of thesis advisor.
Fall and spring, variable credit, 1-12

HBO 695 Oral Biology and Pathology Teaching Practicum

Practice instruction in the teaching of Oral Biology and Pathology at the undergraduate level carried out under faculty orientation and supervision.

Prerequisite: Permission of instructor
Fall and spring, variable credit, 1-4

Pathology

HBP 531 General Pathology

Introduction to the nature and causes of disease, death, reaction to injury, and repair. Analysis of associated structural changes in cells and tissues, with reference to their functional correlates.

Prerequisite: Permission of instructor

Course Coordinator: Dr. Miller

Spring modules, 6 credits with lab, 3 credits without lab

HBP 532 Immunology

A general introduction to the principles of immunology for Health Science Professional Students. It will include: definition of antigens and antibodies; description of cellular events in the immune response; theories of antibody formation; mechanism of inflammation; hypersensitivity states; and diseases associated with responsiveness of the immune system.

Prerequisites: Advanced course in biology and permission of instructor. Biochemistry, genetics, and histology will be helpful
Course Coordinator: Dr. Miller
Spring modules, 2 credits

HBP 533 Basic Immunology

Basic principles of immunology for graduate students in the biological sciences. Includes: definition of antigens and antibodies; specificity of the immune response; serological quantitation of proteins and hormones, immunoglobulin structure; the genetics of immunoglobulin synthesis; cellular cooperation in the immune response; hypersensitivity; tolerance; transplantation. Open to advanced undergraduates.

Prerequisites: Advanced courses in biology and biochemistry and permission of instructor

Instructors: Drs. Godfrey, Habicht and Sherlock

Fall, 3 credits

HBP 535 Cell and Tissue Injury

This course is concerned with cellular mechanisms in disease. The types of physical and chemical agents which can injure cells or aggregates of cells and the nature of the interaction between the injurious agents and the target tissue or cells will be considered first. Cellular alterations occurring as a consequence of the injury or as a response to the injury will then be examined in depth, with particular attention paid to details of the ultrastructural and molecular aspects of injury and the response to injury. Emphasis will be placed upon experimental models which permit elucidation of the mechanisms underlying human disease.

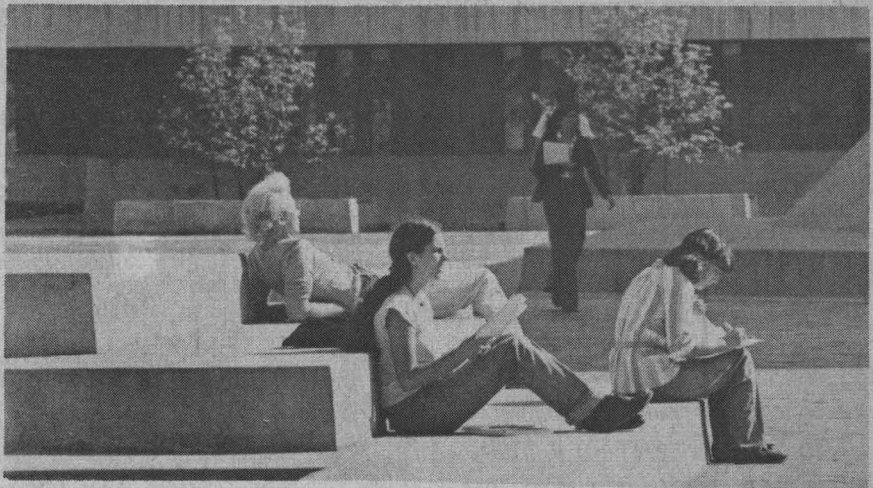
Prerequisite: HBP 531 or permission of instructor

Instructor: Dr. Lane

Spring, 2 credits

HBP 551 Lysosomes

A consideration of the cell biology, biochemistry, physiologic functions and pathologic roles of lysosomes in mammal-



ian cells, with special emphasis on the lysosomes of polymorphonuclear leukocytes and their role in the inflammatory process and specific disease states.

Prerequisite: HBP 531

Instructor: Dr. Janoff

Spring, 2 credits

HBP 552 Radiopathology

A consideration of the biological and pathological effects of ionizing radiations in living organisms, with emphasis on cellular, molecular, and atomic mechanisms.

Prerequisite: HBP 531

Instructor: Staff

Fall and spring, by special arrangement with instructor, 1 credit each semester.

HBP 553 Pathology of Neoplasia

This course will cover the nature and behavior of neoplastic tissue, the etiologies of cancer, the effect of tumors upon the host and will include a special series of laboratories designed to acquaint the student (without a background in histology or physiology) with the appearance and behavior of cancer on the tissue and organ level.

Prerequisite: Permission of instructor

Course Coordinator: Dr. Miller

Instructors: Staff (Special laboratory: Dr. Lane)

Spring modules, 2 credits

HBP 554 Advanced Immunology

Mechanisms of injury produced by immunological reactions in tissues. Autoimmune diseases. Immunodeficiency diseases. Supervised laboratory experience in selected topics in immunochemistry or immunology can be arranged.

Prerequisite: HBP 531, 532, or 533

Instructors: Drs. Miller, Habicht and Janoff
Spring, 2 credits

HBP 555 Biology of Phagocytes

A discussion of monocytes, macrophages and neutrophilic leukocytes of mammalian species, with special emphasis on man. Topics covered include kinetics, cell biology, chemotaxis, metabolism, physiological functions, immunological actions and pathological roles of phagocytic cells.

Prerequisite: HBC 331 or HBC 531 (HBP 531/532 are also recommended.)

Instructors: Drs. Janoff and White

Fall, 2 credits

HBP 561 Electron Microscopy for Experimental Pathologists

Use of the electron microscope (EM), alone and in conjunction with other methodologies, in studies of biological dysfunction. Special techniques include histochemistry, enzyme histochemistry, immunohistochemistry, diffraction, stereo EM and scanning EM. Design of protocols, preparation and interpretation of data.

Prerequisite: Permission of instructor

Instructor: Dr. Lane

Fall and spring, variable, 2-6 credits each semester

HBP 563 Histochemistry

Application of histochemical techniques (enzyme histochemistry, radioautography, cytophotometry, electron histochemistry, and immunohistochemistry) to the analysis of chemical components of cells and tissues.

Prerequisites: HBP 531 or HBP 533 and permission of instructor

Instructor: Mr. Elias

Fall, 3 credits

HBP 590 Seminars in Research in Immunology

A series of bimonthly year round seminars which will discuss research in progress by the participants, current journal articles in the field of immunobiology, and prepared reviews of specified areas in the general field.

Prerequisite: Permission of instructor

Instructor: Dr. Miller

Fall and spring, 1 credit each semester

HBP 621 Clinical Histopathology

Histologic study of human pathologic anatomy as seen in surgical biopsy and necropsy tissues. Emphasis is placed upon correlation between clinical presentations of human disease and histomorphology. Special reference to diagnostic and therapeutic implications of the pathologic process. Designed for students in the Health

Professions.

Prerequisite: Permission of instructor

Instructor: Staff

Course Coordinators: Drs. Miller and Kane
Fall, variable, 1-3 credits

HBP 622 Clinical Pathologic Correlations: Gross Pathology

Correlative exercises in clinical pathology and human gross anatomic pathology including surgical biopsy material. Open to students in medical sciences.

Prerequisite: Permission of instructor

Instructor: Staff

Course Directors: Drs. Kane and Miller

Fall, variable, 1-3 credits

HBP 690 Seminar in Pathology

Seminar in major topics in experimental pathology by students, staff, and visiting scientists.

Prerequisite: Permission of instructor

Instructors: Drs. Phillips and Godfrey

Fall and spring, variable and repetitive, 1-4 credits each semester

HBP 691 Journal Club in Pathology

Critical discussions of selected topics in experimental and descriptive pathology with presentation of papers from the literature.

Prerequisite: Permission of instructor

Instructors: Drs. Godfrey and Janoff

Fall and spring, 2 credits each semester

HBP 692 Advanced Tutorial Experimental Pathology

Advanced tutorial in pathology under faculty supervision with emphasis on material not normally experienced in didactic course work. Directed readings and other educational experiences may relate to other preparation for thesis research or for the Ph.D. qualifying examinations.

Prerequisites: Permission of instructor and successful completion of Program

Committee assigned courses.

Staff

Fall and spring, variable, 1-12 credits each semester

HBP 694 Thesis Research in Pathology

Original investigation undertaken with the supervision of a member of the staff.

Prerequisite: Permission of instructor

Staff

Fall and spring, variable and repetitive, 1-12 credits each semester

HBP 695 Teaching Practicum in Pathology

Practice instruction in the teaching of pathology, carried out under faculty orientation and supervision.

Prerequisite: Permission of instructor

Staff

Fall and spring, variable and repetitive, 1-4 credits each semester



Pharmacological Sciences

HBH 531 Pharmacological Basis of Therapeutics

Basic principles that underlie action of drugs on physiological processes with particular reference to their therapeutic and toxic actions. A general course in pharmacology for medical and graduate students.

