Materials Science and Engineering (MAT SCI)

Courses

Expand all course descriptions [+]Collapse all course descriptions [-]

**MAT SCI 24 Freshman Seminar 1 Unit**

Terms offered: Spring 2022, Spring 2020, Spring 2019

The Freshman Seminar Program has been designed to provide new students with the opportunity to explore an intellectual topic with a faculty member in a small seminar setting. Freshman seminars are offered in all campus departments, and topics vary from department to department and semester to semester. Enrollment limited to 20 freshmen.

Freshman Seminar: Read More [+]

**Hours & Format**

Fall and/or spring: 15 weeks - 1 hour of lecture per week

**Additional Details**

**Subject/Course Level: Materials Science and Engineering/Undergraduate**

**Grading/Final exam status:** Offered for pass/not pass grade only. Final Exam To be decided by the instructor when the class is offered.

Freshman Seminar: Read Less [-]

**MAT SCI 45 Properties of Materials 3 Units**

Terms offered: Fall 2022, Spring 2022, Fall 2021

Application of basic principles of physics and chemistry to the engineering properties of materials. Emphasis on establishing structure, property, processing, and performance interrelationships in metals, ceramics, and polymers. While core concepts are fully covered each semester, examples and contextualization in Fall editions focuses on metals, ceramics, and functional/electronic properties and in Spring editions on polymers and soft-materials.

Properties of Materials: Read More [+]

**Rules & Requirements**

**Prerequisites:** Students should have completed high school AP or honors chemistry and physics

**Hours & Format**

Fall and/or spring: 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level: Materials Science and Engineering/Undergraduate**

**Grading/Final exam status:** Letter grade. Final exam required.

Instructor: Chrzan

Properties of Materials: Read Less [-]

**MAT SCI 45L Properties of Materials Laboratory 1 Unit**

Terms offered: Fall 2022, Spring 2022, Fall 2021

This course presents laboratory applications of the basic principles introduced in the lecture-based course MSE45 – Properties of Materials.

Properties of Materials Laboratory: Read More [+]

**Rules & Requirements**

**Credit Restrictions:** Students will receive no credit for MSE 45L after taking E45L

**Hours & Format**

Fall and/or spring: 15 weeks - 3 hours of laboratory per week

**Additional Details**

**Subject/Course Level: Materials Science and Engineering/Undergraduate**

**Grading/Final exam status:** Letter grade. Final exam not required.

Instructors: Martin, Messersmith

Properties of Materials Laboratory: Read Less [-]

**MAT SCI 102 Bonding, Crystallography, and Crystal Defects 3 Units**

Terms offered: Fall 2022, Fall 2021, Fall 2020

Bonding in solids; classification of metals, semiconductors, and insulators; crystal systems; point, line, and planar defects in crystals; examples of crystallographic and defect analysis in engineering materials; relationship to physical and mechanical properties.

Bonding, Crystallography, and Crystal Defects: Read More [+]

**Rules & Requirements**

**Prerequisites:** MAT SCI 45

**Hours & Format**

Fall and/or spring: 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level: Materials Science and Engineering/Undergraduate**

**Grading/Final exam status:** Letter grade. Final exam required.

**Instructor:** Chrzan

Bonding, Crystallography, and Crystal Defects: Read Less [-]
MAT SCI 103 Phase Transformations and Kinetics 3 Units
Terms offered: Spring 2022, Spring 2021, Spring 2020
The nature, mechanisms, and kinetics of phase transformations and microstructural changes in the solid state. Atom diffusion in solids. Phase transformations through the nucleation and growth of new matrix or precipitate phases. Martensitic transformations, spinodal decomposition. The use of phase transformations to control microstructure.

