ESM

Materials Science

ESM 501: Teaching and Mentoring Techniques

Discussion of various phases of teaching, including preparation, classroom technique, and student evaluation. Also exploration of skills and understanding necessary for mentoring of undergraduates and others involved in research.

Fall, 1 credit, S/U grading

ESM 502: Scanning Electron Microscopy Skills

Practical introduction to the operation of scanning electron microscopes, including energy-dispersive X-ray spectrometers. Required of all students who use the SEM in their research.

Spring, 1 credit, Letter graded (A, A-, B+, etc.)

ESM 503: Electron Diffraction

A quantitative discussion of electron diffraction as a means of micro-characterization of materials and as a basis for understanding image contrast in the transmission electron microscope. Topics covered include atomic, kinematical, and dynamical scattering; indexing diffraction patterns; and convergent-beam diffraction.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 508: Impact of Materials on Environment

This course will focus on several concepts underlying the impact of materials on the environment and various methods of minimizing them, More specifically this course will explore the concepts of air and water pollution associated with product manufacturing, various concepts of hazardous materials impact on human health, several topics of sustainable developments and selected methods of contaminated water and air treatment. Additionally this course will be addressing the issues of how to minimize the environmental pollution by product substitution and by decreasing the energy input into materials production. It will also give an overview of the concepts of green chemistry, green engineering and industrial ecology.

Offered in Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 511: 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 reactions such as diffusion, exication, and phase transformations; thermodynamic analysis of phase equilibrium diagrams.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 512: Structure of Materials

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, the concept of reciprocal vector space. Laboratory work in X-ray diffraction is also included.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 513: Strength of Materials

A unified approach for all solid materials will be used with regard to the correlation between microstructure and their macroscopic mechanical properties. The course deals with various testing techniques for delineating mechanical properties of materials, considering elasticity, inelasticity, plasticity, dislocation theory, cohesive strength, fracture, and surface wear. Attention is given to strengthening mechanisms for solids, metals, ceramics, and polymers.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 514: Technical Writing for Materials Scientist

Students will examine writing as it appears in published and draft format, taking into account different audience needs. Processes we will cover include: planning, organizing, writing, review, editing and rewriting. Grammar issues, particularly those that challenge non-native speakers, will also be addressed. We will be working with Professor Gerald Graff's idea of "They Say/I Say," a cornerstone strategy of academic conversation, in which newer colleagues in a field (i.e., undergraduate and graduate students) learn by apprenticeship how to engage their peers in the discussion of ideas through written format. Offered

Spring, 0-3 credits, S/U grading

ESM 519: Electrochemistry and Electrochemical Materials Science

This course will survey electrochemistry and electrochemical materials science. Topics will include fundamental measurements in electrochemistry, galvanostatic and potentiostatic methods, the electrochemical double layer, corrosion and passivation. Relevant applications such as fuel cells, batteries, and supercapacitors will be discussed.

3 credits, Letter graded (A, A-, B+, etc.)

ESM 521: Kinetics of Materials

This Kinetics of Materials course will discuss important kinetic phenomena in materials science and engineering. The studies of kinetics explore how materials evolve and change in structure, morphology and composition. The understanding of kinetics in materials leads to a broad impact in all scientific and engineering fields concerning materials design and processing. This course will cover topics ranging from core knowledges such as various diffusion phenomena and motions of defects and interfaces, to more complex subjects such as phase transformations and development of microstructure. It emphasizes the comprehension of fundamentals, leading to a better understanding of processing-structure-property relationships.

3 credits, Letter graded (A, A-, B+, etc.)

ESM 522: 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 fracture.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 523: 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, galvomagnetic, thermomagnetic, and thermoelectric effects. Hall effect and magnetoresistance. Conductivity in thin films.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 531: Phase Transformations

Kinetics and Transformations II changed to Phase Transformations. A review of the processes by which structures are changed in the solid state. Classical nucleation theory including homogeneous and heterogeneous mechanisms. Diffusion and diffusionless growth mechanisms. Transformation kinetics.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 532: Materials Processing

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, Letter graded (A, A-, B+, etc.)

