

## Suggested Courses for ME Students Interested in Materials

**Note** – Many other courses are available to students who meet the required prerequisites; the courses below are just a sampling of the courses that are acceptable as ME technical electives.

### Technical Electives:

*A limit of 6 credits of List #2 technical electives can be used to satisfy the 15 credits of technical electives required to earn a BSME degree. There is no limit in List #1 technical electives. Be sure to consult the current list of approved technical electives for the year in which you plan to graduate to make sure the courses listed below are valid technical electives.*

### List #1 Technical Electives:

#### **MSE/ESM 3054– Mechanical Behavior of Materials & Lab (3 credits total)**

**This course is a prerequisite to many of the other courses on this list, so it is highly recommended that you take this course first so you have more options later on.**

Mechanical properties and behavior of engineering materials subjected to static, dynamic, creep, and fatigue loads under environments and stress states typical of service conditions; biaxial theories of failure; behavior of cracked bodies; microstructure-property relationships and design methodologies for homogeneous and composite materials. Pre: ESM 2204, MSE 2034 or MSE 2044 or MSE 3094 or AOE 3094, or CEE 3684.

#### **MSE/ESM 3064: Mechanical Behavior of Materials & Lab (3 credits total)**

Laboratory experiments on behavior and mechanical properties of solid materials. Tension, compression, bending, hardness, nano-indentation, and impact tests; behavior of cracked bodies; fatigue and crack growth tests; creep deformation; microstructure-property relationships; laboratory equipment, instrumentation, and computers. Co: MSE 3054.

#### **MSE 3204 – Fundamentals of Electronic Materials (3 credits)**

Introduction to the electrical, magnetic, and optical properties of solid-state materials. Development of atomic scale models for physical phenomena that are observable at the macroscopic scale. Connection is made between basic materials properties and the operational characteristics of selected solid-state devices. Pre: MSE 2054, PHYS 2306.

#### **MSE 3304 – Physical Metallurgy (3 credits) Spring only.**

Deformation of crystalline solids and its relationship to crystal structure and crystal defects: crystal structures of metals, dislocations and plastic deformation, vacancies, recovery, recrystallization, grain growth, deformation twinning and martensite. Pre: MSE 2034 or MSE 2044. This course may be major restricted.

#### **MSE 3314 – Physical Metallurgy Lab (1 credit, co-requisite: MSE 3304) Spring only.**

Sample preparation for materials characterization techniques including various types of microscopy, spectroscopy, diffraction, and hardness testing. Instruction in the use of heat treating equipment and polishing and chemical etching procedures. Pre: MSE 2034 or MSE

2044.

**MSE 4055 – Materials Selection & Design I (3 credits) Fall only.**

Selection of materials for engineering systems, based on constitutive analyses of functional requirements and material properties. Pre: MSE 3054, MSE 3044, MSE 3204 or MSE 4414 or MSE 3204, MSE 4554 or MSE 4414. This course may be major restricted.

**MSE 4164 – Principles of Materials Corrosion (3 credits) Spring only.**

Introduction to the scientific principles of materials corrosion and corrosion protection. Topics include: thermodynamics of materials corrosion, including potential-PH (Pourbaix) diagrams, kinetics of corrosion reactions and mixed potential theory, types of corrosion (uniform, galvanic, crevice, pitting, fatigue, stress corrosion cracking, intergranular, and hydrogen embrittlement), material/environmental factors that promote or prevent the various types of corrosion, and methods and techniques of corrosion testing. Co: MSE 4034

**MSE 4304 – Metals and Alloys (3 credits) Spring only.**

This course covers the production, properties and uses of commercially important metals and alloys. The influence of structure, chemistry, and processing upon the properties of metals is emphasized. Alloy selection is discussed. Mechanical, electrical, thermal and chemical characteristics of ferrous and nonferrous alloys are studied. Pre: MSE 2034 or MSE 2044

**MSE 4384: Nuclear Materials (3 credits) Fall only.**

An introduction to materials for nuclear applications with emphasis on fission reactors. Fundamental radiation effects on materials; material properties relevant to structural, moderator, reflector, blanket, coolant, control shielding and safety systems; processes such as nuclear fuel cycles, fuel enrichment and reprocessing; and related structural systems. Pre: (MSE3044 or ME 3304), (MSE 3054 or ESM 3054 or ME 3614).

**MSE 4554 – Polymer Engineering (3 credits). Spring only.**

This course is designed to introduce the student to polymers from the MSE perspective. The basics of polymer syntheses and polymerization will be outlined. The relationship between processing, structure, and properties will be presented with respect to the performance and design requirements of typical polymer applications. Pre: MSE 4034. This course may be restricted by major.

**MSE/ESM 4574 – Biomaterials (3 credits) Spring only.**

Materials for biomedical applications. Basic material types and properties, functional uses of materials in medical applications, and tissue response mechanisms. Integrated design issues of multicomponent material design in prosthetic devices for hard and soft tissues, orthopedics, cardiovascular, and drug delivery applications. Pre: MSE 3054 or ESM 3054.

**MSE 4584 – Biomimetic Materials (3 credits) Fall only.**

Introduction to structure property relationships in biological materials such as wood, bone, shells, spider silk, connective tissue, blood vessels and jellyfish. Proteins and

polysaccharides, biosynthesis and assembly, biomineralization, hierarchical organization. Introduction to tissue engineering and regenerative medicine. Life cycle, environmental aspects of biofabrication. Pre: MSE 2034 or MSE 2044, CHEM 1036 or BIOL 1106.

**MSE4604 – Composite Materials (3 credits) Spring only.**

The application of the fundamental concepts of mechanics, elasticity, and plasticity to multiphase and composite materials. Constitutive equations for the mechanical and physical properties of metal, ceramic, and polymeric matrix composites. The role of processing and microstructure on properties. Pre: MSE 2034 or MSE 2044, ESM 2204.

**MSE 4634 – Design with Materials (3 credits)**

Offered every other year.

The role and implications of material properties, processing, and structure in engineering and/or functional design. The role of material selection in the conceptualization, specification, and implementation phases of the design process. Case studies in state-of-the-art, material-limiting component design. Multidisciplinary enrollment encouraged. Co: senior capstone experience or permission of the instructor.

**MSE/ESM 4154 – Nondestructive Evaluation of Materials (3 credits)**

Concepts and methods of nondestructive evaluation of materials. Discussion of techniques and mathematical bases for methods involving mechanical, optical, thermal, and electromagnetic phenomena; design for inspectability; technique selection criteria; information processing and handling; materials response measurement and modeling; signal analysis Pre: MSE/ESM 3054, (PHYS 2176 or PHYS 2306).

**ESM 4044 – Mechanics of Composite Materials (3 credits) Fall only.**

Introduction to the deformation, stress, and strength analysis of continuous-fiber-polymer-matrix laminated composites. Fabrication, micromechanics of stiffness and expansional coefficients, classical lamination theory (CLT). Environmentally induced stresses. Computerized implementation and design. Pre: ESM 2204.

**PHYS 4574 – Nanotechnology (3 credits) Spring only.**

Introduction to methods of controlling matter on the nanometer length scale and the applications thereof. Nanolithography, self-assembly, and scanned probe microscopy; nanomaterials including fullerenes, carbon nanotubes, and quantum dots; nanoscale and molecular electronics; nanoelectromechanical systems; nanoscale optoelectronics; and nanobiotechnology. Pre: PHYS 2205 and PHYS 2206 or PHYS 2305 and PHYS 2306.

*\*courses in grey have not been offered in at least one academic year and may not be available.*