ESM 221 Introduction to Chemistry of Solids
Introduction to the synthesis, structure, properties, and applications of solid materials. Topics include preparation and characterization of solids (introduction to X-ray diffraction), thermal decomposition, crystal structure, crystal defects, and solid-state properties that influence chemical reactivity. This course is offered as both CHE 221 and ESM 221.
Prerequisites: CHE 132 or 142 or 198, and CHE 133 or 143 or 199 or ESG 111 or CSE 114 or MEC 111 or MEC 112; MAT 132 or 127 or 142 or AMS 161, PHY 126 or 131/133 or 141
3 credits

ESM 299 Directed Research in Materials Science
A directed research project with faculty supervision or as part of a research team. Intended for freshman or sophomore students to develop research skills in a closely mentored environment. A final report and oral presentation are required at the end of the project. ESM 199 is a recommended prerequisite.
Prerequisite: Permission of the Undergraduate Program Director
0-3 credits

ESM 302 Introduction to the Crystalline State
A laboratory/lecture course introducing the concept that crystallography is based on a few easily understood ideas. These provide a working knowledge of crystal geometry and the ability to interpret X-ray powder photographs and electron diffraction patterns. Includes structures and lattices, planes and directions, crystal geometry, atomic coordinates, stereographic projections, X-ray Laue photographs, the reciprocal lattice, and electron diffraction.
Prerequisite: CHE/ESM 221; ESG 332
3 credits

ESM 309 Thermodynamics of Solids
The application of thermodynamics to analysis of phase equilibria and reactions in solids. Topics include ideal and real solutions, phase equilibrium diagrams; first- and higher-order phase transitions; and thermodynamics of diffusion, oxidation, and corrosion reactions.
Prerequisite: MEC 301 or ESG 302
3 credits

ESM 325 Diffraction Techniques and Structure of Solids
X-ray diffraction techniques are emphasized. Topics include coherent and incoherent scattering of radiation, structure of crystalline and amorphous solids, stereographic projection, and crystal orientation determination. The concept of reciprocal vector space is introduced early in the course and is used as a means of interpreting diffraction patterns. Laboratory work in X-ray diffraction patterns is also included to illustrate the methods.
Prerequisite: ESG 332
3 credits

ESM 334 Materials Engineering
Practical application of basic material and engineering concepts to fundamental and advanced material utilization. To that end, the course is divided into three sections: (1) “Tough stuff,” (2) “Hot stuff,” and (3) “Smart stuff.” Combined, these address issues of material operation and failure under normal and harsh conditions, high-temperature electrochemical devices (e.g., solid oxide fuel cells), thermal barrier coatings, electro-magnetic devices and shape memory alloys.
Prerequisite: ESG 332
3 credits

ESM 335 Strength of Materials
The mechanical behavior of materials, assuming a basic knowledge of elasticity, plasticity, fracture, and creep. Provides treatment of these topics across size scales. Continuum mechanics, advanced phenomena in mechanics of materials, and case studies and measurement techniques.
Prerequisites: ESM 334; AMS 261 or MAT 203; ESG 302
3 credits

ESM 336 Electronic Materials
The properties of intrinsic and extrinsic semiconductors are discussed with particular attention first to the equilibrium distribution of electrons in the bands and then to the nonequilibrium transport of charge carriers. The properties and applications of photoconductors and of luminescent materials are then described. The concept of stimulated emission is introduced, laser operation explained, and laser materials discussed in relation to their applications in science and technology. Other topics considered are the properties of magnetic materials, of dielectric materials, and of superconductors.
Prerequisite: ESG 333
3 credits

ESM 350 Advanced Engineering Laboratory
Students work in teams to perform advanced laboratory projects that emphasize the structure-property relationships. Emphasis on statistical analysis, multivariate fitting of data, and technical manuscript preparation.
Prerequisite: ESG 312
Pre- or Corequisite: ESG 333
3 credits

ESM 353 Biomaterials: Manufacture, Properties, and Applications
The engineering characteristics of materials, including metals, ceramics, polymers, composites, coatings, and adhesives, that are used in the human body. Emphasizes the need of materials that are considered for implants to meet the material requirements specified for the device application (e.g., strength, modulus, fatigue and corrosion resistance, conductivity) and to be compatible with the biological environment (e.g., nontoxic, noncarcinogenic, resistant to blood clotting if in the cardiovascular system). This course is offered as both ESM 353 and BME 353.
Prerequisite: ESG 332 or ESM 333
3 credits

ESM 355 Materials and Processes in Manufacturing Design
The design of mechanical and electrical systems, materials selection, and fabrication processes are surveyed and shown to be essential components of manufacturing engineering. The mechanical and thermal processing of a wide range of metallic and nonmetallic materials is reviewed. Modern computer-based materials selection, advanced processing methods, and automation are explored.
Prerequisite: ESG 332 or ESM 333
3 credits

ESM 369 Polymers
An introductory survey of the physics, chemistry, and technology of polymers. Topics covered include classification of polymers, molecular forces and bonds, structure of polymers, measurement of molecular weight and size, rheology and mechanical properties, thermodynamics of crystallization, polymerization mechanisms, and commercial polymer production and processing techniques.
Prerequisite: ESG 332
3 credits

ESM 450 Phase Changes and Mechanical Properties of Materials
A laboratory course. Phase diagrams and microstructural changes in solids are investigated by thermal experiments. Other experiments demonstrate the mechanical properties of ductile and brittle materials.
Prerequisite: ESG 332
3 credits

ESM 475 Undergraduate Teaching Practicum
May be used as an open elective only and repeated once.
Prerequisites: U4 standing as an undergraduate major within the college; a minimum g.p.a. of 3.00 in all Stony Brook courses and the grade of B or better in the course in which the student is to assist; permission of department
3 credits

ESM 488 Cooperative Industrial Practice
A design engineering course oriented toward both research/development and manufacturing technology. Students work in actual industrial programs carried out cooperatively with companies established as university incubators or with regionally located organizations. Supervised by a committee of faculty and industry representatives to which students report.
Prerequisite: Permission of department
0-3 credits

ESM 499 Research in Materials Science
An independent research project with faculty supervision. Permission to register requires a B average in all engineering courses and the agreement of a faculty member to supervise the research. May be repeated, but only three credits of course electives (AMS 487, BME 499, CSE 487, ESE 499, ESG 499, EST 499, ISE 487, MEC 499) may be counted toward technical elective requirements.
Prerequisite: B average in all engineering courses and the agreement of a faculty member to supervise the research
0-4 credits