

## **Materials Science & Engineering**

### **MY 2000 - Introduction to Materials Processing**

Introduction to the science and technology of the production of primary and engineering materials. Topics include mineral processing, extractive metallurgy, casting, deformation processing, powder fabrication, thin film deposition, joining and machining. Demonstrations and laboratory exercises will be employed to highlight these processing techniques.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-2)

**Semesters Offered:** Spring

**Pre-Requisite(s):** ENG 1101 or ENG 1100

### **MY 2100 - Introduction to Materials Science and Engineering**

Introduction to the structure, processing, properties, and performance of engineering materials, including metals, polymers, glasses, ceramics, and composites. Presents case studies covering selection of materials, component design, and analysis of component failures.

**Credits:** 3.0

**Lec-Rec-Lab:** (3-0-0)

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** CH 1100 or CH 1110

### **MY 3100 - Materials Processing I**

Classical chemical thermodynamics as applied to single and multicomponent materials systems. Topics include heat and mass balance, enthalpy, entropy, free energy, chemical reactions and equilibria, mass action, solution thermodynamics, phase diagram, stability/Pourbaix diagrams and electrochemistry.

**Credits:** 4.0

**Lec-Rec-Lab:** (4-0-0)

**Semesters Offered:** Fall

**Pre-Requisite(s):** MY 2100

### **MY 3110 - Materials Processing II**

A continuation of Materials Processing I, which introduces the fundamental theories and equations governing transport phenomena. Topics include fluid flow, heat flow, diffusion, and chemical kinetics. Discusses the relationships between these subjects and the thermodynamic concepts covered in Materials Processing I.

**Credits:** 4.0

**Lec-Rec-Lab:** (4-0-0)

**Semesters Offered:** Spring

**Pre-Requisite(s):** MY 3100

**MY 3200 - Materials Characterization I**

Fundamentals of microstructural and chemical characterization of materials. Examines the physical principles controlling the various basic characterization techniques. Topics include crystallography, optics, optical and electron microscopy, diffraction and spectroscopy. Laboratory focuses on proper operational principles of characterization equipment, which includes optical and other microscopy methods and various diffraction techniques.

**Credits:** 4.0

**Lec-Rec-Lab:** (2-1-3)

**Semesters Offered:** Fall

**Pre-Requisite(s):** MY 2100

**MY 3210 - Materials Characterization II**

Fundamentals of structural characterization. A continuation of Materials Characterization I which examines additional structural techniques such as thermal analysis, calorimetry, and particulate analysis, scanning tunneling and atomic force microscopy. Discusses the limitations/capabilities of basic characterization techniques as well as data analysis methods and practices.

**Credits:** 4.0

**Lec-Rec-Lab:** (2-1-3)

**Semesters Offered:** Spring

**Pre-Requisite(s):** MY 3200

**MY 3300 - Design of Microstructure**

Relates thermodynamic and kinetic principles to phase transformations and microstructural evolution. Topics include nucleation, solidification, precipitation, recrystallization, grain growth, and sintering. Applications of these concepts (e.g., heat treatment of steel, casting, powder processing, etc.) are presented and reinforced by laboratory exercises in the corequisite course Materials Characterization II.

**Credits:** 3.0

**Lec-Rec-Lab:** (3-0-0)

**Semesters Offered:** Spring

**Pre-Requisite(s):** MY 3100 and MY 3200

**MY 3400 - Mechanical Properties of Materials**

An introduction to the deformation and fracture behavior of metals, ceramics, polymers, and composites. Topics include yielding criterion, plastic deformation, strain hardening, strengthening mechanisms, viscoelasticity, fatigue, fracture, and microstructure/mechanical property relationships.

**Credits:** 3.0

**Lec-Rec-Lab:** (3-0-0)

**Semesters Offered:** Spring

**Pre-Requisite(s):** MY 2100 and (MEEM 2150 or ENG 2120)

**MY 3700 - Electronic, Optical, and Magnetic Properties of Materials**

Provides background needed to understand how electrons and electromagnetic waves interact with materials. Topics include waves, bonding, phonons, bands, the basics of semiconducting, metallic, dielectric, optical, and magnetic material properties, and how elementary devices made from these materials operate.