ESM 533: Polymeric Materials

This course offers an opportunity to students for learning mechanical, optical, and transport properties of polymeric materials including polymer solutions/melts/thin films as well as the underlying physics behind the properties. Topics include thermodynamics of polymer solutions/blends/thin films, phase separation and phase transition of polymer blends, block copolymers, crystallization of polymers, structural and property characterization, and commercial polymer production, processing, and recycling.

3 credits, Letter graded (A, A-, B+, etc.)

ESM 534: Advanced Laboratory

Students perform a series of advanced materials experiments which involve some independent research. The results are then written in a report suitable for publication in a journal or proceeding.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 537: Cellular Interactions

This course is intended to introduce cellular and biological concepts and principles for graduate students in chemical engineers related to their research projects that involve cellular interactions with materials as possible scaffolds in bioengineering. This course may be counted as either CSE 370 or ESM 537.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 542: Modern Electron Microscopy

Principles and practice for transmission and scanning transmission electron microscopes. Instrument design. Specimen preparation. Instrument operation. Electron diffraction and imaging theory. Microanalysis using X-ray and electron spectra. Typical electron microscope investigations are outlined and used as examples.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 550: Introduction to Homeland Security

The course is a combination of lectures and laboratory experience to introduce students to critical issues and assess needs for homeland security. The course includes invited lectures by experts on special topics such as fundamentals of nuclear, chemical, and biological weapons and the associated threat to the transportation of goods and the public. The students will learn about cyber security, devices to safeguard materials from terrorist threats, safety of nuclear power plants and water supply, forensics and emergency preparedness. The students will submit a term paper on a selected topic in lieu of the final exam.

Prerequisite: undergraduate level biology, chemistry and physics.
Fall, Spring, 3 credits, Letter graded (A, A-, B +, etc.)

ESM 553: Nuclear Safeguards and Security

The course is intended to familiarize students with the fundamentals of nuclear physics, radiation, mining, weapons and fuel cycle, other than producing electricity, as it pertains to nuclear power plants. Topics include nuclear detection, devices to safeguard nuclear materials from terrorist threats, needed physical protection for safe handling and its relevance to Homeland Security. The course combines lectures with hands-on experience at the newly installed nuclear detection facility located at the nearby United States Department of Energy's Brookhaven National Laboratory.

Prerequisite: undergraduate equivalent physics and chemistry.
Fall, Spring, 4 credits, Letter graded (A, A-, B +, etc.)

ESM 554: Chemical & Biological Weapons: Safeguards and Security

This course deals with the fundamentals of chemistry and biochemistry related to chemical weapons (CW) and biological weapons (BW) that could be used by terrorists. Topics include CW and BW history, production, control, detection, identification, and emergency response measures to deal with intended or unintended release and escape, and security measures to protect and control stockpiles.

Prerequisite: Undergraduate equivalent chemistry, biochemistry, and microbiology.
Fall, Spring, 4 credits, Letter graded (A, A-, B +, etc.)

ESM 555: Synchrotron Techniques in Materials Science

A short course in a selected synchrotron analytical technique as applied to problems in Materials Science. May include demonstration and hands-on experience at the national synchrotron light source at Brookhaven National Laboratory, and synchrotron safety training.

1 credit, Letter graded (A, A-, B+, etc.)

ESM 560: Risk Assessment, Regulation, and Homeland Security

The course focus is on risk assessment associated with nuclear, chemical and biological weapons as it relates to Homeland Security. Topics include air dispersion, uncertainty analysis, exposure measurements, epidemiology, toxicology, regulatory issues, risk management, risk communication, risk perception, and risk preparedness. The course will also cover laws and regulation, and disaster preparedness, various acts passed by the U.S. Congress to regulate water, air, and controlled substances.

Prerequisite: undergraduate or equivalent physics, math and chemistry.
Fall, Spring, 4 credits, Letter graded (A, A-, B +, etc.)

