

# Materials Engineering - MATL

---

## Courses

- MATL 2100 INTRODUCTION TO MATERIALS SCIENCE (3)** LEC. 3. The science of solid materials and the relationship between this science and material properties.
- MATL 2210 MATERIALS FOR SUSTAINABLE ENERGY PRODUCTION AND STORAGE (1)** LEC. 1. Technologies for sustainable energy production and storage, renewable energy conversion, associated materials challenges.
- MATL 2220 MATERIALS AND THE ENVIRONMENT (1)** LEC. 1. Environmental impact of the production, use and disposal of materials.
- MATL 2230 MINERAL RESOURCES: PROCESSING AND AVAILABILITY (1)** LEC. 1. Mineral resources for engineering materials; processing and availability of mineral resources.
- MATL 3100 ENGINEERING MATERIALS - METALS (3)** LEC. 3. Pr. MATL 2100. The relationship among processing, microstructure, properties and engineering applications of metallic materials.
- MATL 3101 METALLOGRAPHY LABORATORY (1)** LAB. 3. Coreq. MATL 3100. The use of microstructural characterization to understand the relationship between microstructure and properties of metallic materials.
- MATL 3200 ENGINEERING MATERIALS POLYMERS (3)** LEC. 3. Pr. CHEM 1040. The synthesis, processing, structure and properties of polymers and polymer matrix composites.
- MATL 3201 POLYMER AND COMPOSITES LABORATORY (1)** LAB. 3. Coreq. MATL 3200. A hands-on lab course on the synthesis, processing, structure and properties of polymers and polymer matrix composites.
- MATL 3300 ENGINEERING MATERIALS - CERAMICS (3)** LEC. 3. Pr. MATL 2100. The engineering of ceramic materials. Structural property relationships of crystalline and glassy ceramics will be included.
- MATL 4100 THERMODYNAMICS AND KINETICS OF MATERIALS (3)** LEC. 3. Pr. CHEM 1040 and ENGR 2200. Laws of thermodynamics to describe phase equilibria and phase transformations in one-component and multi-component systems, mechanisms of diffusion, the interplay of thermodynamic driving forces and kinetics of mass transfer in materials systems
- MATL 4500 MATERIALS PROPERTIES AND SELECTION (4)** LEC. 3. LAB. 3. Pr. ENGR 2070 and MATL 3100 and MATL 3200. Methods for microstructure control. Design of processing sequences, statistical and economical analysis.
- MATL 4930 DIRECTED STUDIES (1-6)** IND. SU. Departmental approval. Areas of interest within Materials Engineering. Course may be repeated for a maximum of 6 credit hours.
- MATL 4980 SENIOR DESIGN PROJECT (3)** LEC. 1. LAB. 6. Students select, design, schedule, fabricate and perform an engineering design project related to Materials Engineering.
- MATL 5100 THERMODYNAMICS OF MATERIALS SYSTEMS (3)** LEC. 3. Pr. CHEM 1040 and ENGR 2200. Departmental approval. Application of thermodynamics to describe phase stability, crystal imperfections, solubility, oxidation, surface, and interface energy and transformations.
- MATL 5200 MATERIALS CHARACTERIZATION (2)** LEC. 2. Pr. PHYS 1610 or PHYS 1617. Principles of materials characterization including x-ray diffraction, optical and electron microscopy, and other advanced analytical methods for materials design.
- MATL 5201 MATERIALS CHARACTERIZATION LABORATORY (1)** LAB. 3. Coreq. MATL 5200. Laboratory on the use of x-ray diffraction, metallography, and optical/electron microscopy for materials characterization.
- MATL 5300 PHASE TRANSFORMATIONS IN MATERIAL PROCESSING (3)** LEC. 3. Pr. MATH 2650 and ENGR 2200. Departmental approval. Principles that govern phase transformations in materials systems and control of nucleation and growth, microstructure and morphology.
- MATL 5400 PHYSICS OF SOLIDS (3)** LEC. 3. Pr. PHYS 1610 or PHYS 1617. Departmental approval. The physics of solid-state materials, including the electronic, optical and magnetic properties of materials.