Prerequisite: Permission of instructor

Staff

Spring modules, 5 credits

HBH 550 Biophysics

Theoretical background and application of current physical techniques to the study of the molecular mechanisms of biological function. Topics to include spectroscopy, diffusion processes, noise and fluctuation, interfacial phenomena.

Prerequisite: Physical Chemistry or permission of instructor

Instructor: Dr. Eisenberg

Fall, odd years, 3 credits

HBH 560 Topics in Biochemical Pharmacology

This course will examine the biochemical characteristics of drug and hormone action. Several drugs, hormones, and neurotransmitters will be examined in detail to illustrate: (1) the interaction of drugs and hormones with cellular receptors, (2) bonding forces and determinants of specificity in drug receptor interactions, (3) the central role of adenylyl cyclase in pharmacological regulation, (4) transduction of the chemical signal to the pharmacological response (5) mechanism of drug entry into cells. Emphasis will be placed on current concepts and experimental approaches.

Instructors: Drs. Williams, Brynes, Grollman, Cohen, Benjamin and Schmidt
Spring, 3 credits

HBH 599 Graduate Research in Pharmacological Sciences

Original research projects undertaken with the supervision of a faculty member.

Prerequisite: Permission of instructor

Fall and spring, variable, 1-12 credits each semester

HBH 650 Clinical Pharmacology

A clinically oriented, seminar-discussion course emphasizing rational therapeutics. Patients are studied at the bedside to illustrate therapeutic problems. May include field trips.

Prerequisite: Permission of instructor

Instructor: Dr. Raisfeld

Spring, variable, 2-4 credits

HBH 680 Selected Topics in Pharmacology

Student seminars and readings on topics to be arranged through consultation with staff.

Prerequisite: Permission of instructor

Staff

Fall and spring, variable and repetitive, 1-8 credits each semester

HBH 690 Pharmacology Seminars

Advanced research seminars by staff and visiting lecturers.

Prerequisite: Permission of instructor

Staff

Fall and spring, 1 credit each semester, repetitive

HBH 694 Dissertation Research in Pharmacology

Original investigation undertaken as part of the Ph.D. program under supervision of thesis advisor and committee.

Prerequisite: Permission of thesis advisor

Fall and spring, variable and repetitive, 1-12 credits each semester

Philosophy

The Department of Philosophy offers programs leading to the Master of Arts in Philosophical Perspectives, and to the Doctor of Philosophy. The two programs are extremely different in content and purpose.

Students should consult the department's course list each semester for specific offerings and descriptions.

MASTER'S PROGRAM IN PHILOSOPHICAL PERSPECTIVES

Course Offerings: (all courses are 3 credits unless otherwise noted)

PHI 524, 525 History of Philosophical Perspectives

PHI 527, 528 Individual Thinkers in the History of Philosophy

PHI 530 Anglo-American Philosophy in the Twentieth Century

PHI 531 Existentialism and Phenomenology

PHI 532 Marxism and Communism

PHI 533 Oriental Views of Man and Nature: China

PHI 534 Oriental Views of Man and Nature: Japan

PHI 535 Metaphysics and the Philosophy of Religion

PHI 542 The Structure of Inquiry

PHI 543 Logic

PHI 544 Perspectives on Communication

PHI 545, 546, 547 Perspectives on Social and Political Issues (Variable topics, including equality, genetics, the cities, technology, etc.)

PHI 548 Philosophical Dimensions of American Experience

PHI 549 Perspectives on Law

PHI 550, 551 Perspectives on Contemporary Moral Problems

PHI 552 Perspectives on Feminism

PHI 553 Perspectives on the Environment

PHI 554 Perspectives on Death

PHI 555, 556 Perspectives on Education

PHI 580 Guilt and Responsibility

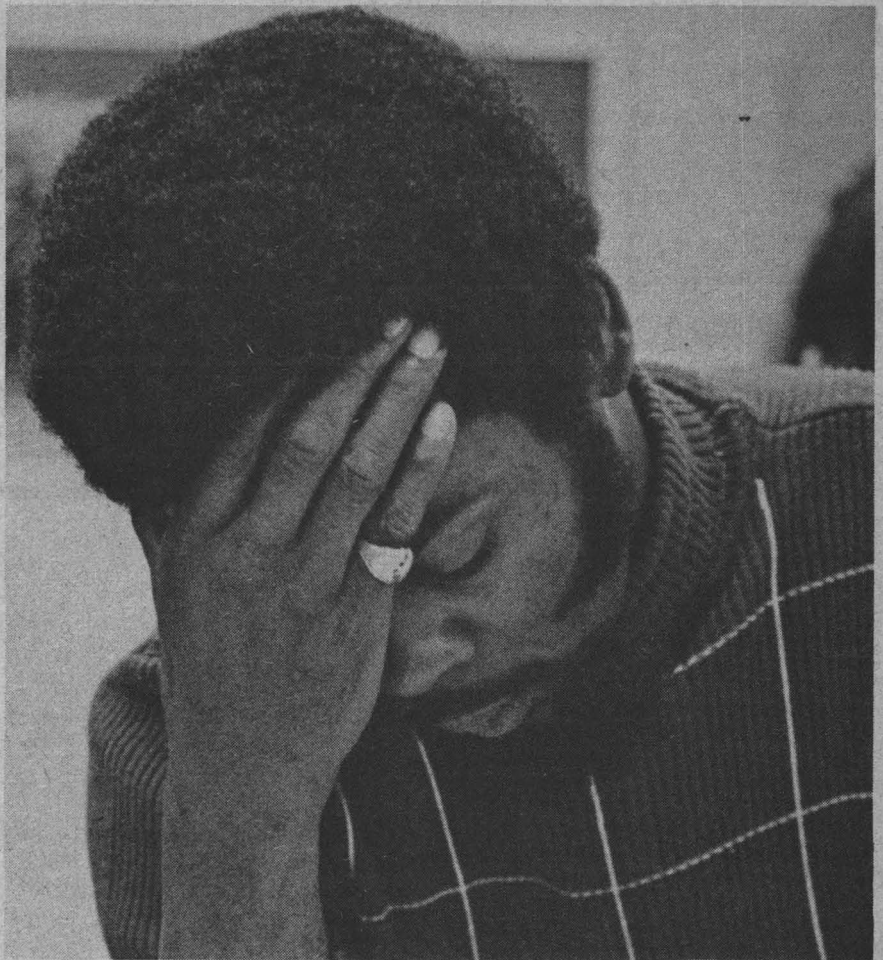
PHI 581 Moral Theories of the Modern World

PHI 582, 583 Colloquium: Contemporary Problems

PHI 584, 585 Teaching Practicum

PHI 586, 587 Directed Readings (variable credit)

PHI 588, 589 Directed Research (variable credit)



DOCTORAL PROGRAM IN PHILOSOPHY

Course offerings: (all courses are 3 credits unless otherwise noted.)

I. AREA COURSES

PHI 500 History of Philosophy and Philosophical Texts

PHI 501 Philosophy of Science and Logic

PHI 502 Metaphysics and Systematic Philosophy

PHI 503 Epistemology, Philosophy of Mind, Perception and Experience

PHI 504 Philosophy of Value, Culture, and Society

PHI 505 Aesthetics and Rhetoric

PHI 506 Oriental Philosophy

II. PROSEMINARS

PHI 590 Analytic Philosophies

PHI 591 Phenomenological-Existential Philosophies

PHI 592 Contemporary Systematic Philosophy

III. ONGOING STYLE SEMINARS

PHI 600 Ongoing Style Seminar: Analysis

PHI 601 Ongoing Style Seminar: Phenomenology and Existentialism

PHI 602 Ongoing Style Seminar: Systematic Philosophies

IV. ONGOING INTERDISCIPLINARY SEMINARS

PHI 610 Interface Seminar: Philosophy-Natural Science

PHI 611 Interface Seminar: Philosophy-Social Science

PHI 612 Interface Seminar: Philosophy-Humanities

V. INDEPENDENT AND DIRECTED STUDIES

PHI 620 Advanced Problems in Philosophy (variable and repetitive credit)

PHI 621 Independent Study (variable and repetitive credit)

PHI 622 Supervised Teaching (3 credits, repetitive)

PHI 690 Dissertation (variable and repetitive credit, maximum 6 hours)

Physics

PHY 501 Classical Mechanics

Lagrangian and Hamiltonian formulations, variational principles, Hamilton-Jacobi theory, mechanics of fields, special relativity.
3 credits

PHY 503, 504 Methods of Mathematical Physics I, II

A selection of mathematical techniques useful for physicists. Topics will be selected from the following: linear vector spaces, matrices, Green's functions, complex analysis, differential equations, special functions, boundary value problems, integral transforms, integral equations, probability. This course should be taken only by entering graduate students who have a deficiency in this area.
3 credits each semester

PHY 505, 506 Classical Electrodynamics

Electrostatics and magnetostatics with emphasis on the solution of boundary value problems through the use of eigenfunction expansions and Green's functions; dielectrics, magnetic materials, Maxwell's equations, electromagnetic waves, wave guides, diffraction, plasma physics, special relativity, relativistic particle kinematics and dynamics, energy loss and scattering of charged particles in matter, radiation, multipole fields, spin resonance, and superconductivity.
3 credits each semester