**Credits:** 4.0

**Lec-Rec-Lab:** (3-1-0)

**Semesters Offered:** Fall

**Pre-Requisite(s):** (PH 2200 or PH 2260) and MA 3160 and (MA 3520 or MA 3530) or (MA 2321 and MA 3521)

**MY 4130 - Principles of Metal Casting**

Principles of metal casting, including melting practice, casting design, mold design, heat transfer and solidification, fluid flow and gating design. Introduction to computer simulation techniques for mold filling, solidification, and development of residual stress. Structure-property relations in cast metals. Recycling and environmental issues of the cast metals industry.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-0-3)

**Semesters Offered:** Fall

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore

**Pre-Requisite(s):** MY 2100

**MY 4140 - Science of Ceramic Materials**

The structure, defect chemistry, and properties of crystalline and amorphous ceramics. Utilization of these materials in a variety of applications such as electrolytes in fuel cells and as bioceramics are examined.

**Credits:** 3.0

**Lec-Rec-Lab:** (3-0-0)

**Semesters Offered:** Spring

**Pre-Requisite(s):** MY 2100

**MY 4150 - Composite Materials**

Structure, processing and properties of composite materials based on combinations of metals, ceramics, and polymers.

**Credits:** 2.0

**Lec-Rec-Lab:** (2-0-0)

**Semesters Offered:** On Demand

**Pre-Requisite(s):** MY 2100

**MY 4165 - Corrosion and Environmental Effects**

Mechanisms of corrosion processes, electrochemical and oxidation kinetics, and fundamentals of corrosion engineering.

**Credits:** 3.0

**Lec-Rec-Lab:** (3-0-0)

**Semesters Offered:** Spring - Offered alternate years beginning with the 2007-2008 academic year

**Pre-Requisite(s):** MY 2100

**MY 4180 - Science and Engineering of Structural Metals**

Examines what exactly makes a particular industrial alloy useful. From the light metals (aluminum, magnesium and titanium) to the heavy weights (nickel and high alloy steels), this course examines the structure, properties, and processing of metals into industrially useful materials. Covers internationally accepted alloy designations, heat treatment standards, modification and processing.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-1-0)

**Semesters Offered:** On Demand

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**Pre-Requisite(s):** MY 2100 and MY 3300

**MY 4190 - Environmental Engineering for Materials Processing Industries**

Assessment and analysis of environmental impacts from materials processing industries. Regulations, permits, and industrial practices for monitoring and solving air, water, and solid environmental issues. Pollution prevention. Life cycle analysis. Material flow analysis.

**Credits:** 3.0

**Lec-Rec-Lab:** (3-0-0)

**Semesters Offered:** Fall

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore

**MY 4200 - Introduction to Scanning Electron Microscopy**

Practical training on the operation and image formation in a scanning electron microscope (SEM). Applications of the SEM to the analysis of metallic, ceramic, geological and biological materials are discussed, including qualitative chemical analysis using energy dispersive spectroscopy.

**Credits:** 2.0

**Lec-Rec-Lab:** (1-0-3)

**Semesters Offered:** Fall

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore

**MY 4240 - Introduction to MEMS**

Fundamentals of micromachining and microfabrication techniques, including planar thin-film process technologies, photolithographic techniques, deposition and etching techniques, and the other technologies that are central to MEMS fabrication.

**Credits:** 4.0

**Lec-Rec-Lab:** (3-1-0)

**Semesters Offered:** Fall

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**MY 4240D - Introduction to MEMS**

Fundamentals of micromachining and microfabrication techniques, including planar thin-film process technologies, photolithographic techniques, deposition and etching techniques, and the other technologies that are central to MEMS fabrication.

**Credits:** 4.0

**Lec-Rec-Lab:** (3-1-0)

**Semesters Offered:** Fall

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**MY 4410 - Metal Forming**

Introduction to metal forming, including rolling, forging, extrusion, drawing, stamping, and sheet metal forming. Covers practical aspects of manufacturing processes, as well as continuum-mechanical and finite element modeling of deformation during working, and metallurgical aspects of forming processes and resulting products.