Rules & Requirements
Prerequisites: MAT SCI 102 and ENGIN 40

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Materials Science and Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Materials Characterization: Read More [+]

MAT SCI 104 Materials Characterization 3 Units
Terms offered: Spring 2022, Spring 2021, Spring 2020
This 3-unit course will cover basic principles and techniques used for the characterization of engineering materials. The course is designed to introduce undergraduate students to the basic principles of structural, chemical and property characterization techniques. The course is grounded in modern x-ray diffraction and electron microscopy techniques for characterization of the chemical and structural properties of a material. The course introduces the fundamental theoretical framework for diffraction, spectrometry and imaging methods.

Rules & Requirements
Prerequisites: MAT SCI 102. A basic knowledge of structure, bonding and crystallography will be assumed

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Materials Science and Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Scott, Minor

Materials Characterization: Read Less [-]
**MAT SCI 104L Materials Characterization Laboratory 1 Unit**

Terms offered: Spring 2022, Spring 2021, Spring 2020

This 1-unit laboratory course covers X-ray diffraction (XRD), scanning electron microscopy (SEM), and transmission electron microscopy (TEM), as well as lab writeup protocols and academic integrity. Students will get hands-on experience using the XRD, SEM and TEM equipment to perform microstructural characterization of materials. Students will also design and run their own project on a topic of their choosing.

Materials Characterization Laboratory: Read More [+]

**Objectives & Outcomes**

- Course Objectives: Practical experience on the most common materials characterization equipment for structural and chemical analysis of materials. Introduction to laboratory procedures and independent projects.

**Rules & Requirements**

- Prerequisites: MAT SCI 102; and MAT SCI 104 must be taken concurrently. A basic knowledge of structure, bonding and crystallography will be assumed. Undergraduate student in engineering, physics or chemistry

**Hours & Format**

- Fall and/or spring: 15 weeks - 1.5 hours of laboratory and 1 hour of discussion per week

**Additional Details**

- Subject/Course Level: Materials Science and Engineering/Undergraduate
- Grading/Final exam status: Letter grade. Final exam not required.
- Instructors: Scott, Minor

Materials Characterization Laboratory: Read Less [-]

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**MAT SCI 111 Properties of Electronic Materials 4 Units**

Terms offered: Spring 2022, Spring 2021, Spring 2020

Introduction to the physical principles underlying the electric properties of modern solids with emphasis on semiconductors; control of defects and impurities through physical purification, bulk and thin film crystal growth and doping processes, materials basis of electronic and optoelectronic devices (diodes, transistors, semiconductor lasers) and optical fibers; properties of metal and oxide superconductors and their applications.

Properties of Electronic Materials: Read More [+]

**Rules & Requirements**

- Prerequisites: PHYSICS 7A, PHYSICS 7B, and PHYSICS 7C; or PHYSICS 7A, PHYSICS 7B and consent of instructor

**Hours & Format**

- Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

**Additional Details**

- Subject/Course Level: Materials Science and Engineering/Undergraduate
- Grading/Final exam status: Letter grade. Final exam required.
- Instructors: Dubon, Wu, Yao

Properties of Electronic Materials: Read Less [-]

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**MAT SCI 112 Corrosion (Chemical Properties) 3 Units**

Terms offered: Spring 2022, Spring 2021, Spring 2020


Corrosion (Chemical Properties): Read More [+]

**Rules & Requirements**

- Prerequisites: MAT SCI 45 and ENGIN 40

**Hours & Format**

- Fall and/or spring: 15 weeks - 3 hours of lecture per week

**Additional Details**

- Subject/Course Level: Materials Science and Engineering/Undergraduate
- Grading/Final exam status: Letter grade. Final exam required.
- Instructor: Devine

Corrosion (Chemical Properties): Read Less [-]
**MAT SCI 113 Mechanical Behavior of Engineering Materials 3 Units**

Terms offered: Fall 2022, Fall 2021, Fall 2020

This course covers elastic and plastic deformation under static/dynamic loads. Prediction/prevention of failure by yielding, fracture, fatigue, wear and environmental effects are addressed. Design issues of materials selection for load-bearing applications are discussed. Case studies of engineering failures are presented. Topics include engineering materials, structure-property relationships, mechanical behavior of metals, ceramics, polymers and composites, complex stress/strain states, stress concentrations, multiaxial loading, plasticity, yield criteria, dislocations, strengthening mechanisms, creep, fracture mechanics and fatigue.

