

MSE-Material Science & Egr Courses

Courses

MSE 011. Undergraduate Internship in MSE. 0 Hours.

Engineering internship experience in preparation for the student's intended career. Students in a university recognized cooperative education experience should register for [COP 011](#) or [COP 012](#).

MSE 280. Engineering Materials. 3 Hours.

Fundamentals of materials engineering, including terminology, mechanical testing and behavior, heat treating, and processing of metals, ceramics, polymers, and composites. Degradation of materials and criteria for materials selection. Course requires completion of 4 credits of Area III Science.

MSE 281. Physical Materials I. 4 Hours.

Structure of metals, ceramics and polymers; crystal bonding; phase diagrams, diffusion, dislocations and grain boundaries. Applications to the iron-carbon system, including heat treatment. MSE 281L must be taken concurrently.

Prerequisites: ([MA 125](#) [Min Grade: C] or [MA 225](#) [Min Grade: C]) and [MSE 280](#) [Min Grade: C]

MSE 281L. Physical Materials I Laboratory. 0 Hours.

Laboratory component of [MSE 281](#) and must be taken concurrently with [MSE 281](#).

MSE 350. Introduction to Materials. 3 Hours.

Concepts and applications, crystal structure of materials, formation of microstructures, and selected structure-property relationships. Not available for credit toward engineering major. For non-engineering majors only.

MSE 380. Thermodynamics of Materials. 3 Hours.

First, second, and third laws of thermodynamics. Gibbs free energy, heat capacity, enthalpy, entropy, and relationships between thermodynamic functions. Free-energy versus composition relationships; behavior of ideal and non-ideal solutions; concept of thermodynamic activity of components in solution. Applications to materials systems.

Prerequisites: [CH 117](#) [Min Grade: D] and [CH 118](#) [Min Grade: D] and ([MA 126](#) [Min Grade: C] or [MA 226](#) [Min Grade: C]) and [MSE 280](#) [Min Grade: D]

MSE 381. Physical Materials II. 3 Hours.

Microstructural changes in response to temperature and time; vacancies, annealing, diffusion, nucleation and growth kinetics. Equilibrium and non-equilibrium microstructures. Applications to precipitation hardening and solidification of metals.

Prerequisites: [MSE 281](#) [Min Grade: D]

MSE 382. Mechanical Behavior of Materials. 3 Hours.

Microscopic deformation mechanisms in materials leading to macroscopic properties of fatigue; creep; ductile, transitional, and brittle fracture; friction; and wear. [CE 220](#) (Mechanics of Solids) is recommended as a prerequisite for this course.

Prerequisites: [MSE 281](#) [Min Grade: D]

MSE 401. Materials Processing. 3 Hours.

Processing of metals, ceramics, polymers, and composites. Casting, forging, rolling, welding, powder processing, 3D printing, compression molding, and other advanced methods. Ethics and Civic Responsibility are significant components of this course.

Prerequisites: [MSE 280](#) [Min Grade: D] and ([BME 333](#) [Min Grade: D] or [CE 220](#) [Min Grade: D])

MSE 405. Frontiers of Automotive Materials. 3 Hours.

Advanced lightweight automotive materials, manufacturing and modeling techniques. Technology advancements in cost-effective carbon, glass and related reinforcements; "green" and sustainable materials, crashworthiness and injury protection of occupants and pedestrians, metal castings, heavy truck, mass transit, fuel cell and hybrid vehicles.

Prerequisites: [MSE 281](#) [Min Grade: D]

MSE 408. Nanobiomaterials. 3 Hours.

Basic tools of nanotechnology, building blocks of nanostructured materials. Behavior of materials with nanoscale structures and their technological applications, including automotive, medical, and electronic applications. Introduction to biomaterials and nanobiomaterials, concepts in tissue engineering with special focus on nanoscaffolds for tissue engineering, nanoparticles in drug delivery and safety and toxicity of nanomaterials.

Prerequisites: [MSE 280](#) [Min Grade: D]

MSE 409. Principles of Metal Casting. 3 Hours.

Engineering theory and practice on the production of cast ferrous (gray iron, ductile iron, steel) and non-ferrous metals (brass, bronze, aluminum). Producer requirements/responsibilities such as part and mold design, material specifications, and testing requirements are discussed. Laboratory on common testing and production methods and analysis and handling techniques required to produce high quality castings.

Prerequisites: [MSE 280](#) [Min Grade: D]

MSE 409L. Principles of Metal Casting Laboratory. 0 Hours.

Laboratory component of [MSE 409](#) and must be taken concurrently with [MSE 409](#).

MSE 413. Composite Materials. 3 Hours.

Processing, structure, and properties of metal-, ceramic-, and polymer-matrix composite materials. Roles of interfacial bond strength, reinforcement type and orientation, and matrix selection in physical and mechanical properties of composite materials. [MSE 382](#) (Mechanical Behavior of Materials) is recommended as a prerequisite for this course. Writing is a significant component of this course.

Prerequisites: [MSE 281](#) [Min Grade: D]

MSE 425. Statistics and Quality. 3 Hours.

This course is arranged to reflect the sequential steps an engineer or scientist take to assess process capability and implement process improvement studies. There is a focus on connecting the theoretical equations to practical examples as well as interpreting and communicating of statistical results.