PHY 511, 512 Quantum Mechanics I, II

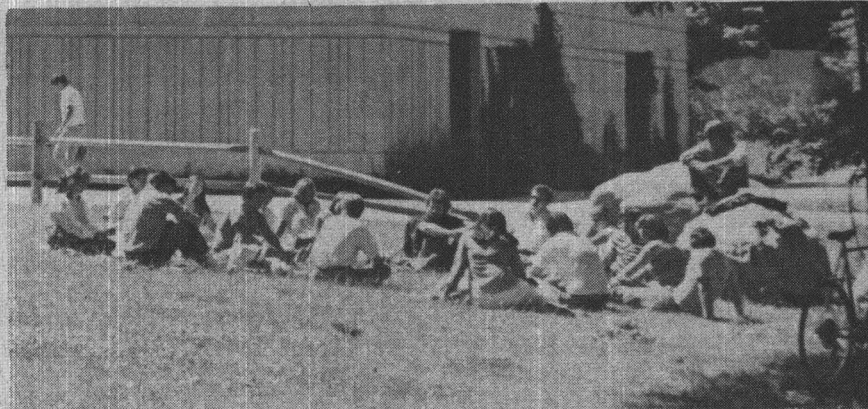
Topics include: basic quantum physics and mathematical apparatus, angular momentum, symmetries, semiclassical theory of radiation, Dirac theory, and numerous concrete applications to atoms, nuclei, etc.
Prerequisite: Undergraduate course in quantum mechanics
3 credits each semester

PHY 515 Methods of Experimental Research

A laboratory-lecture course designed to help start beginning graduate students on a path toward independent, professional research. Students undertake three modest but original projects. Lectures cover tools, techniques, and concepts considered indispensable in the laboratory.
3 credits

PHY 520 Overview of Energy Problems

Designed to serve both as an initial course for students specializing in energy studies and as a broad survey for graduate students in other fields of the physical sciences and engineering. Topics include the availability of energy resources, physical principles and technology involved in energy production, and environmental, economic, and social problems related to energy production and use.
Prerequisite: Permission of instructor
3 credits



PHY 530 Role of Energy Resources in the World's Future

A seminar course in which students are involved in independent projects pertaining to the role of energy resources in the world's future. Topics for discussion and for projects, which will vary from year to year, will be chosen from those of current interest. Repetitive credit may be approved for an individual student.

Prerequisite: Permission of instructor
3 credits

PHY 540 Statistical Mechanics

Brief review of thermodynamics. Thermal equilibrium ensembles for classical and quantum systems. Applications to systems for which the Hamiltonian is separable; approximate treatment of nonseparable Hamiltonians.
3 credits

PHY 541 Advanced Statistical Mechanics

High temperature properties: cluster expansions, ionized systems; low temperature properties: elementary theory of quantum fluids, model calculations; phase transitions: transfer matrix, Ising and ferroelectric models; introduction to fluctuation and nonequilibrium phenomena.
3 credits

PHY 551 Nuclear Physics I

Basic properties of nuclei, radioactivity and electromagnetic properties; experimental techniques, accelerators and nuclear detectors: the two-body problem and nuclear forces.
3 credits

PHY 552 Nuclear Physics II

Nuclear models and their relations to properties of nuclei, theory of nuclear reactions, nuclear beta decay.
3 credits

PHY 555, 556 Solid State Physics I, II

A comprehensive introduction to solid state physics. Topics covered include crystal structures and symmetries, energy band theory, semiclassical electron dynamics and transport theory, Fermi surface measurements, optical properties, phonons and electron-phonon interactions, dielectric properties, semiconductors, magnetism, and superconductivity.
3 credits each semester

PHY 557, 558 Elementary Particle Physics I, II

Introduction to elementary particle characteristics and phenomena, symmetry and invariance principles, partial wave analysis and resonance phenomena, models for strong interaction, high energy phenomena, weak interactions, accelerator and detector development.
3 credits each semester

PHY 563 Nuclear Astrophysics

The course covers nuclear processes underlying a star's evolution from initial hydrogen burning through nucleosynthesis and supernova explosions to the final state which may be a neutron star. Problems discussed include the generation of solar neutrinos, the production of heavy elements, the role of neutrinos in supernova explosions, and observable consequences of neutron star composition and structure.
Prerequisites: PHY 511, 512
3 credits

PHY 580 Special Research Projects

Research under the direction of a faculty member. Not open to Ph.D. candidates who have passed the Preliminary Examination.
Each semester, variable and repetitive credits

PHY 585 Special Study

Reading course in selected topics.
Each semester, variable and repetitive credits

PHY 599 Graduate Seminars (I and II)

Special research topics centered on monographs, conference proceedings or journal articles. Topics include Solid State Physics, Elementary Particles, Atomic Physics and Quantum Electronics, Nuclear Physics.
Both semesters are required for all first-year graduate students.
1 credit each semester

PHY 600 Practicum in Teaching

2 credits, repetitive credit permitted

PHY 610, 611 Quantum Field Theory I, II

Field quantization: interacting fields; S-matrix theory; Feynman diagrams; charge and mass renormalization; dispersion relations; general field theory.
3 credits each semester

PHY 620 Relativity

General theory of relativity; cosmology.
3 credits

PHY 630 Low Temperature Physics

Subject matter varies from semester to semester, depending on the interest of students and staff. Topics covered may include quantization effects in superfluids and superconductors, superfluid hydrodynamics, tunnelling in superconductors, low temperature properties of solids.
3 credits

SEMINARS

Each semester, several seminars for advanced graduate students will be offered. These courses are intended primarily for students doing research in the area, although other students may enroll with permission of the faculty seminar leaders. Each semester carries one credit, with repetitive credit permitted.

PHY 670 Seminar in Theoretical Physics**PHY 671 Seminar in Statistical Physics****PHY 672 Seminar in Elementary Particle Physics****PHY 674 Seminar in Nuclear Physics****PHY 676 Seminar in Solid State Physics****SPECIAL TOPICS COURSES**

The subject matter of each special topics course varies from semester to semester, depending on the interests of students and staff. Advanced topics will be discussed, particularly those that are of current interest. Each course carries three credits, with repetitive credit permitted.

PHY 680 Special Topics in Theoretical Physics**PHY 681 Special Topics in Statistical Mechanics****PHY 682 Special Topics in Solid State Physics****PHY 683 Special Topics in Radiation Physics****PHY 684 Special Topics in Nuclear Physics****PHY 685 Special Topics in Mathematical Physics****PHY 686 Special Topics in Elementary Particles****PHY 688 Special Topics in Astrophysics****PHY 690 Special Topics in Quantum Electronics****PHY 692 Special Topics in Biophysics**
2 credits, repetitive**PHY 698 Colloquium**
1 credit**PHY 699 Dissertation Research**

Independent research for Ph.D. degree. Open only to students who have passed the Ph.D. Preliminary Examination. Each semester, variable and repetitive credit

Physiology and Biophysics

HBY 531 Introduction to Mammalian Physiology

An introduction at the graduate level to physiology, with emphasis on man. The principle of cellular physiology, followed by an introduction to the circulatory, respiratory, gastrointestinal, renal, endocrine, and nervous systems.

Prerequisites: Admission to medical or dental school and permission of instructor.
Instructor: Dr. Levy
Fall modules, 5 credits

HBY 551 Membrane Physiology and Biophysics

The molecular structure of biological membranes, using NMR, spin labels, X-rays, DTC, etc. The fundamental concepts relevant to the study of solute permeation through membranes are reviewed by considering successively the properties of a thin film of hydrocarbon, a phospholipid bilayer, a bilayer with pores and channels, and finally, a biological membrane.

Prerequisite: Permission of instructor
Instructor: Dr. McLaughlin
Spring, 3 credits

HBY 552 Physiology and Pharmacology of Excitable Membranes

The origins of electrophysiological phenomena; the ionic theory of resting and action potentials, the physical and chemical properties of membrane ionic conductances, and the biophysics and physiology of sensory organs will all be discussed. This is a seminar course which stresses the understanding of electrophysiological phenomena in terms of molecular mechanisms. One semester of calculus is a sufficient math background. Open to all graduate students and to advanced undergraduates with permission of instructor.

Instructor: Dr. Strichartz
Fall, odd years only, 3 credits

HBY 590 Special Topics in Physiology and Biophysics

Student seminars on topics to be arranged through consultation with faculty members.

Prerequisite: Permission of instructor
Instructor: Staff
Fall and spring, variable and repetitive, 1-2 credits each semester

HBY 591 Physiology and Biophysics Research

Original investigation undertaken with a member of the staff.

Prerequisite: Permission of instructor
Instructor: Staff
Fall and spring, variable and repetitive, 1-12 credits each semester

HBY 690 Seminar in Physiology and Biophysics

Seminars and discussions on major topics in physiology and biophysics by students, staff and visiting scientists.

Prerequisite: Permission of instructor
Instructor: Staff
Fall and spring, variable and repetitive, 1-2 credits each semester

HBY 694 Thesis Research in Physiology and Biophysics

Original thesis research undertaken with the supervision of a member of the staff.

