

MATERIALS SCIENCE & ENGR (MSE)

MSE 1111. Introduction to Materials Science and Engineering. 1 Credit Hour.

A general introduction to the field of Materials Science and Engineering and the MSE curriculum at Georgia Tech.

MSE 1750. Introduction to Bioengineering. 3 Credit Hours.

An introduction to the field of bioengineering, including the application of engineering principles and methods to problems in biology and medicine, the integration of engineering with biology, and the emerging industrial opportunities. Crosslisted with AE, BMED, CHE, ECE, and ME 1750.

MSE 1801. Special Topics. 1 Credit Hour.

Topics of current interest not covered in other courses.

MSE 1802. Special Topics. 2 Credit Hours.

Topics of current interest not covered in other courses.

MSE 1803. Special Topics. 3 Credit Hours.

Topics of current interest not covered in other courses.

MSE 1XXX. Materials Science & Engineering Elective. 1-21 Credit Hours.

MSE 2001. Principles and Applications of Engineering Materials. 3 Credit Hours.

The structure-property-processing-performance relationships of engineering materials are described. Materials selection is treated as a part of engineering design.

MSE 2021. Materials Characterization. 4 Credit Hours.

The fundamentals of basic microstructural and compositional materials characterization techniques are presented with an emphasis on tools using electromagnetic radiation and electrons as stimuli.

MSE 2698. Undergraduate Research Assistantship. 1-12 Credit Hours.

Independent research conducted under the guidance of a faculty member.

MSE 2699. Undergraduate Research. 1-12 Credit Hours.

Independent research conducted under the guidance of a faculty member.

MSE 2801. Special Topics. 1 Credit Hour.

Topics of current interest not covered in other courses.

MSE 2802. Special Topics. 2 Credit Hours.

Topics of current interest not covered in other courses.

MSE 2803. Special Topics. 3 Credit Hours.

Topics of current interest not covered in other courses.

MSE 2XXX. Materials Science & Engineering Elective. 1-21 Credit Hours.

MSE 3001. Chemical Thermodynamics of Materials. 3 Credit Hours.

Principles and applications of thermodynamics to materials science and engineering. Phase equilibria and the concepts necessary to interpret phase diagrams.

MSE 3002. Structural Transformations in Metallic, Ceramic, and Polymeric Systems. 3 Credit Hours.

Principles that govern the important structural transformations that occur in engineering materials.

MSE 3005. Mechanical Behavior of Materials. 3 Credit Hours.

The correlation of mechanical properties with atomic bonding, microstructure, and micromechanics, for applications relevant to materials selection and design, mechanical forming, and failure of materials.

MSE 3012. Thermal and Transport Properties of Materials. 3 Credit Hours.

The thermophysical and transport properties of solids and fluids, i.e. heat capacity, expansion, viscosity, conduction, convection, and radiation are discussed, along with thermal analysis instrumentation.

MSE 3015. Electrical, Optical, and Magnetic Properties. 3 Credit Hours.

Introduction to quantum mechanics and the band theory of solids to describe semiconducting, superconducting, dielectric, optical, and magnetic properties of nano- and micro-structured materials.

MSE 3021. Materials Laboratory I. 2 Credit Hours.

Characterization of engineering properties of materials through hands-on experiments. Instruction on basic laboratory skills, safety, statistical analysis of data, use of laboratory notebooks and technical report writing.

MSE 3025. Statistics and Numerical Methods in Materials Science and Engineering. 3 Credit Hours.

Concepts of computational modeling and statistics, with examples based on materials science and engineering applications.

MSE 3210. Transport Phenomena. 3 Credit Hours.

An introduction to transport emphasizing applications to materials. Credit not allowed for MSE 3210.

MSE 3220. Operations and Management Methods. 3 Credit Hours.

Principles and applications of production and operations management to the manufacturing enterprise, including process flow analysis, production planning and scheduling, optimization, quality management and facilities planning. Restricted to MSE majors. Credit not allowed for MSE 3220.

MSE 3225. Rheology. 3 Credit Hours.

Introduction to non-Newtonian fluid mechanics and rheology.

MSE 3230. Polymer and Fiber Processing. 3 Credit Hours.

Discussion of the principles of fiber formation from polymers including rheology, mechanics, energetics, phase transition, and polymer structure. High-performing fiber processing, and plastics processing. Credit not allowed for both MSE 3230 and PTFE 3230.

MSE 3300. Materials Science & Engineering of Sports. 3 Credit Hours.

The structure-property-performance relationships of engineered materials are described as it relates to past, present, and future use in sports.

MSE 3720. Introduction to Polymer/Fiber Enterprise. 3 Credit Hours.

Approaches the manufacture of engineered fibrous structures from a manager's viewpoint and gives a working knowledge and understanding of various processes used in producing polymers/fibers/fiber products. Restricted to non-MSE majors. Credit not allowed for MSE 3720.

MSE 3801. Special Topics. 1 Credit Hour.

Topics of current interest not covered in other courses.