**Rules & Requirements**

**Prerequisites:** CIV ENG C30/MEC ENG C85 and MAT SCI 45

**Credit Restrictions:** Students will receive no credit for 113 after taking C113 or Mechanical Engineering C124. Deficiency in C113 or Mechanical Engineering C124 maybe removed by taking 113.

**Hours & Format**

Fall and/or spring: 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Materials Science and Engineering/Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**Instructor:** Ritchie

**Properties of Dielectric and Magnetic Materials: Read Less [-]**

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**MAT SCI 117 Properties of Dielectric and Magnetic Materials 3 Units**

Terms offered: Spring 2021, Spring 2017, Spring 2011

Introduction to the physical principles underlying the dielectric and magnetic properties of solids. Processing-microstructure-property relationships of dielectric materials, including piezoelectric, pyroelectric, and ferroelectric oxides, and of magnetic materials, including hard- and soft ferromagnets, ferrites and magneto-optic and -resistive materials. The course also covers the properties of grain boundary devices (including varistors) as well as ion-conducting and mixed conducting materials for applications in various devices such as sensors, fuel cells, and electric batteries.

**Rules & Requirements**

**Prerequisites:** PHYSICS 7A, PHYSICS 7B, and PHYSICS 7C; or PHYSICS 7A, PHYSICS 7B, and consent of instructor. MAT SCI 111 is recommended

**Hours & Format**

Fall and/or spring: 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Materials Science and Engineering/Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**Instructor:** Ritchie

**Properties of Dielectric and Magnetic Materials: Read Less [-]**
MAT SCI C118 Biological Performance of Materials 4 Units
Terms offered: Fall 2022, Fall 2021, Fall 2020
This course is intended to give students the opportunity to expand their knowledge of topics related to biomedical materials selection and design. Structure-property relationships of biomedical materials and their interaction with biological systems will be addressed. Applications of the concepts developed include blood-materials compatibility, biomimetic materials, hard and soft tissue-materials interactions, drug delivery, tissue engineering, and biotechnology.
Biological Performance of Materials: Read More [+]

Objectives & Outcomes
Course Objectives: The course is separated into four parts spanning the principles of synthetic materials and surfaces, principles of biological materials, biological performance of materials and devices, and state-of-the-art materials design. Students are required to attend class and master the material therein. In addition, readings from the clinical, life and materials science literature are assigned. Students are encouraged to seek out additional reference material to complement the readings assigned. A mid-term examination is given on basic principles (parts 1 and 2 of the outline). A comprehensive final examination is given as well. The purpose of this course is to introduce students to problems associated with the selection and function of biomaterials. Through class lectures and readings in both the physical and life science literature, students will gain broad knowledge of the criteria used to select biomaterials, especially in devices where the material-tissue or material-solution interface dominates performance. Materials used in devices for medicine, dentistry, tissue engineering, drug delivery, and the biotechnology industry will be addressed.

Student Learning Outcomes:
- Apply math, science & engineering principles to the understanding of soft materials, surface chemistry, DLVO theory, protein adsorption kinetics, viscoelasticity, mass diffusion, and molecular (i.e., drug) delivery kinetics.
- Design experiments and analyze data from the literature in the context of the class design project.
- Apply core concepts in materials science to solve engineering problems related to the selection biomaterials, especially in devices where the material-tissue or material-solution interface dominates performance.
- Develop an understanding of the social, safety and medical consequences of biomaterial use and regulatory issues associated with the selection of biomaterials in the context of the silicone breast implant controversy and subsequent biomaterials crisis.
- Work independently and function on a team, and develop solid communication skills (oral, graphic & written) through the class design project.
- Understanding of the origin of surface forces and interfacial free energy, and how they contribute to the development of the biomaterial interface and ultimately biomaterial performance.