Prerequisite: Permission of thesis advisor
Fall and spring, variable and repetitive, 1-12 credits each semester

HBY 695 Practicum in Teaching in Physiology and Biophysics

Practical experience and instruction in the teaching of physiology and biophysics carried out under faculty orientation and supervision.

Prerequisite: Permission of instructor
Fall and spring, variable and repetitive, 1-4 credits each semester



Political Science

M.A. PROGRAM COURSES

POL 510 Statistical Methods for Public Policy Analysis

An introduction to the basic analytic techniques necessary to the analysis of governmental programs and agencies. Students will be introduced to computer programming and statistical analytic techniques, as well as to alternate sources of information from which crucial data on public events and programs can be drawn and analyzed. Fall, 3 credits

POL 511 Research Methods for Public Policy Analysis

A workshop following the Statistical Methods course in which students will engage in actual problem solving research utilizing such techniques as cost/benefit analysis, social and economic indicators, and program evaluation. The course will emphasize the application of quantitative and qualitative methods to the analysis of public sector problems.

Prerequisite: POL 510
Spring, 3 credits

POL 531 Topics in Public Affairs: Planning

Topics in Public Affairs will address the planning process as a decision-making tool in the implementation of public policy in housing, land-use, transportation and environmental management. The course will include intergovernmental roles and the impact of citizen participation on policy changes.

Fall, 3 credits

POL 533 Administration and Public Policy

A systematic introduction to the principles of public administration and public policy, with an emphasis on the formulation of legislative and administrative decisions. A major part of the course is devoted to student projects which analyze the formulation of a governmental program or policy.

Fall, 3 credits

POL 534 Intergovernmental Relations and Policy Delivery

This course focuses on the formulation, implementation, and impact of intergovernmental policy. Several policies will be examined in depth, including grant-in-aid programs. General Revenue Sharing, Housing and Community Development and Employment programs. The historical, economic and political foundations of intergovernmental policy delivery will be examined.

Fall, 3 credits

POL 535 Public Policy Analysis and Evaluation

This course concentrates on the strategies and methods of public policy analysis and evaluation. Topics covered in the course will include: developing a research strategy and design, choosing measures, analyzing data, and communicating results. Students will develop a program evaluation



tion of their own and partially conduct their research during the semester. Finally, the course will consider the role of evaluation research in a political context and the role of the policy analyst in the public sector. Prerequisite: POL 533 or Permission of MA Program Director
Spring, 3 credits

POL 536 Introduction to Budgeting

This course will examine the United States federal, state and local budgeting procedures. Special emphasis will be placed upon the current federal practices and upon the probable impact of proposed changes.

Spring, 3 credits

POL 538 Urban Politics

This course concentrates on urban and suburban growth; the decentralization of metropolitan areas; land use policy and reforming metropolitan policy making. Several additional policy areas, such as education, finance, and police will be considered. Political phenomena, including parties and ethnic groups will also be discussed.

Spring, 3 credits

POL 539 Law for Administrators

A professional course aimed at preparing individuals training for or already engaged in an administrative career to meet the growing legal scrutiny to which the actions of administrators are now subject. The course will focus on the legal responsibilities and obligations of administrators and help enable them more efficiently to determine when professional legal counselling may be necessary.

Spring, 3 credits

POL 543 Environmental Politics and Policy

Federal environmental legislation, such as the National Environmental Policy Act, the Coastal Zone Management Act and the Federal Pure Waters Management Act will be examined. The policies, politics and administrative activities of federal, state and local levels will be considered. Finally the interaction of the public sector, the private sector and citizen groups in the implementation of environmental policy will be discussed.

Spring, 3 credits

POL 549 Education Policy

A course on the formulation, implementation and evaluation of education policy in the United States. Education policy at the elementary, secondary and higher education levels will be covered. Readings and lectures will examine how educational institutions at all levels set goals, find resources, identify and solve problems, and adapt to change. The role of education in the political and governmental process will be discussed.

Spring, 3 credits

POL 580 Special Projects/Internships

This work, tailored to fit the needs of individual students, may include participation in student-faculty research teams or internship assignments in a local, state or federal public sector agency.

Spring or summer, 3 to 6 credits each semester

POL 599 Independent Study

This course can be arranged between a student and faculty member for the purpose of allowing the student to pursue independently supervised research, at the Master's level.

Fall and spring, variable credit

DOCTORAL PROGRAM IN POLITICAL SCIENCE

Course offerings: (all courses are 3 credits unless otherwise noted.)

POL 550 Foundations: American Politics

A review of the basic political science literature of American politics, with emphasis on electoral behavior, parties, and groups.

Fall, 3 credits

POL 551 Foundations of Political Science: Political Behavior

A review and analysis of the political behavior literature, including such topics as attitude formation and change, belief systems, political socialization, demographic and small group influences on political beliefs and conduct, political leadership, voting, elite vs. mass politics, decision making, personality and politics, political conformity and protest.

Prerequisite: POL 550

Spring, 3 credits

POL 552 Foundations: Public Policy

A systematic introduction to the study of public policy in the United States. This course investigates the formulation of public policy and the political and social forces that structure that formulation. Techniques for the study of policy implementation and the evaluation of policy effects are also introduced. In addition to the procedures of policy analysis, substantive policy areas such as education, welfare, and environmental preservation will be investigated.
Fall, 3 credits

POL 553 Foundations: Comparative/International

Survey and critical evaluation of the major theoretical approaches, issues and problems in comparative political analysis. The course examines such problem areas as political development, empirical democratic theory, and political socialization among others, along with detailed examination of one or more selected non-American political systems.
Prerequisite: POL 552
Spring, 3 credits

POL 560 Political Psychology I

Survey of the political psychology literature, with emphasis on the application of conceptual and methodological approaches from social and experimental psychology to the analysis of political behavior.
Fall, 3 credits

POL 561 Political Psychology II

Continuation of POL 560, with emphasis on the psychophysical, psychophysiological and behavioral measurement of political variables.
Prerequisite: POL 560
Spring, 3 credits

POL 562 Laboratory & Field Instrumentation

This course is an introduction to real time applications of mini-computers in laboratory experimentation. The following major topics will be discussed: 1) Review of experimental design, techniques (factorial, Latin, square, etc.) 2) Introduction to the PDP-11 operating system (use of the job control language and packages) 3) The design and use of laboratory instrumentation 4) A review of programming techniques and the Fortran IV language on the PDP 11/03 computer. In addition, each student will design and conduct a series of laboratory experiments which will illustrate the capabilities and problems of computer experimentation.
Fall, 3 credits

POL 601 Teaching Methods and Practicum

A course designed to prepare students for undergraduate teaching. Students will be assigned to one of the basic undergraduate courses as a teaching assistant. In addition to teaching in weekly discussion groups, students will meet weekly with the professors in each basic undergraduate course to discuss teaching skills, the preparation of lecture material, the construction of exams.
Prerequisites: POL 550, 551
Fall, 3 credits

POL 602 Teaching Methods and Practicum

A continuation of POL 601.
Prerequisite: POL 601
Spring, 3 credits

POL 603 Applied Data Analysis I

The application of statistical and mathematical models to the analysis of political data, with emphasis on methodological assumptions and problems.
Prerequisites: PSY 501 and PSY 502 or equivalent
Fall, 3 credits

POL 604 Applied Data Analysis: II

The application of statistical and mathematical models to the analysis of political data, with emphasis on methodological assumptions and problems.
Prerequisite: POL 603
Spring, 3 credits

POL 610 Research Practicum I

A course involving students actively in an ongoing research project under the direction of the principle investigator. Students will participate in all stages of the research project and be required to prepare a research report on one aspect of the project.
Prerequisites: POL 550, 551, 552, 553
Fall, 3 credits

POL 611 Research Practicum II

A continuation of POL 610. Students will actively participate in either a second research project, where they will again prepare a research report, or continue their participation in the same project, where they will then be assigned a subset of data for analysis or carry out a specific research aim of the project.
Prerequisite: POL 610
Spring, 3 credits

POL 620 Research Colloquium

Students will participate in weekly departmental colloquia where they will serve as discussants of research reports presented by individual faculty members or outside investigators reporting on current research.
Prerequisite: POL 553
Fall, 3 credits

POL 621 Research Colloquium

A continuation of POL 620 except that in this course students will present formal papers on their research projects (POL 610-611) and faculty members will serve as discussants.
Prerequisite: POL 620
Spring, 3 credits

POL 630 Psychophysiological Methods

Covers organization of the human nervous system and its interaction with physiological response systems. Studies methods of recording and analyzing psychophysiological response measures. Examines the application of psychophysiological response measures and patterns to the study of individual attitudes and behavior. (Cross-listed with PSY 566)
Fall, 3 credits

POL 658 Political Attitudes and Attitude Change

The content, structure, determinants and behavioral consequences of political attitudes are examined. Particular focus will be given to testing hypotheses about atti-

tude formation and change. Attitude research methods will be studied for the purpose of empirically testing hypotheses.
Fall, 3 credits