**MATL 5420 PLASMONICS AND NANOPHOTONICS (3)** LEC. 3. Pr. PHYS 1600 or PHYS 1610. This course will cover both fundamental and application aspects, with an emphasis on basic principles in nanophotonics, nanophotonic devices for light manipulation, plasmonic energy transfer, biomedical treatment, plasmonics in emerging materials, etc.

**MATL 5500 NUMERICAL SIMULATION OF MATERIALS PROCESSING (3)** LEC. 3. Pr. MATL 5100 and P/C MATL 5300. Departmental approval. Fundamental principles and applications of computer-aided simulation of transport phenomena in materials processing systems.

**MATL 5600 CORROSION (3)** LEC. 3. Pr. CHEM 1040. Fundamentals of chemical degradation of materials. Types and methods for prevention and minimization of corrosion.

**MATL 5700 BIOMATERIALS (3)** LEC. 3. Departmental approval. Interactions between materials and proteins, cells, and tissue as related to medicine and biotechnology including tissue culture, cardiovascular, drug delivery, tissue engineering and other applications. Thermodynamics of protein adsorption. Cell biology of adhesion. Analytical methods, sterilization, and regulations.

**MATL 5720 BIOMEDICAL APPLICATIONS OF POLYMERIC MATERIALS (3)** LEC. 3. LAB. 13. Pr. P/C BIOL 1030 or P/C CHEM 2070. Study of polymers used in the body for the purposes of aiding healing, correcting abnormalities, and restoring lost function.

**MATL 5750 MICROSTRUCTURE AND MECHANICS OF SKELETAL TISSUES (3)** LEC. 3. Pr. MATL 2100 and (ENGR 2070 or MECH 3130). Molecular and cellular microstructural influence over the viscoelastic deformation of the skeletal tissues of bone muscle, ligament, tendon and cartilage; mechanics of failure and biomechanical injury mechanisms; consideration of the physiological processes of adaptive remodeling and healing of tissues; recent developments in orthopedic implant materials.

**MATL 5970 INTERMEDIATE SPECIAL TOPICS (1-3)** LEC. 1-3. Departmental approval. Regular course addressing an advanced specialized area of Materials Engineering not covered by regularly offered courses. Course may be repeated with change in topics.

**MATL 6100 THERMODYNAMICS OF MATERIALS SYSTEMS (3)** LEC. 3. Departmental approval. Application of thermodynamics to describe phase stability, crystal imperfections, solubility, oxidation, surface and interface energy and transformations.

**MATL 6200 MATERIALS CHARACTERIZATION (2)** LEC. 2. Principles of materials characterization including x-ray diffraction, optical and electron microscopy, and other advanced analytical methods for materials design.

**MATL 6201 MATERIALS CHARACTERIZATION LABORATORY (1)** LAB. 3. Coreq. MATL 6200. Laboratory on the use of x-ray diffraction, metallography, and optical/electron microscopy for materials characterization.

**MATL 6300 PHASE TRANSFORMATIONS IN MATERIAL PROCESSING (3)** LEC. 3. Departmental approval. Principles that govern phase transformations in materials systems and control of nucleation and growth, microstructure, and morphology.

**MATL 6400 PHYSICS OF SOLIDS (3)** LEC. 3. Departmental approval. The physics of solid-state materials, including the electronic, optical, and magnetic properties of materials.

**MATL 6420 PLASMONICS AND NANOPHOTONICS (3)** LEC. 3. This course will cover both fundamental and application aspects, with an emphasis on basic principles in nanophotonics, nanophotonic devices for light manipulation, plasmonic energy transfer, biomedical treatment, plasmonics in emerging materials, etc.

**MATL 6500 NUMERICAL SIMULATION OF MATERIALS PROCESSING (3)** LEC. 3. Departmental approval. Fundamental principles and applications of computer-aided simulation of transport phenomena in materials processing systems.

**MATL 6600 CORROSION (3)** LEC. 3. Pr. CHEM 1040. Fundamentals of chemical degradation of materials. Types and methods for prevention and minimization of corrosion.

**MATL 6700 BIOMATERIALS (3)** LEC. 3. Departmental approval. Interactions between materials and proteins, cells, and tissue as related to medicine and biotechnology including tissue culture, cardiovascular, drug delivery, tissue engineering and other applications. Thermodynamics of protein adsorption. Cell biology of adhesion. Analytical methods, sterilization and regulations.

