Materials Science and Engineering (MSE)

MSE 111. Introduction to Materials Science and Engineering. 1 Credit.
This course is designed to introduce students to the field of materials science and engineering. This course introduces students to the materials that make up the world around us-metals, plastics, ceramics, composites and more. Through simple real-life examples, and interactive discussions, students will learn how materials behave and why they're chosen for different applications. Three laboratory sessions will also be included.

MSE 211. Fundamentals of Materials Science and Engineering. 3 Credits.
This course introduces students to computational techniques used in materials to model, simulate, and analyze materials properties. Topics include atomistic, mesoscale, and continuum modeling methods, with hands-on experience in coding and simulation tools. Prereq: MSE 250.

MSE 250. Thermodynamics. 3 Credits.
This course introduces the fundamental laws of thermodynamics and their application to materials systems. Topics include equilibrium criteria, phase equilibria, thermodynamic properties of solutions, and the thermodynamic basis of phase diagrams. Prereq: MATH 165, CHEM 121, CHEM 122, MSE 111.

MSE 321. Kinetics and Phase Transformation in Materials. 3 Credits.
This course introduces students to computational techniques used in materials to model, simulate, and analyze materials properties. Topics include atomistic, mesoscale, and continuum modeling methods, with hands-on experience in coding and simulation tools. Prereq: ME 223.

MSE 323L. Structure and Characterization of Materials laboratory. 2 Credits.
This laboratory course provides hands-on experience with techniques used to characterize the structure, composition, and properties of engineering materials. Students learn to operate advanced instrumentation and analyze data related to: Crystallography, Microstructure, Surface chemistry, and Mechanical properties. Prereq: MSE 211. Coreq: MSE 323.

MSE 323. Structure and Characterization of Materials. 3 Credits.
This course will cover details of the atomic structure of materials and their determination using X-ray diffraction techniques. In addition, this course will cover a description of crystalline defects and microstructure, and their impact on material properties. In addition, the course will also cover characterizing and quantifying materials' microstructure using optical and electron microscopy. Prereq: MSE 211. Coreq: MSE 323L.

MSE 335. Electronic Optical and Magnetic Properties of Materials. 3 Credits.
This course explores the fundamental physical principles governing the electronic, optical, and magnetic behavior of materials. Topics include band theory, semiconductors, dielectric and ferroelectric materials, magnetism, and photonic properties. Emphasis is placed on the structure-property relationships and applications in modern technologies such as electronics, photonics, and spintronics. Prereq: PHYS 252.

MSE 445. Computational materials Science. 3 Credits.
This course introduces students to computational techniques used in materials to model, simulate, and analyze materials properties. Topics include atomistic, mesoscale, and continuum modeling methods, with hands-on experience in coding and simulation tools. Prereq: MSE 211, MSE 250, MSE 321, MSE 323 and CSCI 160.

MSE 465. Materials Selection and Design. 3 Credits.
This course will cover systematic, quantitative strategies for selecting materials and processes as a foundation for designing with materials across a range of engineering applications. Students will also visit case studies in materials design. Prereq: MSE 335 and MSE 323.

MSE 489. Senior Design. 3 Credits.
This is an open-ended capstone design project that encompasses appropriate design and the use of materials for varying applications. This is a Required Course in the Materials Science and Engineering Curriculum. Students will work with consultants to design either an industry-sponsored problem or a research problem. They will conduct experiments and simulations to design materials for specific applications. Students will combine all aspects of the materials design and processing for an engineering application into a single comprehensive, meaningful, & educational capstone experience that integrates engineering, leadership, management, industry, and public policy disciplines, reflecting real-world engineering design practices. May be repeated for credit. Prereq: MSE 465.