POL 660 Advanced Topics in Political Behavior

Review of the literature and methods related to a single topic or problem in contemporary political science, e.g., voting behavior, issue formation, interest groups, political economy or personality.
Prerequisites: POL 550, 551, 552, 553
Fall, 3 credits (every 2 years)

POL 661 Advance Topics in Political Behavior

Review of the literature and methods related to a single topic or problem in contemporary political science, e.g., voting behavior, issue formation, interest groups, political economy or personality.
Prerequisites: POL 550, 551, 552, 553
Spring, 3 credits (every 2 years)

POL 662 Group Decision Models

Topics to be discussed include the theory of games, individual choice theory and social choice theory. The purpose of the course is to show how these models aid our understanding of politics.
Spring, 3 credits

POL 663 Campaigns & Voting

This course will include readings on the impact of campaigns on the vote. Included in the course will be analyses on voting behavior, with special emphasis upon impact of campaign techniques upon persuasion and turnout. Useful prerequisites include statistical and computer (SPSS) methods.
Spring, 3 credits

POL 664 Political Information Processing

Surveys contemporary psychological models of information processing, with emphasis on experimental applications to the analysis of the content and structure of political concepts.
Spring, 3 credits

POL 665 Advanced Topics in Political Analysis

A semester course reviewing the literature and methodology of specific areas of political science research. The course will relate directly to research applications and provide students an opportunity to apply advanced research tools to selected substantive problems.
Prerequisite: POL 553
Fall, once every two years, 3 credits

POL 666 Advanced Topics in Political Analysis

A continuation of POL 665.
Prerequisite: POL 665
Spring, once every two years, 3 credits

POL 667 Dimensional Analysis

The course provides training--in both theory and applications--in the several statistical methods collectively labelled dimensional analysis. These include unfolding, Guttman scaling, factor analysis, and multidimensional scaling. Particular emphasis will be on the family of methods associated with multidimensional scaling, including related techniques for analysis of variance,

multiple regression, and principal components analysis, in situations where variables may be measured at the ordinal or categorical level. Students will be expected to apply methods to actual research problems.

Prerequisite: training in basic statistics
Spring, 3 credits

POL 670 Advanced Topics in Public Policy Analysis

An intensive examination of the major substantive and methodological concerns involved in the investigation of the public policy process. Program evaluation methodologies will be investigated as well as the political milieu within which these evaluations must be utilized.

Prerequisites: POL 551, 553
Once every two years, 3 credits

POL 671 Advanced Topics in Public Policy Analysis II

A continuation of POL 670. The skills learned in POL 670 will be applied to the actual examination and evaluation of government policy in a substantive area of concern chosen jointly by the instructor and the student.

Prerequisite: POL 670
Once every two years, 3 credits

POL 672 Urban and Suburban Growth Policy

The processes of urban and suburban community growth are the central concern of this course. Growth policies enacted by local, state and national governments are examined. The course is concerned with both historical processes of growth and past government policies, as well as those conditions and policies presently being practiced.

Prerequisite: POL 538
Spring, 3 credits

POL 675 Advanced Topics in Government Institutions

An intensive examination of the major substantive and methodological problems involved in the study of political institutions and processes.

Prerequisites: POL 551, 553
Once every two years, 3 credits

POL 676 Advanced Topics in Governmental Institutions

A continuation of POL 675. An intensive examination of a second substantive area of political institutions and processes.

Prerequisite: POL 675
Once every two years, 3 credits

POL 677 Political Elites

Critical review of established and new theoretical approaches and methodological orientations to the study of political elites.

Prerequisite: graduate standing
Spring, 3 credits

POL 678 Political Development

A study of rapid political change, its origins and consequences. This will include several theoretical perspectives, and the detailed study of a number of cases, for example, Brazil, China, and Tanzania, as well as an historical overview of some western nations.

Spring, 3 credits

POL 680 Independent Study

Prerequisite: POL 611
Fall and spring, variable credit

POL 681 Independent Study

Prerequisite: POL 611
Fall and spring, variable credit

POL 699 Doctoral Dissertation Research

Prerequisite: POL 611
Fall and spring, variable credit



Psychology

PSY 500 Quantitative Background

Intended to prepare students with inadequate mathematical background and/or aptitude to enter PSY 501 and 502. Includes review and practice on topics in algebra, logic, sets and relations, functions, and elementary probability, as well as individually assigned remedial work on more elementary topics as required.

Prerequisite: Undergraduate Statistics
Fall, 3 credits

PSY 501 Foundations of Scientific Psychology

A comprehensive introduction to the application of the scientific method in psychology, developed from the Baconian perspective. The course focuses upon the interpretation of observed relationships among both manipulated and classificatory variables and presents statistics as a tool of the social sciences. Required of all Ph.D. students in psychology.

Fall, 3 credits

PSY 502 Quantitative Methods

The application of linear equations to the testing of causal models and the description of complex relationships among observations. Special attention is devoted to equation models for longitudinal data, variables with measurement error, and computer programs for multiple regression.

Prerequisite: PSY 501
Spring, 3 credits

PSY 503 Experimental Design

An examination of the properties of common experimental designs in psychology

together with the study of appropriate statistical analyses. Topics include factorial, hierarchical, latin square, and incomplete designs. Statistical procedures include analysis of variance, linear contrasts, analysis of covariance, and selected post-hoc procedures. This is an advanced course in design and statistics. It will assume one year of study in basic statistics.

Prerequisite: PSY 502
Fall, 3 credits

PSY 504 First Year Lectures

Presentation and discussion of current research progress and interests.
Fall and spring, 1 credit each semester

PSY 505 Structural Equation Modelling

Extension of the approach to model testing that is developed in PSY 502; the application of stochastic linear equation models to a wide variety of research situations. Special attention is given in this seminar to models of measurement error, quasi-experimental and longitudinal designs, and estimation of structural models that incorporate measurement hypotheses.

Prerequisite: PSY 502
Fall, 3 credits

PSY 507 Distribution-Free Statistics

Statistical inference when the exact form of population distributions is not specified, or when interval scale measures are not available. These techniques will be compared with "classical" methods.
Spring, 3 credits

PSY 510 History of Psychology

Intensive reading in the history of psychology from original sources. Emphasis will be on class discussion and relation to modern problems.
Spring, 3 credits

PSY 511 Classical Theories and Animal Learning

A consideration of the basic principles of learning. Analysis of the leading theories of learning as well as areas of controversy and dispute.
Fall, 3 credits

PSY 512 Cognition and Memory

An introduction to research and theory related to human learning and information processing. A review of major historical contributions as well as critical review of contemporary developments.
Spring, 3 credits

PSY 514 Sensation and Perception

An introduction to the phenomena of sensation and perception and the methods by which they may be studied. Different theoretical frameworks will also be considered.
Fall, 3 credits

PSY 515, 516 Research Practicum in Experimental Psychology

A review of the basic literature of experimental psychology. Emphasis will be placed on a research project which each student will formulate and complete within the year.
Fall and spring, 3 credits each semester

PSY 522 Children's Learning

The literature relating to learning processes in children will be covered. Respondent, operant, and observation learning will be major topics. The experimental analysis of behavior will be stressed.
Prerequisite: Permission of instructor
Fall, 3 credits

PSY 524 Cognitive Development

The information in this course will integrate and expand some of the research and new methods available in the study of complex human processes such as language, memory, and growth of logical thinking.
Fall, 3 credits

PSY 525 Processes of Socialization

An intensive examination of psychological factors in the socialization of children. Emphasis is placed both on various forms of learning (classical and instrumental condition as well as observational learning), and also on biological and maturational factors that may influence social development.
Fall or spring, 3 credits each semester

PSY 533 Principles of Therapeutic Intervention

A critical review of various therapeutic intervention procedures, and an examination of their theoretical bases and empirical support. Special focus will be placed on those procedures having relevance for clinical behavior therapy. Integrated with practicum dealing with clinical procedures.

Clinical students only
Fall, 3 credits

PSY 534 Behavior Assessment: Theory, Research, and Practicum

Techniques of psychological measurement and assessment as they relate both to theoretical formulations and to specific clinical problems; supervised experience in the use of various assessment procedures.
Spring, 3 credits

PSY 537 Methods of Intervention: Child and Adolescent

Strategies, methods, and techniques used in broadly-construed behavioral approach to working with children and adolescents in clinic, home, school, institutional, and community settings. Supervised application in coordinated practicum (PSY 602).
Clinical students only.
Fall, 3 credits

PSY 538 (effective Spring, 1977) Methods of Intervention: Adult

Strategies, methods, and techniques used in a broadly-construed behavioral approach to working with adults in clinic, family, work, institutional and community settings. Supervised application in coordinated practicum (PSY 603).
Clinical students only
Spring, 3 credits

PSY 543 Biobehavioral Development

This course will cover areas relevant to growth and physiology as they relate structurally to psychological functioning during development. Among the topics considered will be: behavioral genetics,

developmental sensory physiology, psychological aspects of infancy, early neurological characteristics and infant assessments of normal and abnormal functioning.