Rules & Requirements
Prerequisites: MAT SCI 45 and BIO ENG 103 are required.
BIO ENG 102 and BIO ENG 104 are strongly recommended.
**MAT SCI 122 Ceramic Processing 3 Units**

Terms offered: Fall 2012, Fall 2011, Fall 2010

Powder fabrication by grinding and chemical methods, rheological behavior of powder-fluid suspensions, forming methods, drying, sintering, and grain growth. Relation of processing steps to microstructure development.

Ceramic Processing: Read More [+]

**Rules & Requirements**

**Prerequisites:** MAT SCI 45 and ENGIN 40

**Hours & Format**

Fall and/or spring: 15 weeks - 3 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Materials Science and Engineering/Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

Ceramic Processing: Read Less [-]

**MAT SCI 123 ELECTRONIC MATERIALS PROCESSING 4 Units**

Terms offered: Spring 2022, Spring 2021, Spring 2020

This 4-unit course starts with a brief review of the fundamentals of solid-state physics including bands and defects in semiconductors and oxides, and then moves to bulk semiconductor crystals growth and processing including doping, diffusion and implantation, and then to thin film deposition and processing methods, and finishes with a discussion of materials analysis and characterization. Recent advances in nanomaterials research will also be introduced.

ELECTRONIC MATERIALS PROCESSING: Read More [+]

**Objectives & Outcomes**

**Course Objectives:**
To prepare students a) for work in semiconductor processing facilities and b) for graduate studies related to thin film processing and relevant materials science topics.
To present the relevant materials science issues in semiconductor and oxide processing.
To provide an introduction into the principles of thin film processing and related technologies.

**Student Learning Outcomes:**
Basic knowledge of gas kinetics and vacuum technology, including ideal gas, gas transport theory, definition, creation and measurement of vacuum.
Knowledge of electrical and optical properties of thin films.
Knowledge of the formation of p-n junction to explain the diode operation and its I-V characteristics. Understanding of the mechanisms of Hall Effect, transport, and C-V measurements, so that can calculate carrier concentration, mobility and conductivity given raw experimental data.
The ability to describe major growth techniques of bulk, thin film, and nanostructured semiconductors, with particular emphasis on thin film deposition technologies, including evaporation, sputtering, chemical vapor deposition and epitaxial growths.
To have basic knowledge of doping, purification, oxidation, gettering, diffusion, implantation, metallization, lithography and etching in semiconductor processing.
To have basic knowledge of electronic material characterization methods: x-ray diffraction, SEM and TEM, EDX, Auger, STM and AFM, Rutherford Back Scattering and SIMS, as well as optical methods including photoluminescence, absorption and Raman scattering.
To understand the concepts of bands, bandgap, to distinguish direct and indirect bandgap semiconductors. Understanding of free electron and hole doping of semiconductors to determine Fermi level position.
To understand the effect of defects in semiconductors, so that can describe their electronic and optical behaviors, and the methods to eliminate and control them in semiconductors.

**Rules & Requirements**

**Prerequisites:** MAT SCI 111, PHYSICS 7C, or consent of instructor

**Hours & Format**

Fall and/or spring: 15 weeks - 4 hours of lecture per week

**Additional Details**

**Subject/Course Level:** Materials Science and Engineering/Undergraduate

**Grading/Final exam status:** Letter grade. Final exam required.

**Instructors:** Wu, Yao

ELECTRONIC MATERIALS PROCESSING: Read Less [-]
MAT SCI 125 Thin-Film Materials Science 3 Units
Terms offered: Fall 2022, Fall 2021, Fall 2020
Thin-Film Materials Science: Read More [+]