Prerequisites: [MSE 281](#) [Min Grade: D]

MSE 430. Polymeric Materials. 3 Hours.

Processing methods, structure/engineering/property relationships, and applications of polymeric materials.

Prerequisites: [MSE 281](#) [Min Grade: D] and ([CH 117](#) [Min Grade: D] or [CH 127](#) [Min Grade: D]) and ([CH 118](#) [Min Grade: D] or [CH 128](#) [Min Grade: D])

MSE 430L. Polymeric Materials Laboratory. 0 Hours.

Laboratory component of [MSE 430](#) and must be taken concurrently with [MSE 430](#).

MSE 433. Nondestructive Evaluation of Materials. 3 Hours.

This course reviews the principles, history, applications, and strengths/weaknesses of the five primary NDE techniques (RT, UT, EC, MP, and LP) with an emphasis on the fundamentals and techniques of each testing method. Importance of NDE on part performance and engineering design is also discussed.

Prerequisites: MSE 281 [Min Grade: D]

MSE 445. The Evolution of Engineering Materials. 3 Hours.

Past, present and future of engineering materials; how new materials and processing methods have impacted human society, from the Stone Age until today. Taught as a 3-week study abroad course in Germany, with visits to universities, industrial facilities, research labs, museums and selected cultural sites.

Prerequisites: MSE 280 [Min Grade: D]

MSE 462. Composites Manufacturing. 3 Hours.

Principles of manufacturing and processing of polymeric matrix composites. Production techniques including filament winding, pultrusion, and liquid infusion techniques combined with design, environmental and manufacturing issues of polymer matrix composites.

Prerequisites: MSE 281 [Min Grade: D]

MSE 464. Metals and Alloys. 4 Hours.

Microstructures, properties, heat treatment, and processing of ferrous and nonferrous materials.

Prerequisites: MSE 281 [Min Grade: D]

MSE 464L. Metals and Alloys Laboratory. 0 Hours.

Laboratory component of MSE 464 and must be taken concurrently with MSE 464.

MSE 465. Characterization of Materials. 4 Hours.

Theory and practice of materials characterization, with emphasis on optical metallography, quantitative metallography, scanning electron microscopy, crystallography, and x-ray diffraction. Specific applications in metals and ceramics considered. MSE 465L must be taken concurrently.

Prerequisites: MSE 281 [Min Grade: D]

MSE 465L. Characterization of Materials Laboratory. 0 Hours.

Laboratory component of MSE 465 and must be taken with MSE 465.

MSE 470. Ceramic Materials. 4 Hours.

Structure, processing, properties, and uses of ceramic compounds and glasses. Mechanical, thermal, and electrical behavior of ceramic materials in terms of microstructure and processing variables.

Prerequisites: MSE 281 [Min Grade: D] and CH 117 [Min Grade: D] and CH 118 [Min Grade: D]

MSE 470L. Ceramic Materials Laboratory. 0 Hours.

Laboratory component of MSE 470 and must be taken concurrently with MSE 470.

MSE 474. Metals and Alloys II. 3 Hours.

Production and physical metallurgy of ferrous and non-ferrous alloys including: steel alloys, inoculation and production of ductile, gray, compacted and malleable iron; advanced heat treatments of steel and iron; conventional and ultra-high strength aluminum alloys; wrought and cast copper alloys; wrought and cast magnesium alloys.

Prerequisites: MSE 281 [Min Grade: D] and MSE 464 [Min Grade: D] (Can be taken Concurrently)

MSE 489. Undergraduate Research in MSE. 0 Hours.

Undergraduate research experiences in materials science and/or engineering.

Prerequisites: (EGR 110 [Min Grade: C] and EGR 111 [Min Grade: C]) or EGR 200 [Min Grade: C] or HC 111 [Min Grade: C] and (MA 125 [Min Grade: C] or MA 225 [Min Grade: C]) and PH 221 [Min Grade: C](Can be taken Concurrently)

MSE 490. Special Topics in Materials Engineering. 1-6 Hour.

Special Topics in Materials Engineering.

MSE 491. Individual Study in Materials Engineering. 1-6 Hour.

Individual Study in Materials Engineering.

MSE 496. MSE Honors Seminar. 1 Hour.

Research presentations by faculty, students, and invited guests on topics related to Materials Science and Engineering.

MSE 497. MSE Honors Research. 2-6 Hours.

Honor students develop materials engineering research skills by working closely with faculty and graduate students.

Prerequisites: EGR 301 [Min Grade: C](Can be taken Concurrently)

MSE 498. Capstone Design Project I. 3 Hours.

Capstone design project: interdisciplinary design teams, ethics, materials selection, design process, development of proposal, project planning and scheduling, project execution and resource scheduling, and communication of design. Writing is a significant component of this course.

Prerequisites: MSE 401 [Min Grade: D](Can be taken Concurrently) and (MSE 413 [Min Grade: D] or MSE 430 [Min Grade: D] or MSE 465 [Min Grade: D] or MSE 470 [Min Grade: D])

MSE 499. Capstone Design Project II. 3 Hours.

Continuation of MSE 498 which must be taken in the previous term.

Interim and final design reviews with written and oral reports. Writing is a significant component of this course.

Prerequisites: MSE 498 [Min Grade: D]