Fall or spring, every other year, 3 credits each semester

PSY 545 Behavior Deviation

Theory and research on abnormal behavior such as neuroses, schizophrenia, addiction, sexual dysfunction, and childhood problems. Coverage of models of deviance, assessment, diagnosis, and treatment approaches. Broad approach to topic with stress on behavioral theories and presentation of biological and psychodynamic points of view. A departmental core course, open to all graduate students.
Fall, 3 credits

PSY 546 Measurement and Scaling

A historical introduction to the measurement of psychological variables and survey of contemporary scaling methods with an emphasis on psychophysical scaling and experimental applications.

Fall or spring, every other year, 3 credits each semester

PSY 550, 551 Topics in Social Psychology

Content varies from year to year as function of staff and student interests. Recent topics include environmental psychology, group dynamics, history of social psychology, society and health, aggression, politics of social psychology, research methods, attitude change, and social inequality.
Fall and spring, variable and repetitive credit each semester

PSY 553 Social/Community Practicum

Provides supervised experiences in a variety of community settings, including mental health centers, social action and self-help organizations, and alternative institutions.

Prerequisite: Permission of instructor
Fall and/or spring, variable and repetitive

PSY 555 Contemporary Issues in Social and Community Psychology

A critical survey of salient aspects of current social and community psychology, including historical background and political-economic factors affecting these fields.

Fall or spring, 3 credit hours each semester

PSY 560 Neuropsychology

The functions of the normal and pathological primate brain in behavior. Consideration of anatomical, electrophysiological (EEG), and pharmacological correlates of behavioral functions as: perception, attention, motivation, learning, memory, cognition, and language. The behavioral consequences of various forms of brain pathology will be discussed.

Spring, 3 credits

PSY 561, 562 Physiological Methods

Basic bioelectric principles and techniques, stereotaxic techniques, lesioning methods, pharmacological methods, and histological techniques will be presented and practiced. Basic methods for bioelectric stimulation and recording will be emphasized. This course will be

taught in conjunction with PSY 563, 564.
Fall and spring, 3 credits each semester

PSY 563, 564 Physiological Methods Lab
Experience in practical application of techniques for manipulating the physiological substrate in relation to behavior in an experimental setting. Emphasis will be placed on individual projects, library research, and seminar reports.
Fall and spring, 3 credits each semester

PSY 566 Psychophysiological Methods
Covers organization of the human nervous system and its interaction with physiological response systems. Studies methods of recording and analyzing psychophysiological response measures. Examines the application of psychophysiological response measure and patterns to the study of individual attitudes and behavior. (Cross-listed with POL 630)
Spring, 3 credits

PSY 573, 574 Comparative Behavior Lab
The use of detection response techniques, conditioning techniques, and habituation methods in the study of adaptive behavior will be practiced using a wide variety of vertebrate and invertebrate species.
Fall and spring, 3 credits each semester

PSY 575 Psychobiology of Primates
An advanced general course in the behavior of Old World monkeys and apes. Emphasis will be placed on social organization, communication, development, and learning, especially under naturalistic conditions; but beyond this, topics are selected to reflect the most important current advances in the area.
Prerequisite: Permission of instructor
Fall or spring, 3 credits each semester

PSY 581, 582 Comparative Physiological Colloquium
Colloquium presentations on current research problems by advanced students, staff, and visiting scientists. Lecture and seminar each week.
Fall and spring, 3 credits each semester

PSY 583, 584 Experimental Psychology Colloquium
Seminars on current research problems directed by students, staff, and invited scientists.
Fall and spring, 3 credits each semester, repetitive

PSY 590 Theories of Child Development
This course is oriented toward analyzing three classes of developmental theory (analytic, cognitive, and behavioral approaches) and relating the basic structure of each class of theory to current notions of philosophy and science.
Spring, 3 credits

PSY 599 Instructional Methods for Child Development
The purposes of this course are (1) to introduce the student to literature on college teaching, (2) to aid the student in formulating instructional objectives, (3) to consider instructional methodologies, and (4) to provide the student with systematic feedback on his teaching performance.
Fall and spring, 3 credits each semester

PSY 600 Teaching Methods and Practicum
Variable and repetitive credit

PSY 601 Clinical Practicum
Provides supervised experience in the use of clinical methods
1 credit

PSY 602 Clinical Practicum—Child
Provides supervised experience in the use of methods covered in corequisite PSY 537.
Fall, 3 credits

PSY 603 Clinical Practicum—Adult
Provides supervised experience in the use of methods covered in corequisite PSY 538.
Spring, 3 credits

PSY 604 Internship
Advanced students in the clinical program carry supervised clinical responsibilities in approved setting.
Variable and repetitive credit

PSY 605 Orientation to Clinical Psychology
Ethics, professional issues, and ongoing faculty research. Required of all first-year clinical students.
Fall and spring, 1 credit each semester

PSY 606 Clinical Case Conference and Colloquium
Regularly scheduled conferences and colloquia to discuss ongoing work with Psychological Center cases. Required of clinical students.
Fall and spring, 1 credit each semester

PSY 610, 620 Seminars in Selected Topics
Topics will be selected on the basis of the needs of the graduate program and the research interests of the staff. The seminar will consider such topics as: the physiological basis of higher mental processes, sensory processes, animal behavior, psychopharmacology, theories and problems of learning, and social psychology, and computer application in psychology.
Variable and repetitive credit each semester

PSY 621 Seminar in Teaching Methods
Working seminar on the teaching of some particular course(s), particularly PSY 101, 102, or 303, with emphasis on delineation of course objectives, the preparation and presentation of special material or topics, and the evaluation of teaching methods.
Prerequisites: Appointment as Teaching Fellow by Dept. Instructor's permission
Fall or spring, 2 credits each semester, may be repeated

PSY 630 Strategies of Intervention with Children
Introduce the student to the literature on the approaches to a variety of institutional concerns with children's education and rearing. Coverage will include those systematic programs designed to foster social skills, cognitive skills, and motor and perceptual development. Course designed especially for developmental psychology students who wish to pursue training in applied settings.
Prerequisite: Permission of instructors
Fall or spring, 3 credits each semester

PSY 631 Evaluation of Intervention Strategies
A rigorous, methodologically oriented course which will familiarize the student with the research designs, tests and behavioral assessment techniques, and practice in test construction required to evaluate, developmental intervention at the programs or systems level.
Prerequisite: PSY 630 or permission of instructor
Spring, 3 credits

PSY 696 Readings
Variable and repetitive credit

PSY 698 Research
Variable and repetitive credit

PSY 699 Doctoral Research
Variable and repetitive credit



Russian



RUS 500 Reading Russian
Intensive introductory Russian for non-majors. Practice in reading and translation: Russian prose; use of dictionaries and reference materials; as much attention as possible to special problems of various disciplines.
Staff
Spring, 3 credits

RUS 504 Russian Culture
An in-depth study of determinant features

of Russian culture. Approach will be thematic. Emphasis will be on the twentieth century.
Instructor: Vogel.
Fall, 3 credits

RUS 506 Stylistics of Russian
Advanced stylistic and textual analysis. Designed to deepen the advanced student's knowledge of the finer points of syntax, structure and stylistic versatility of the Russian language.
Instructor: Radley
Fall, 3 credits

Sociology

SOC 501, 502 Statistics and Research Design

A review of the main statistical techniques used in sociological research. Discussion of, and practical experience in the design of sociological research.
3 credits each semester

SOC 503 Multivariate Analysis of Social Data

The general linear model and multivariate analysis, including dummy variable analysis, multiple covariance, multivariate analysis of variance, and factor analysis.

Prerequisite: SOC 502 or permission of instructor
3 credits

SOC 505, 506 Sociological Theory

A review of the intellectual development of the discipline, its epistemological foundations, current major theoretical orientations, and newly developing perspectives.
3 credits each semester

SOC 508 Experimental Methods

The design, conduct, analysis of laboratory and field experiments.
3 credits

SOC 509 Field Work

Practicum in field interviews and observations; problems of rapport, reliability, and validity.
3 credits

SOC 511 Population Analysis

A survey of demographic theory and research. Determinants and consequences of population size, growth rates, composition and spatial distribution, family formation, fertility, mortality, and migration.
Prerequisite: One course in statistics
3 credits

SOC 513 The Metropolitan Community

Determinants and consequences of the growth of urban settlements. Their demographic composition and spatial structure. Problems in metropolitan community organization.
3 credits

SOC 514 Sociological Methods

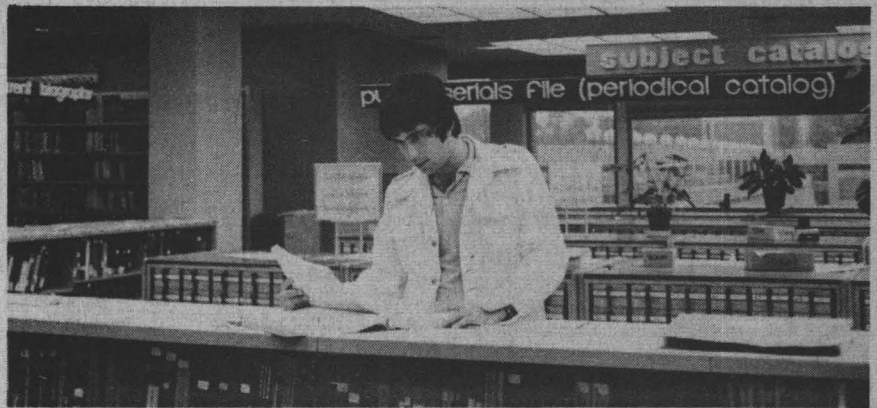
An introduction to the logic of research and data analysis. Emphasis on concepts of association, elementary causal analysis, sampling, and problems of measurement. Applications to the interpretation of data encountered in the school curriculum and the mass media.
4 credits