MSE 3802. Special Topics. 2 Credit Hours.

Topics of current interest not covered in other courses.

MSE 3803. Special Topics. 3 Credit Hours.

Topics of current interest not covered in other courses.

MSE 3XXX. Materials Science & Engineering Elective. 1-21 Credit Hours.

MSE 4002. Ceramic Materials: Properties, Processing, Applications. 3 Credit Hours.

Properties, processing, and applications of the industrially and technically important ceramic materials. Traditional and oxide ceramics in addition to glass and nonoxide ceramics.

MSE 4004. Materials in Electronic Applications. 3 Credit Hours.

Basics of photolithography, screen printing, and tape casting. Requirements for fuel cells, magnetic nanocomposites, flat-panel displays, gas sensors, piezoelectric actuators, photonic crystals, etc.

MSE 4006. Processing and Applications of Engineering Alloys. 3 Credit Hours.

Solidification, deformation, and powder processing of metals and alloy;; microstructural design at nano- and meso-length scales; and structure-property correlations.

MSE 4010. Environmental Degradation. 3 Credit Hours.

Theory of environmental degradation of metals, ceramics, polymers, and biomaterials. Emphasis on the scientific principles of corrosion and physical degradation.

MSE 4022. Materials Laboratory II. 2 Credit Hours.

Processing, structure, properties relationships are explored through a series of hands-on experiments. Instruction on basic laboratory skills, safety, statistical analysis of data, use of laboratory notebooks and technical report writing.

MSE 4025. Fiber Product Manufacturing. 3 Credit Hours.

The manufacture of fiber products and their process- structure-property relationships are detailed, covering fibers, yarns, fabrics, nonwovens, carpets, composites, and related materials.

MSE 4026. Testing and Evaluation of Polymer and Fiber Products. 3 Credit Hours.

Properties influencing the end use performance of fiber and polymer products including that of plastic materials will be tested using standard ASTM, AATC and federal test methods. Standard statistical tools will be used to analyze and interpret the test data.

MSE 4100. Chemical Applications to Fiber Materials. 2 Credit Hours.

The chemical, thermal, and mechanical processes used in the preparation, coloration, printing and finishing of polymeric fiber materials are explored. Credit not allowed for MSE 4100.

MSE 4105. Deformation and Fracture of Materials. 3 Credit Hours.

Deformation and fracture of metals, ceramics, polymers and composites for applications relevant to material selection and design, mechanical forming processes, and analysis of engineering failures.

MSE 4122. Fiber Chemistry Lab. 1 Credit Hour.

Laboratory course in preparation, coloration and finishing of fiber materials. Credit not allowed for MSE 4122.

MSE 4140. Polymer Physics. 3 Credit Hours.

Physical chemistry of polymer solutions, polymer miscibility, adsorptions, sorptions, plasticization, molecular weights, molecular weight distributions. Study of polymer surfaces. Credit not allowed for MSE 4140.

MSE 4230. Industrial Ctrl's In MFG. 3 Credit Hours.

Introduction to industrial controls in manufacturing, process modeling, control of continuous-variable processes, digital control, discrete control, and control of manufacturing systems.

MSE 4315. Nondestructive Evaluation. 3 Credit Hours.

Principles and theory of industrial nondestructive evaluation methods are covered. Emphasis is on testing the soundness and reliability of primary and secondary engineering structures.

MSE 4320. Electronic Packaging and Design. 3 Credit Hours.

Electronic packaging design, covering properties of materials, fabrication and assembly processes, thermal-mechanical considerations, practical concerns regarding interconnection and processing issues, and reliability assessment.

MSE 4325. Thin Film Materials Science. 3 Credit Hours.

Introduction to principal vapor deposition processes and vacuum technology. The fundamentals of the formation, characterization, and properties of inorganic nano- to micro-scale thin films.

MSE 4330. Fundamentals of Nanomaterials and Nanostructures. 3 Credit Hours.

Introduction to nanotechnology. Description of various nanomaterials, their applications and synthesis methods.

MSE 4335. Soft Nano and Bio Materials. 3 Credit Hours.

Introduction soft nanomaterials and nanostructures that have been discovered and synthesized for prospective applications in nanotechnology.

MSE 4410. Capstone Engineering Design I. 3 Credit Hours.

A capstone engineering design course covering the principles of concurrent product/process design and development. Team-based projects will explore product/process design and development. Credit not allowed for MSE 4410.

MSE 4420. Capstone Engineering Design II. 3 Credit Hours.

A team problem-solving approach is used to work on a project developed in cooperation with industry. Weekly communications, both oral and written, are required. Credit not allowed for MSE 4420.

MSE 4698. Undergraduate Research Assistantship. 1-12 Credit Hours.

Independent research conducted under the guidance of a faculty member.

MSE 4699. Undergraduate Research. 1-12 Credit Hours.

Independent research conducted under the guidance of a faculty member.

MSE 4723. Interdisciplinary Capstone Design. 3 Credit Hours.