**Credits:** 2.0

**Lec-Rec-Lab:** (2-0-0)

**Semesters Offered:** On Demand

**Pre-Requisite(s):** MY 3400 or MEEM 2150

**MY 4600 - Introduction to Polymer Engineering**

Basics in polymer science including molecular characteristics, synthesis, structure and properties of polymers. Various processing techniques and mechanical/ structural applications of polymers.

**Credits:** 3.0

**Lec-Rec-Lab:** (3-0-0)

**Semesters Offered:** On Demand

**Pre-Requisite(s):** MY 2100

**MY 4710 - Photonic and Micromechanical Materials and Devices**

The use of materials science and engineering principles in the design and processing of electronic materials and devices. Topics include operating principles of solid-state electronic devices, electronic materials structure-processing-properties relationships, and materials issues in electronic device fabrication and performance.

**Credits:** 3.0

**Lec-Rec-Lab:** (3-0-0)

**Semesters Offered:** Spring

**MY 4740 - Hydrometallurgy/Pyrometallurgy**

Extracting metal from ores by aqueous chemical techniques. The unit processes and unit operations in the dissolution, solubility, aqueous chemistry, concentrating and purifying metal-bearing solutions, and recovery of metals by precipitation and electrolytic processing will be discussed.

**Credits:** 4.0

**Lec-Rec-Lab:** (4-0-0)

**Semesters Offered:** Spring - Offered alternate years beginning with the 2007-2008 academic year

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore

**Pre-Requisite(s):** CH 1120

**MY 4800 - Material and Process Selection in Design**

The principles of materials selection for engineering design. Topics include selection based on strength, stiffness, thermal properties, high temperature behavior, corrosion resistance, formability, joinability, manufacturability, recyclability, etc. Considers ethics and economics. Presents numerous case studies and examples.

**Credits:** 3.0

**Lec-Rec-Lab:** (3-0-0)

**Semesters Offered:** Spring

**Pre-Requisite(s):** MY 2100

**MY 4900 - Materials Science and Engineering Professional Development**

Engineering ethics, professional registration, industrial safety and hygiene, intellectual property, professional development and communication skills in the context of Capstone Senior Design and professional employment.

**Credits:** 1.0

**Lec-Rec-Lab:** (0-1-0)

**Semesters Offered:** Fall

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**Pre-Requisite(s):** MY 3110 and MY 3210 and MY 3300 and MY 3400

**MY 4901 - Materials Science and Engineering Senior Design Project I**

Conducted in teams of students working with an industrial partner. Open to all engineering majors interested in interdisciplinary senior design projects. Non-MSE majors must be senior project ready as defined by their major program and obtain permission of the MSE department.

**Credits:** 2.0

**Lec-Rec-Lab:** (0-0-6)

**Semesters Offered:** Fall

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**Co-Requisite(s):** MY 4900

**Pre-Requisite(s):** MY 2100 and MY 3110 and MY 3210 and MY 3300 and MY 3400

**MY 4910 - Materials Science and Engineering Senior Design Project II**

Capstone senior design project, conducted in teams of students working on a problem with an industrial partner. Open to all engineering majors interested in interdisciplinary projects. (Senior project ready as defined by major substitutes for prerequisites)

**Credits:** 3.0

**Lec-Rec-Lab:** (0-1-6)

**Semesters Offered:** Spring

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**Pre-Requisite(s):** MY 4901

**MY 4970 - Special Topics - Materials**

Special topics in materials science and engineering.

**Credits:** variable to 4.0; May be repeated

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of instructor required

**MY 4990 - Undergraduate Research**

Undergraduate research in materials science and engineering. Independent research conducted under the guidance of a faculty member.

**Credits:** variable to 6.0; May be repeated

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of instructor required

**Undergraduate Course Descriptions Effective Fall 2007**

[https://www.banweb.mtu.edu/pls/owa/stu\\_ctg\\_utils.p\\_online\\_all\\_courses\\_ug](https://www.banweb.mtu.edu/pls/owa/stu_ctg_utils.p_online_all_courses_ug)

For more information, contact

Office of Student Records and Registration

Michigan Technological University

1400 Townsend Drive

Houghton, Michigan 49931-1295

906/487-2319

Fax: 906/487-3343

Email: [stuosrr@mtu.edu](mailto:stuosrr@mtu.edu)