Rules & Requirements
Prerequisites: Upper division or graduate standing in Engineering, Physics, Chemistry, or Chemical Engineering; and MAT SCI 45. PHYSICS 111A or PHYSICS 141A recommended

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Materials Science and Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Dubon

Thin-Film Materials Science: Read Less [-]

MAT SCI 129 Experimental Materials Science of Thin Films and Coatings 3 Units
Terms offered: Spring 2022
This course covers the fundamental experimental materials science and processing of thin film and coatings that incorporates fundamental knowledge of materials transport, accumulation, defects and epitaxy. Through this course, an understanding of the fundamental physical and chemical processes which are involved in crystal growth and thin film fabrication will be gained. Important synthesis and processing techniques used for the fabrication of electronic and photonic devices will be discussed. Finally, it will provide an understanding of how material characteristics are influenced by processing and deposition conditions. This course addresses current challenges and future needs of the semiconductor and coating industries.
Experimental Materials Science of Thin Films and Coatings: Read More [+]

Objectives & Outcomes
Student Learning Outcomes:
The development of proper protocols for data collection, analysis, and dissemination.
To apply this knowledge to scholarly report writing and the hypothesis driven insights and conclusions.
To familiarize students with some of the important experimental methods growth of materials.
To gain an understanding of how material characteristics are influenced by processing and deposition conditions of thin films and coatings.
To gain an understanding of the fundamental physical and chemical processes which are involved in crystal growth and thin film fabrication.

Rules & Requirements
Prerequisites: MAT SCI 45, MAT SCI 104, and MAT SCI 125; or consent of instructor

Hours & Format
Fall and/or spring: 15 weeks - 2 hours of lecture and 3 hours of laboratory per week

Additional Details
Subject/Course Level: Materials Science and Engineering/Undergraduate
Grading/Final exam status: Letter grade. Alternative to final exam.
Instructor: Al Balushi

Experimental Materials Science of Thin Films and Coatings: Read Less [-]
### MAT SCI 130 Experimental Materials Science and Design 3 Units

**Terms offered:** Fall 2022, Fall 2021, Fall 2020  
This course provides a culminating experience for students approaching completion of the materials science and engineering curriculum. Laboratory experiments are undertaken in a variety of areas from the investigations on semiconductor materials to corrosion science and elucidate the relationships among structure, processing, properties, and performance. The principles of materials selection in engineering design are reviewed.  
Experimental Materials Science and Design: Read More [+]

#### Rules & Requirements

**Prerequisites:** Senior standing or consent of instructor  
**Hours & Format**  
**Fall and/or spring:** 15 weeks - 2 hours of lecture and 3 hours of laboratory per week  
**Additional Details**  
**Subject/Course Level:** Materials Science and Engineering/Undergraduate  
**Grading/Final exam status:** Letter grade. Final exam required.

### MAT SCI 136 Materials in Energy Technologies 4 Units

**Terms offered:** Fall 2021, Fall 2019, Fall 2017  
In many, if not all, technologies, it is materials that play a crucial, enabling role. This course examines potentially sustainable technologies, and the materials properties that enable them. The science at the basis of selected energy technologies are examined and considered in case studies.  
Materials in Energy Technologies: Read More [+]

#### Rules & Requirements

**Prerequisites:** Junior or above standing in Materials Science and Engineering or related field  
**Hours & Format**  
**Fall and/or spring:** 15 weeks - 3 hours of lecture and 1 hour of discussion per week  
**Additional Details**  
**Subject/Course Level:** Materials Science and Engineering/Undergraduate  
**Grading/Final exam status:** Letter grade. Final exam required.  
**Formerly known as:** Materials Science and Engineering 126  
Materials in Energy Technologies: Read Less [-]