ESM 561: Crystal Growth Technology

The main goal of this course is to introduce graduate students to the fundamentals and physical principles that govern the process of crystal growth and show them how to apply those principles to design and engineer growth systems for different crystalline materials. While microscopic theory of nucleation and growth kinetics will be an essential part of this course, its core will mainly focus on applying transport phenomena and thermodynamics of chemical reactions to the design of processing reactors. As part of the academic requirements associated with this course, students will form teams and work on the virtual design of crystal growth reactors using software packages for transport phenomena modeling.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 562: Traditional Fossil Fuels

The course will focus on the original and history of traditional fossil fuels, coal, petroleum and natural gas. Discuss mining methods and the role of fossil fuels play in the post-industrial revolution era. A comparison of the three fossil fuels with respect to their energy content, CO2 output and associated environmental impact tied to global warming.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 566: Fuel Combustion

The course will focus on combustion process for heat and power generation. Describe both fundamentals and actual systems involving fossil feuls and upcoming CO2-neutral biofuels. Emphasis on fuel combustion in stationary equipment, emissions characteristics

of burning fuels and challenges in developing the next-generation combustion equipment.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 569: Biofuels

The course will focus on biofuels- a promising option to replace fossil fuels. Topics to be covered include crop-growth cycle and its impact on land-use, biomass to various fuel options, their integration into the exiting energy delivery infrastructure and potential benefit in CO2 reduction.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 575: The Material World

The evolution of the Material World starting from the Big Bang, the creation of stars and galaxies, the nucleosynthesis of the elements in supernova explosions, formation of the Earth and Solar System, human adaptation of Earth resources to create the Modern World will be discussed. In this process we will discover the fundamental laws governing material behavior and explore the cosmic significance of our existence.

3 credits, Letter graded (A, A-, B+, etc.)

ESM 599: Research

Fall and Spring, 1-12 credits, S/U grading
May be repeated for credit.

ESM 604: Seminar in Ultrasonic Methods and 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 are discussed. Use of ultrasonics for nondestructive evaluation is considered.

Prerequisite: ESM 513
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

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, Letter graded (A, A-, B+, etc.)

ESM 614: Seminar in Diffusion 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, S/U grading

ESM 694: Directed Studies in Materials Science

This course is designed for research on special topics in Materials Science and is directed by a faculty member. Designed for students who want to research areas that are not typically covered by regular coursework. Registration requires the faculty member's and departmental approval. Cannot be repeated for credit with the same faculty member.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

ESM 695: Graduate Internship

Participation in private corporations, public agencies, or non-profit institutions for ongoing research activities related to thesis research. Students will be required to have a faculty coordinator as well as a contact in the outside organization, to participate with them in regular consultations on the project, and to submit a final report to both. Not accepted for credit toward the M.S. degree.

1-3 credits, S/U grading
May be repeated for credit.

ESM 696: Special Topics 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.

Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

ESM 697: Materials Science Colloquium

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

Fall and Spring, 0-3 credits, S/U grading
May be repeated for credit.

ESM 698: Practicum in Teaching

Fall and Spring, 0-3 credits, S/U grading
May be repeated for credit.

ESM 699: Dissertation Research on Campus

Prerequisite: Advancement to candidacy (G5). Major portion of research must take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab.

Fall, Spring, and Summer, 1-9 credits, S/U grading
May be repeated for credit.

ESM 700: Dissertation Research off Campus - Domestic

Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.

Fall, 1-9 credits, S/U grading
May be repeated for credit.

ESM 701: Dissertation Research off Campus - International

Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces.

Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home countries are not covered by the mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home countries are charged for the mandatory health insurance. If they are to be covered by other insurance plans they must file waivers by the second week of classes. The charge will only be removed if the other plans are deemed comparable. All international students must receive clearance from an International Advisor.
Fall, 1-9 credits, S/U grading
May be repeated for credit.

ESM 800: FULL TIME SUMMER RSH

May be repeated for credit.