SOC 521 Social Interactions

The study of interaction in formal and informal settings. The reciprocal influence among group structure, norms, and interactive processes. A prior course in social psychology is assumed.
3 credits

SOC 522 Socialization and the Self

Socialization as a continuous process



throughout the life-cycle. Social and cultural sources of identity. Self-other systems as a form of social control. A prior course in social psychology is assumed.
3 credits

SOC 523 Sociology of Education

Relationship between education and other institutions. Internal dynamics of the school and the classroom.
3 credits

SOC 531 Stratification

Causes and consequences of the unequal distribution of wealth, power, prestige, and other social values in different societies. Changes in the stratification system as a result of industrialization and revolution.
3 credits

SOC 532 Complex Organizations

Division of labor, communication, and decision-making in large and formally administered organizations, such as industrial concerns, governmental agencies, political parties, trade unions, schools, hospitals, and prisons.
3 credits

SOC 541 Conflict and Violence

Conflict and violence as related to social change. Examination of community controversies, social movements, uprisings, and war.
3 credits

SOC 542 Deviance

Survey of recent research literature on various kinds of deviance (crime, delinquency, and morally stigmatized behavior). Controversial issues in theory and research methods.
3 credits

SOC 545 Social Movements and Collective Behavior

Unorganized collectives and their role in change. Studies of specific social movements and other collective behavior episodes.
3 credits

SOC 546 Sociological Perspectives on American Society

Analysis of American social structure. Political and economic institutions and their bearing on social problems. Students at-

tend the lectures of CES 581 and a supplementary seminar.
4 credits

SOC 549 Social Change

The image of technological, generational and cultural forces on social organization from a historical and comparative perspective.
3 credits

SOC 556 Political Sociology

The study of political institutions and of the politically relevant actions and attitudes of individuals and groups. Particular stress will be placed on the reciprocal relationships between social movements and political institutions.
3 credits

SOC 561 Sociology of Intellectual Life

A comparative and historical analysis of the social conditions leading to the development of intellectual professionals.
3 credits

SOC 562 Sociology of the Arts

The relations between social structure, social change and the development of major art forms.
3 credits

SOC 563 Sociology of Science

The relations between science and society; social influences on the choice of problems and methods; the social organization of scientific research.
3 credits

SOC 564 Communications

The social organization of the communications industry; the effects of mass communication.
3 credits

SOC 571 Sociology of Health and Medicine

Social factors in health and illness; the socialization of health practitioners; the social organization of hospitals, clinics and other facilities.
3 credits

SOC 590 Independent Study

Intensive reading, under supervision of one or more instructors, of material not

covered in the formal curriculum.
Variable and repetitive credit

SOC 591, 595 Special Seminars

Topics to be arranged. The seminar will be built around actual research activities of students and faculty.
3 credits each semester

SOC 598 Research

Execution of a research project under the supervision of one or more faculty members.
Variable and repetitive credit

SOC 603 Advanced Topics in Quantitative Analysis

Mathematical and statistical methods in the analysis of quantitative data.
Prerequisites: SOC 501 and SOC 502
3 credits

SOC 604 Advanced Topics in Quantitative Analysis

The use of personal documents, official records, field observations, and interviews.
3 credits

SOC 606 Sociological Theory Construction

Modes of conceptualization and theory construction. Problems in developing a theory.
Prerequisites: SOC 361 and SOC 362 or permission of instructor
3 credits

SOC 691 Practicum in the Teaching of Sociology

Lectures, discussions, and case studies of effective teaching. Designed especially for graduate teaching assistants.
3 credits

SOC 694, 695 Practicum in the Teaching of Social Studies

The first semester consists of a number of day-long sessions (during weekends or school holidays), each of which introduces a particular teaching technique or new materials for the social studies curriculum. Students are expected to make use of the ideas and techniques when teaching their regular classes and to write papers describing the development, teaching, and evaluation of such projects. Similar sessions occur during the first half of the second (spring) semester. During the second half of the spring semester, students develop, teach, and evaluate a unit several weeks in length on a topic of their choice.
4 credits each semester

SOC 698 Dissertation Research

Variable and repetitive credit

W. Averell Harriman College for Urban and Policy Sciences

FIRST YEAR

The First Year curriculum is required of all students and is designed to provide a commonly shared analytic base upon which the students build a specialization in the second year. However, in instances where the student can demonstrate prior mastery of a particular area in the first year curriculum, exemption is permitted and an advance course in that area is taken.
Prerequisites for all UPS graduate courses: UPS graduate student or permission of instructor

UPS 515/516 Data Analysis

The uses and limitations of mathematical techniques, especially in the development of a sophisticated approach to the use of data in advocating alternative policies, computer simulation of models, regression analysis, linear programming, optimization concepts.
Fall and spring, 3 credits each semester

UPS 518 Operations Research for the Public Sector

Documented applications of operations research techniques to the public sector. Among specific areas modelled are emergency services, sanitation, environmental protection, crime prevention, the criminal justice, blood banking, energy supply and demand, manpower scheduling and education. Techniques discussed include queueing theory, simulation and Markov processes.
Fall, 3 credits

UPS 531 Political and Administrative Decision-Making

Theory and practice of public sector decision-making. Group decision models, bargaining and coalition theory, public choice, economic organization of public

agencies, regulation exit and voice theory, metropolitan governance, the role of formal planning.
Fall, 3 credits

UPS 533/534 Economic Theory for Public Analysis I and II

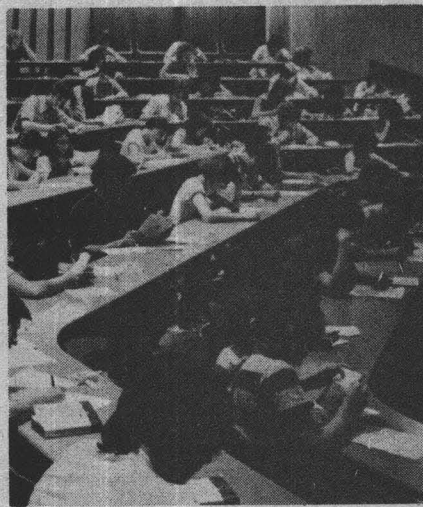
The techniques and approaches of micro-economic reasoning are applied to issues of public policy. The theory of the market and the price system is closely examined for the purpose of identifying those areas where neoclassical economics is helpful to the public sector analyst and manager. Special attention is paid to cost-benefit analysis and models of economic behavior.
Fall and spring, 3 credits each semester

UPS 541/542 Workshop in Urban and Policy Sciences

Under faculty supervision, groups of students work for clients in local agencies on public policy issues in a variety of areas such as energy, housing and health. The course is intended to provide students with an opportunity to apply the analytic skills they have learned in the classroom to real problems. Other purposes are to give them practice in writing, speaking, and working cooperatively in small groups, all of which are important skills for the policy analyst.
Fall and spring, 3 credits each semester

UPS 543/544 Modelling Techniques in the Public Sector

The course develops the mathematical and computational tools useful in the analysis of public sector problems and applies them to areas ranging from the design of local service delivery to the modelling of national policy issues. Topics include linear and integer programming, networks, and queueing. Applications to school bussing,



facility location, environmental and energy issues.
Spring, 3 credits

SECOND YEAR

UPS 520 Econometrics for Policy-Making

A course on the use of statistics and mathematics to analyze economic problems in the public sector. The emphasis is on the relevance of a tool to a practical situation and a good appreciation of the main problems that occur when policy-makers and econometrics work together.
Spring, 3 credits

UPS 552 Advanced Data Analysis

Advanced statistical techniques for analyzing data in the context of public policy making. Classical approaches to hypothesis testing, estimation, regression and time series analysis are discussed and contrasted with exploratory procedures. Statistical decision analysis is presented and illustrated by examples chosen from the field of public policy. Emphasis throughout is on public sector applications of statistical concepts.
Spring, 3 credits

UPS 555 Techno Policy Seminar

Two topics in public policy are examined in depth, chosen from among energy, transportation, health, criminal justice, child welfare, educational finance. A range of solutions are compared and evaluated.
Fall, 3 credits

UPS 581/582 Management of Organizations in the Public Sector

How can organizations in the public sector be made more effective? Focus of the course is on the concept of appropriateness of fit between managerial strategy and organizational structure. Theory is drawn from Taylorism, the Hawthorne studies, job re-design, management by objectives.