### MAT SCI 140 Nanomaterials for Scientists and Engineers 3 Units

**Terms offered:** Spring 2022, Spring 2020, Spring 2015  
This course introduces the fundamental principles needed to understand the behavior of materials at the nanometer length scale and the different classes of nanomaterials with applications ranging from information technology to biotechnology. Topics include introduction to different classes of nanomaterials, synthesis and characterization of nanomaterials, and the electronic, magnetic, optical, and mechanical properties of nanomaterials.  
Nanomaterials for Scientists and Engineers: Read More [+]

#### Rules & Requirements

**Prerequisites:** PHYSICS 7C and MAT SCI 45. MAT SCI 102 recommended  
**Hours & Format**  
**Fall and/or spring:** 15 weeks - 3 hours of lecture per week  
**Additional Details**  
**Subject/Course Level:** Materials Science and Engineering/Undergraduate  
**Grading/Final exam status:** Letter grade. Final exam required.  
**Instructor:** Zheng  
Nanomaterials for Scientists and Engineers: Read Less [-]

### MAT SCI C150 Introduction to Materials Chemistry 3 Units

**Terms offered:** Fall 2022, Fall 2021, Spring 2021, Spring 2020  
The application of basic chemical principles to problems in materials discovery, design, and characterization will be discussed. Topics covered will include inorganic solids, nanoscale materials, polymers, and biological materials, with specific focus on the ways in which atomic-level interactions dictate the bulk properties of matter.  
Introduction to Materials Chemistry: Read More [+]

#### Rules & Requirements

**Prerequisites:** CHEM 104A. CHEM 104B recommended  
**Hours & Format**  
**Fall and/or spring:** 15 weeks - 3 hours of lecture per week  
**Additional Details**  
**Subject/Course Level:** Materials Science and Engineering/Undergraduate  
**Grading/Final exam status:** Letter grade. Final exam required.  
**Also listed as:** CHEM C150  
Introduction to Materials Chemistry: Read Less [-]
MAT SCI 151 Polymeric Materials 3 Units
Terms offered: Spring 2022, Spring 2021, Spring 2020
This course is designed for upper division undergraduate and graduate students to gain a fundamental understanding of the science of polymeric materials. Beginning with a treatment of ideal polymeric chain conformations, it develops the thermodynamics of polymer blends and solutions, the modeling of polymer networks and gelations, the dynamics of polymer chains, and the morphologies of thin films and other dimensionally-restricted structures relevant to nanotechnology.

Polymeric Materials: Read More [+]

Rules & Requirements

Prerequisites: CHEM 1A or MAT SCI 45. MAT SCI 103 is recommended

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Materials Science and Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Xu

Polymeric Materials: Read Less [-]

MAT SCI C157 Nanomaterials in Medicine 3 Units
Terms offered: Fall 2022, Fall 2021, Fall 2020
Nanomedicine is an emerging field involving the use of nanoscale materials for therapeutic and diagnostic purposes. Nanomedicine is a highly interdisciplinary field involving chemistry, materials science, biology and medicine, and has the potential to make major impacts on healthcare in the future. This upper division course is designed for students interested in learning about current developments and future trends in nanomedicine. The overall objective of the course is to introduce major aspects of nanomedicine including the selection, design and testing of suitable nanomaterials, and key determinants of therapeutic and diagnostic efficacy. Organic, inorganic and hybrid nanomaterials will be discussed in this course.

Nanomaterials in Medicine: Read More [+]

Objectives & Outcomes

Course Objectives:
To identify an existing or unmet clinical need and identify a nanomedicine that can provide a solution
To learn about chemical approaches used in nanomaterial synthesis and surface modification.
To learn how to read and critique the academic literature.
To understand the interaction of nanomaterials with proteins, cells, and biological systems.

