MATERIALS SCIENCE AND ENGINEERING (MSE)

MSE 5001. Principles of Materials Engineering. (3 Credits)
Accelerated Introduction to Materials Science and Engineering Concepts, including: structures and defects; phase diagrams; mechanical properties; electronic properties; magnetic properties; optical properties; thermal properties; functional materials; metals and alloys; ceramics; polymers; and composites.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205001)

MSE 5095. Special Topics in Materials Science and Engineering. (1-3 Credits)
Course taught on a provisional basis for the purposes of course development. Students may take multiple instances of MSE 5095, which all can count towards the applicable MSE graduate course credit requirements for M.S. Plan A, M.S. Plan B, M.Eng. or Ph.D. degrees, provided each instance covers a different topic.
Enrollment Requirements: Only MSE graduate students can register for this course, all others require instructor consent.
May be repeated for credit
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205095)

MSE 5097. Research Methods in Materials Science and Engineering. (1-3 Credits)
Introduction to modern methodologies of experimental or computational materials research. A maximum of three credits can count toward the MSE graduate course credit requirements for M.S. Plan B or M.Eng. degrees. Cannot substitute for any GRAD course or be used to satisfy M.S. or Ph.D. degree credit requirements for thesis or dissertation research.
Enrollment Requirements: Open to M.S. Plan B or M.Eng. students; major advisor approval required.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205097)

MSE 5098. Variable Topics in Materials Science and Engineering. (1-3 Credits)
Advanced or specialized topics in materials science, engineering and/or technology. A maximum of three credits can count towards the applicable MSE graduate course credit requirements for M.S. Plan A, M.S. Plan B, M.Eng. or Ph.D. degrees.
Enrollment Requirements: Departmental consent required; may be repeated with a change in topic.
May be repeated for a total of 3 credits
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205098)

MSE 5099. Independent Study in Materials Science and Engineering. (1-3 Credits)
Specialized non-classroom-based coursework under the regular supervision of a faculty instructor, or as offered by an accredited third party source. Does not constitute original research. A maximum of three credits can count towards the applicable MSE graduate course credit requirements for M.S. Plan A, M.S. Plan B, M.Eng. or Ph.D. degrees.
Enrollment Requirements: Major advisor consent; MSE gradaute students only.
May be repeated for a total of 3 credits
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205099)

MSE 5135. Textile Structural Composite Materials. (3 Credits)
Provides an in-depth understanding of textile composites, their fabrication and consolidation processes, applications, characterization techniques, mechanical properties, mechanical property models and fatigue and damage tolerance properties. Focus on both 2D and 3D composites made using the textile technologies of weaving, braiding and stitching. The in-plane mechanical properties and failure mechanisms of these composites under static and fatigue loads will be examined along with their enhanced interlaminar fracture toughness, impact resistance and damage tolerance properties.
Enrollment Requirements: Instructor consent. Recommended preparation: MSE 5364 or ME 5430.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205135)

MSE 5301. Thermodynamics of Materials. (3 Credits)
Classical thermodynamics with emphasis on solutions and phase equilibria. Applications to unary and multicomponent, reacting and nonreacting, homogeneous and heterogeneous systems, including development of phase diagrams.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205301)

MSE 5305. Phase Transformations in Solids. (3 Credits)
Thermodynamics, kinetics and crystallography of phase transformations. Nucleation and growth kinetics. Order-disorder, ferroelectric, and ferromagnetic transformations.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205305)

MSE 5307. Solidification of Metals and Alloys. (3 Credits)
Thermodynamic and kinetic principles of solidification. Control of structure and properties of pure and multicomponent materials through casting and solidification processes. Application of solidification principles to shaped casting, continuous casting, crystal growth and particulate processes.
Enrollment Requirements: MSE 5301.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205307)

MSE 5309. Transport Phenomena in Materials Science and Engineering. (3 Credits)
Mechanisms and quantitative treatment of mass, energy, and momentum transfer will be discussed in the context of materials science and engineering applications. Increasingly complex and open-ended applications will be used to illustrate principles of fluid flow; heat conduction, radiation, and diffusion.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205309)

MSE 5311. Mechanical Properties of Materials. (3 Credits)
Mechanics of deformation and fracture; dislocation theory; strength of ductile and brittle materials; toughness; strengthening mechanisms; toughening mechanisms; creep mechanisms; fatigue crack initiation and propagation; reliability and lifetime prediction.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205311)

MSE 5320. Investigation of Special Topics. (3 Credits)
Special courses or individual readings.
May be repeated for a total of 9 credits
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205320)

MSE 5322. Materials Characterization. (3 Credits)
A review of the principal experimental methods used to reveal the microstructure and chemistry of materials. Diffraction techniques: x-ray, electron, neutron and proton scattering. Photon probes: photon microscopies, x-ray topography and XPS. Electron probes: SEM, TEM, EDX, EELS, AES. Atom and ion probes: RBS, SIMS, FIM, PIXE. Scanned probe microscopies.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205322)

MSE 5323. Transmission Electron Microscopy. (3 Credits)
Electron beam-specimen interactions. Basics of electron microscopes. Diffraction: theory, types of patterns and interpretation. Imaging: diffraction contrast, phase contrast and other techniques. Spectrometry: x-ray microanalysis and electron energy-loss spectrometry.
Enrollment Requirements: MSE 5322 or consent of instructor.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205323)

MSE 5330. Classical Atomic-level Simulations in Materials Science and Engineering. (3 Credits)
Introduction to several classical atomic-level simulation techniques (molecular dynamics, Monte Carlo methods) with an emphasis on learning the art of designing simulations and analyzing data generated. The capabilities of the methods to investigate properties and response of materials and the current limitations of materials at the atomic scales will be covered.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205330)