**MATL 6720 BIOMEDICAL APPLICATIONS OF POLYMERIC MATERIALS (3)** LEC. 3. LAB. 13. Study of polymers used in the body for the purposes of aiding healing, correcting abnormalities, and restoring lost function.

**MATL 6970 INTERMEDIATE SPECIAL TOPICS IN MATERIALS ENGINEERING (1-3)** LEC. 3. Departmental approval. Regular course addressing an advanced specialized area of Materials Engineering not covered by regularly offered courses. Course may be repeated with change in topics.

**MATL 7050 DEFORMATION AND FAILURE OF ENGINEERING MATERIALS (3)** LEC. 3. Departmental approval. Theoretical presentation of the fundamental principles of deformation and failure in materials systems.

**MATL 7120 ADVANCED CERAMIC MATERIALS (3)** LEC. 3. Departmental approval. Processing, structure-property relationships and applications of advanced ceramics. Structural and functional applications of ceramics.

**MATL 7130 ADVANCED POLYMER SCIENCE AND TECHNOLOGY (3)** LEC. 3. Departmental approval. Recent developments in both functional and structural polymers including approaches to synthesis, processing techniques, high-strength materials, electronic polymers, optic polymers, and medical polymers.

**MATL 7320 THIN FILM SCIENCE AND TECHNOLOGY (3)** LEC. 3. Departmental approval. Structure, properties, characterization, processing and application of thin films.

**MATL 7330 MATERIALS FOR ENERGY STORAGE (3)** LEC. 3. Introduction of various electrochemical energy storage devices (Batteries, Supercapacitor, etc) and discussion of advancement in development of materials for these devices. Instructor's consent required for prerequisites.

**MATL 7420 SMART MATERIALS AND STRUCTURES (3)** LEC. 3. Departmental approval. An introduction to the principles and applications of various sensor, actuator and functionality smart material systems and structures.

**MATL 7430 DIELECTRIC MATERIALS AND DEVICES (3)** LEC. 3. Pr. (MATL 6100 or MATL 6106) and (MATL 6400 or MATL 6406). Departmental approval. Processing, structure, properties, and application of dielectrics, including physics of dielectrics, material/ device design/fabrication processes, and application of dielectric materials in high-technological industry.

**MATL 7610 ENGINEERING ASPECTS OF BIOLOGICAL AND CHEMICAL DETECTION (3)** LEC. 3. Departmental approval. Biological and chemical scientific concepts related to biological and chemical threat agents. Existing and developing detection technologies, trends and needs for the future detection systems. Physical principles behind the detection technologies. Evaluation of detection device or system performance.

**MATL 7630 NANOMATERIALS FOR BIOTECHNOLOGY (3)** LEC. 3. Departmental approval. Basic understanding of nanobiotechnology and practical applications in the interdisciplinary fields of Materials Science and Engineering and biotechnology/ medicine including nanostructured biomolecules and bioarrays as well as biomolecular nanoelectronics.

**MATL 7950 MATERIALS ENGINEERING SEMINAR (0)** SEM. SU. Required during each semester of residency, but cannot be used toward minimum requirements for graduate degree in Materials Engineering. Content changes each semester and consists of off-campus speakers and presentations by graduate students and faculty.

**MATL 7960 DIRECTED READINGS IN MATERIALS ENGINEERING (1-6)** DSL/IND. SU. Departmental approval. May be taken more than one semester. Up to 6 hours may count toward the minimum degree requirements. Course may be repeated with change in topics.

**MATL 7970 SPECIAL TOPICS IN MATERIALS ENGINEERING (1-3)** DSL. Departmental approval. Regular course addressing an advanced specialized area of Materials Engineering not covered by regularly offered courses. Course may be repeated with change in topics.

**MATL 7980 MASTER MATERIALS ENGINEERING PROJECT (1-3)** LEC. 3. SU. Special design project report directed by major faculty. Topics to be determined by the student's graduate committee. Course may be repeated for a maximum of 3 credit hours.

**MATL 7990 RESEARCH AND THESIS (1-15)** MST. Individual mater's thesis research. Course may be repeated with change in topics.

**MATL 8990 RESEARCH AND DISSERTATION (1-15)** DSL/DSR. Individual doctoral dissertation research. Course may be repeated with change in topics.