Fall and spring, 3 credits each semester

UPS 585 Program Evaluation

How to design experiments that will provide valid inferences for program effectiveness. Accumulating evidence, combining data from mixed sources, monitoring performance and modifying existing programs, cost/benefit analysis, survey research and other analytical methods. Examples from criminal justice, municipal services, educational innovation, health care.

Spring, 3 credits

UPS 590 Professional Development for Public Policy Analysis

What are the ethical questions facing those who exercise public authority? What criteria are available as guides? What is the

calculus of resignation—when do you leave an organization and when do you stay to disagree with policy?

Spring, 1 credit

UPS 591 Special Topics in Urban and Policy Sciences

Section 1—Technology and Public Policy—How can public administrators who are neither engineers nor scientists deal with the problems of public policy that have a substantial technological component? This course aims at summarizing the essence of the technologist's approach. Like UPS 593 it hopes to facilitate interaction between one set of professionals (administrators) and another (scientists and engineers).

Fall, 3 credits

Section 2—Energy Policy in the Developing Nations—The seminar will focus on energy problems and issues of the developing countries. Of particular concern will be the discussion of policy and technological alternatives for these countries as we near the end of the oil era. Among the topics to be discussed are: energy supply and demand, and development; energy and alternative modes of economic development; energy production, distribution, and end use in urban and rural areas; coal and nuclear options; the potential for utilization of renewable resource technologies.

Fall and spring, 3 credits each semester

UPS 593 The Legal Process

This course will teach students basic theories and principles of substantive and administrative law. Students will learn the uses of law in the planning, analysis, and management of public systems. They will also experience where and how to find the law they will need for professional practice as public sector policy makers and implementers. It is not a pre-law course as such; it is a professional course.

Fall, 3 credits

UPS 595 Individual Directed Readings in Urban and Policy Sciences

Designed to accommodate independent research projects on an individual basis with faculty guidance. May be repeated for credit.

Fall and spring, variable credit

UPS 596 Small Group Studies in Urban and Policy Sciences

Designed to accommodate ad hoc small group student research projects on an experimental basis. Projects will be designed by UPS faculty and students. Topics will be announced at the beginning of each semester.

Fall and spring, 1 to 3 credits each semester

UPS 597 Practicum in Teaching

Instruction in the department under the supervision of the faculty. May not be included in the courses taken in fulfillment of degree requirements.

Fall and spring, variable credit

Fall Semester 1979

- AUG. 20, Mon.
Foreign students must arrive; new foreign student residence halls check-in
- AUG. 20-24, Mon.-Fri.
Final registration and payment (or proper deferral) of fees for all students not previously registered (schedule announced prior to registration); foreign student orientation
- AUG. 22, 23, Wed., Thurs.
All residence halls open for new student check-in
- AUG. 22-24, Wed.-Fri.
Undergraduate student orientation for all students not having previously participated
- AUG. 25, 26, Sat.-Sun.
Returning students check into residence halls
- AUG. 27, Mon.
Classes begin (all except CED); late registration period begins with \$20 late fee assessed; add/drop and/or section change period begins
- SEPT. 3, Mon.
Labor Day Holiday (no day or evening classes)
- SEPT. 4, Tues.
CED classes begin
- SEPT. 7, Fri.
End of late registration period (except for CED and graduate special program — GSP — students); last day for undergraduate students to add a course; last day for all students to drop courses without receiving a recorded W (Withdrawal)
- SEPT. 14, Fri.
End of CED and GSP late registration; last day for CED and GSP students to drop courses without receiving a recorded W
- SEPT. 21, Fri.
Last day for graduate students to add or withdraw from a course (W will be recorded for withdrawal); last day for students who have not previously filed (except CED) to file for December graduation. Undergraduates file at the Office of Records. Graduate students file degree cards at the Graduate School Office.
- SEPT. 22, 23, Sat., Sun.
Rosh Hashanah
- SEPT. 28, Fri.
Last day for CED students to file for December graduation at the CED Office; final bills for fall semester 1979 to be mailed; last day for CED and GSP students to add or withdraw from a course (W will be recorded for withdrawal)
- OCT. 1, Mon.
Yom Kippur (no day or evening classes)
- OCT. 3, Wed.
All classes will follow **Monday's schedule**
- OCT. 8, Mon.
Columbus Day Holiday (classes in session)
- OCT. 11, Thurs.
Last day for final payment of fees for the fall semester
- OCT. 20, Sat.
First quarter fall housing period ends
- OCT. 26, Fri.
Last day for undergraduate students to withdraw from a course without withdrawing from the University
- NOV. 1, Thurs.
Last day for removal of incompletes and NR (No Record) grades for all students from the spring semester and the Summer Session
- NOV. 6, Tues.
Election Day Holiday (no day or evening classes)
- NOV. 12, Mon.
Veteran's Day Holiday (classes in session); **Advance registration period begins for the spring semester** for all students (schedule announced prior to registration)
- NOV. 21, Wed.
Thanksgiving recess begins at close of classes
- NOV. 22, Thurs.
Thanksgiving Holiday
- NOV. 26, Mon.
Classes resume
- DEC. 7, Fri.
Bills for spring semester 1980 to be mailed to pre-registered students
- DEC. 14, Fri.
Last day of classes; last day to withdraw from the University
- DEC. 15, 16, Sat., Sun.
Reading days
- DEC. 17, Mon.
Final examinations begin; final grades due in the Registrar's Office 72 hours after last class meeting or after scheduled examination, or as arranged; last day for graduate students to submit theses and dissertations for December graduation
- DEC. 21, Fri.
Final examinations end; CED classes end; fall semester ends; residence halls close for fall semester; **winter recess** begins at close of exams; last day for departments to submit completion statements for December master's and doctoral candidates
- DEC. 22, Sun.
Intersession housing begins
- DEC. 25, Tues.
Christmas Holiday

State University of New York at Stony Brook does not discriminate on the basis of sex, race, religion, national origin, age, physical disability or marital status in education programs and activities.

All programs, regulations and schedules of dates at the State University of New York at Stony Brook are offered subject to change or withdrawal depending upon the availability of funds and the approval of programs by appropriate State authorities.

Spring Semester 1980

- JAN. 1, Tues.
New Year's Day Holiday
- JAN. 3, Thurs.
Last day for mail payment of spring semester fees for all students registered in advance
- JAN. 9, Wed.
Last day for students pre-registered for spring semester 1980 to pay fees in person without late penalty
- JAN. 11, Fri.
Final registration and payment (or proper deferral) of fees for all students not previously registered (schedule announced prior to registration)
- JAN. 14, Mon.
Foreign students must arrive
- JAN. 15, Tues.
Intercession housing ends
- JAN. 16, Wed.
Residence halls open for spring semester
- JAN. 17, Thurs.
Classes begin; late registration period begins with \$20 late registration fee assessed; add/drop and/or section change period begins
- JAN. 30, Wed.
End of late registration period for all students including CED students; last day for undergraduate students to add a course; last day for all students to drop courses without receiving a recorded W (Withdrawal)
- FEB. 6, Wed.
Last day for all students who have not previously filed (except CED and graduate students) to file for May graduation at the Office of Records; final bills for spring semester 1980 to be mailed
- FEB. 12, Tues.
Lincoln's Birthday Holiday (classes in session)
- FEB. 13, Wed.
Last day for graduate students to add or withdraw from a course (W will be recorded for withdrawal)
- FEB. 18, Mon.
Washington's Birthday Holiday (classes in session)
- FEB. 20, Wed.
Last day for graduate and CED students to file degree cards in the Graduate School or CED Office for May graduation
- MAR. 4, Tues.
Last day for final payment of fees for the spring semester to be received by the Bursar
- MAR. 15, Sat.
First quarter spring housing period ends
- MAR. 17, Mon.
Last day for removal of incompletes and NR (No Record) grades for all students from the fall semester
- MAR. 19, Wed.
Last day for undergraduate students to change courses to or from Pass/No Credit; last day for undergraduate students to withdraw from a course without withdrawing from the University
- APR. 4, Fri.
Spring recess begins at close of classes
- APR. 14, Mon.
Classes resume
- APR. 14-18, Mon.-Fri.
Advance room reservations and deposits due for fall semester 1980
- APR. 28, Mon.
Advance registration period begins for fall semester — schedule announced prior to registration; bills for fall semester 1980 to be mailed approximately July 1 with payment date during latter part of July; last day for graduate students to submit theses and dissertations for May graduation; last day for departments to submit completion statements for May doctoral candidates
- MAY 5, Mon.
Advance registration begins for Summer Session 1980 for all students, with Summer Session fees payable at time of registration
- MAY 7, Wed.
Last day of classes; last day to withdraw from the University
- MAY 8-11, Thurs.-Sun.
Reading days
- MAY 12, Mon.
Final examinations begin; final grades due in the Registrar's Office 72 hours after last class meeting, or after scheduled examination, or as arranged.
- MAY 16, Fri.
Final examinations end; spring semester ends
- MAY 18, Sun.
Commencement; all residence halls close
- MAY 19, Mon.
Last day for departments to submit completion statements for May master's candidates
- MAY 30, Fri.
Memorial Day Holiday

Cover photo by Dick Solo

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THE GRADUATE SCHOOL
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