MSE 5333. Imperfections in Crystalline Materials. (3 Credits)
Defects in materials: point defects, line defects, and planar defects. The origins, structure and distribution of defects in crystalline solids will be described. The influence of defects on material properties will be discussed in the context of materials science and engineering applications.
Enrollment Requirements: Open only to Materials Science and Engineering graduate students.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205333)

MSE 5334. Structure of Materials. (3 Credits)
Translation symmetry and space lattices, crystallographic computations, point and space groups, reciprocal space treatment of diffraction, and use of the International Tables for Crystallography. Chemical bonding and descriptive crystal chemistry of metals, ceramics and molecular solids. Structure of amorphous and vitreous materials and introduction to point, line and planar defects. Crystal anisotropy and relations between structure, symmetry and physical properties.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205334)

MSE 5335. High Temperature Materials. (3 Credits)
Strength-determining factors in advanced alloys, ceramics and composites. Role of material chemistry and microstructure. High temperature creep and crack growth. Oxidation. Thermomechanical behavior.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205335)

MSE 5336. Material Selection in Mechanical Design. (3 Credits)
Study of materials and how they are chosen for various mechanical designs. A wide range of materials will be discussed (metal, ceramic, polymer, etc.) and their key properties (modulus, strength, density, etc.) in design will be reviewed. Guidelines for material selection will be shown. Design trades will also be discussed.
Enrollment Requirements: MSE 2101 or instructor consent.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205336)

MSE 5343. Corrosion. (3 Credits)
Mechanisms, characteristics and types of corrosion. Test methods and evaluation of corrosion resistance. Suitability of metals, ceramics, and organic materials in corrosive environments. Oxidation and other high temperature gas-metal reactions.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205343)

MSE 5345. Degradation Mechanisms in High Temperature Materials. (3 Credits)
A large number of conventional commercial alloys of common industrial interest remain prone to degradation due to corrosion and oxidation during exposure to high temperatures. While the bulk metal degradation, corrosion rates and type of corrosion products vary widely from alloy to alloy, a number of alloy formulations offer corrosion protection by forming slow growing, dense and adherent oxides. Oxidation of binary alloys will be studied with emphasis on internal and external oxidation and transition from internal oxidation to external oxidation. Oxide chemistry, morphology and metal loss of select Fe and Ni base alloys (chromia and alumina forming stainless steels and super alloys) will be analyzed and accelerated corrosion due to carburization, sulfidation, and oxide evaporation will be discussed. Melt assisted hot corrosion of super alloys will be examined. Approaches for corrosion protection (coatings) will be presented.
Enrollment Requirements: Instructor consent. Recommended preparation: MSE 5334.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205345)

MSE 5364. Advanced Composites. (3 Credits)
Mechanical properties, analysis and modeling of composite materials. The properties treated include stiffness, strength, fracture toughness, fatigue strength and creep resistance as they relate to fiber, whisker, particulate, and laminated composites.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205364)

MSE 5370. Ceramics. (3 Credits)
A graduate-level treatment of the science and engineering of Ceramic Materials. Concepts to be studied include the structure of both crystalline and non-crystalline material, and defects (including point defects, dislocations and interfaces) in these materials. A broad range of special (for ceramics) methods for the preparation, processing and characterization of these materials will run throughout the course. An important component of the course is consideration of how the crystal structure determines or influences mechanical, electronic, magnetic, and thermal properties. Special topics may include functional ceramics, 2D ceramics, and connections between ceramics, economics and global affairs.
Enrollment Requirements: MSE 5001 or a knowledge of Materials Science at the undergraduate level.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205370)

MSE 5380. Fatigue and Fracture of Composites. (3 Credits)
Provides an in-depth understanding of the fatigue and fracture behavior of composite materials under both uniaxial and multiaxial loading for both unidirectional and multidirectional laminates. Focus on the characterization of these properties and the damage and failure mechanisms including the effects of constituents, loading, layup and stress concentration on the fatigue and fracture behavior. This course will also cover the basic concepts and fundamental models used to describe and predict the fatigue and fracture behavior of composites. It will also cover topics related to the impact damage tolerance of composites and the application of fracture mechanics concepts to characterize and analyze composite delamination propagation under both static and fatigue loading.
Enrollment Requirements: Instructor consent. Recommended preparation: MSE 5364 or ME 5430.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205380)

MSE 5660. New Carbon Materials. (3 Credits)
This course covers the science and technology of carbon materials and their use in automotive, aerospace, environmental protection and energy storage applications. Topics to be covered include new carbon materials, carbon material processing and applications and challenges involving the use of carbon materials in industry. This course will also introduce fundamental principles of carbon material design and relations between carbon structure and material properties.
Enrollment Requirements: Instructor consent.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205660)

MSE 5787. Behavior of Composites. (3 Credits)
This course will cover test methods for the characterization of the mechanical and thermal properties, fatigue and fracture properties, and the nondestructive evaluation of polymer matrix composite materials. It will also cover the qualification of composite materials and the Building Block approach that is used to validate and substantiate the design of composite structures.
Enrollment Requirements: Instructor consent.
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%205787)

MSE 6401. Graduate Seminars in Materials Science and Engineering. (1 Credit)
Presentations by invited guest speakers on topics of current interest in various areas of Materials Science and Engineering.
May be repeated for a total of 14 credits
View Classes (https://catalog.uconn.edu/course-search/?details&code=MSE%206401)