Seniors will work in teams to apply a systematic design process to real multi-disciplinary problems. Problems selected from a broad spectrum of interest areas, including biomedical, environmental, mechanical, industrial design, electrical and thermal/fluids. Projects must be based on the knowledge and skills acquired in earlier course work, and incorporate appropriate engineering standards and multiple realistic constraints. Emphasis is placed on the design process, the technical aspects of the design, and on reducing the proposed design to practice. The course consists of faculty and guest lectures, prototyping in design studios, and a multi-disciplinary design project.

MSE 4740. Biologically Inspired Design. 3 Credit Hours.

We examine evolutionary adaptation as a source for engineering design inspiration, utilizing principles of scaling, adaptability, and robust multifunctionality that characterize biological systems. Credit not allowed for both MSE 4740 and (BIOL 4740 or ISYE 4740 or ME 4740).

MSE 4751. Introduction to Biomaterials. 3 Credit Hours.

Introduction to different classes of biomaterials (polymers, metals, ceramics) and physiological responses to biomaterial implantation. Topics include material properties, host response, and biomaterial characterization techniques. Crosslisted with BMED 4751.

MSE 4754. Electronics Packaging Assembly, Reliability, Thermal Management, and Test. 3 Credit Hours.

The course provides hands-on instruction in electronics packaging, including assembly, reliability, thermal management, and test of next-generation microsystems. Crosslisted with ECE and ME 4754.

MSE 4755. Electronic Packaging Substrate Fabrication. 3 Credit Hours.

This course provides students with hands-on instruction in basic SOP concepts and techniques, including interconnect design, substrate material selection and properties, photodielectric deposition, via formation and photolithography, copper metallization, and finally, substrate testing. Laboratory instructions are augmented by an interactive multimedia educational presentation that makes the course work material remotely accessible via the internet.

MSE 4759. Electrochemical Energy Storage and Conversion. 3 Credit Hours.

An elective class for senior-level students interested in electrochemical storage and conversion, including the fundamentals of electrochemistry and practical battery and fuel cells. Cross-listed with ChBE and ME 4759.

MSE 4761. Industrial Controls and Manufacturing. 3 Credit Hours.

Students are introduced to industrial controls and the fundamentals of manufacturing with hands-on experience based on lab projects using industry software and hardware for communications and control. Credit not allowed for MSE 4761.

MSE 4766. Fabrication and Properties of Nanoscale Devices. 3 Credit Hours.

Fundamental properties at the nanoscale for photonics and sensors. Nanoscale fabrication methods including thin films, ion beam, lithography, electroplating, and example case studies in NEMS/MEMS and photonics. Credit not allowed for both MSE 4766 and ME 4766.

MSE 4775. Polymer Science and Engineering I: Formation and Properties. 3 Credit Hours.

An introduction to the chemistry, structure, and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids. Crosslisted with CHE, CHEM, and ME 4775.

MSE 4776. Polymer Science and Engineering II: Analysis, Processing, and Laboratory. 3 Credit Hours.

Polymer fabrication processes and methods of characterization and identification of polymers are presented. Experiments in polymerization, processing, and property evaluation of polymers. Crosslisted with CHE, CHEM, ME, and TFE 4776.

MSE 4790. Materials Selection and Design. 3 Credit Hours.

Principles of selecting materials and processes for engineering applications. Methodologies for designing new materials and conceiving hybrid solutions. Credit not allowed for both MSE 4790 and ME 4213 (or ME 4790).

MSE 4791. Mechanical Behavior of Composites. 3 Credit Hours.

Introduction to properties and structures of common matrix and reinforcing materials, mechanics of fiber-reinforced composites, lamina and laminate analysis, and mechanical performance. Crosslisted with AE, CEE, CHE, and ME 4791.

MSE 4793. Composite Materials and Processing. 3 Credit Hours.

Basic principles of selecting component materials and manufacturing composites are presented. Polymeric, metallic, and ceramic systems are considered. Crosslisted with AE, CEE, CHE, and ME 4793.

MSE 4794. Composite Materials and Manufacturing. 4 Credit Hours.

Basic principles of selection and design of composite materials and their manufacturing and testing. Cost factors. Laboratory exercises on manufacturing and tests. Crosslisted with AE, CEE, CHE, and ME 4794.

MSE 4795. Fundamental Elements of Nuclear Reactor Materials. 3 Credit Hours.

Introduction to fundamentals of nuclear reactor materials. Topics covered are basics of radiation damage, defect creation and evolution, microstructure-property correlations in cladding and fuel of nuclear materials.

MSE 4801. Special Topics. 1 Credit Hour.**MSE 4802. Special Topics. 2 Credit Hours.****MSE 4803. Special Topics. 3 Credit Hours.****MSE 4901. Special Problems. 1-21 Credit Hours.****MSE 4902. Special Problems. 1-21 Credit Hours.****MSE 4XXX. Materials Science & Engineering Elective. 1-21 Credit Hours.**