Rules & Requirements

Prerequisites: MAT SCI 45 or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Materials Science and Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Messersmith

Also listed as: BIO ENG C157

Nanomaterials in Medicine: Read Less [-]
MAT SCI 159 Introduction to Soft Matter 3 Units
Terms offered: Fall 2022
Soft matter is ubiquitous in synthetic materials and plays a central role in living systems. This course aims to provide students with an introduction to the physics that govern the structure and dynamics of soft matter systems, including polymers, colloids, surfactants, membranes, and active matter. A particular emphasis will be placed on connecting a microscopic physical picture to the emergent phenomena and properties of interest using scaling theory and statistical mechanics.
Specific topics will include Brownian motion and colloidal dynamics, the depletion force, polymer chain conformation, rubber elasticity; and surfactant and liquid crystal thermodynamics.
Introduction to Soft Matter: Read More [+]

Rules & Requirements

Prerequisites: ENGIN 40, MAT SCI 103 or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Materials Science and Engineering/Undergraduate

Grading/Final exam status: Letter grade. Alternate method of final assessment during regularly scheduled final exam group (e.g., presentation, final project, etc.).

Instructor: Omar

Introduction to Soft Matter: Read Less [-]

MAT SCI H194 Honors Undergraduate Research 1 - 4 Units
Terms offered: Fall 2016, Spring 2016, Fall 2015
Students who have completed a satisfactory number of advanced courses with a grade-point average of 3.3 or higher may pursue original research under the direction of one of the members of the staff. A maximum of 3 units of H194 may be used to fulfill technical elective requirements in the Materials Science and Engineering program or double majors (unlike 198 or 199, which do not satisfy technical elective requirements). Final report required.
Honors Undergraduate Research: Read More [+]

Rules & Requirements

Prerequisites: Upper division technical GPA of 3.3 or higher and consent of instructor and adviser

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of independent study per week
Summer: 8 weeks - 1.5-7.5 hours of independent study per week

Additional Details

Subject/Course Level: Materials Science and Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

Honors Undergraduate Research: Read Less [-]

MAT SCI 195 Special Topics for Advanced Undergraduates 1 Unit
Terms offered: Spring 2012, Spring 2011, Spring 2010
Group study of special topics in materials science and engineering. Selection of topics for further study of underlying concepts and relevant literature, in consultation with appropriate faculty members.
Special Topics for Advanced Undergraduates: Read More [+]

Rules & Requirements

Prerequisites: Upper division standing and good academic standing. (2.0 gpa and above)

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of directed group study per week

Additional Details

Subject/Course Level: Materials Science and Engineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Special Topics for Advanced Undergraduates: Read Less [-]
MAT SCI 198 Directed Group Studies for Advanced Undergraduates 1 - 4 Units
Terms offered: Spring 2019, Fall 2018, Spring 2016
Group studies of selected topics.
Directed Group Studies for Advanced Undergraduates: Read More [+]

Rules & Requirements

Prerequisites: Upper division standing in Engineering

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of directed group study per week

Additional Details

Subject/Course Level: Materials Science and Engineering/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Directed Group Studies for Advanced Undergraduates: Read Less [-]

MAT SCI 199 Supervised Independent Study 1 - 4 Units
Terms offered: Fall 2022, Spring 2022, Fall 2021
Supervised independent study. Enrollment restrictions apply; see the Introduction to Courses and Curricula section of this catalog.
Supervised Independent Study: Read More [+]

Rules & Requirements

Prerequisites: Consent of instructor and major adviser

Credit Restrictions: Course may be repeated for a maximum of four units per semester.
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of independent study per week

Summer:
6 weeks - 1-5 hours of independent study per week
8 weeks - 1-4 hours of independent study per week

Additional Details

Subject/Course Level: Materials Science and Engineering/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Supervised Independent Study: Read Less [-]

MAT SCI 200A Survey of Materials Science 4 Units
Terms offered: Fall 2022, Fall 2021, Fall 2020
A survey of Materials Science at the beginning graduate level, intended for those who did not major in the field as undergraduates. Focus on the nature of microstructure and its manipulation and control to determine engineering properties. Reviews bonding, structure and microstructure, the chemical, electromagnetic and mechanical properties of materials, and introduces the student to microstructural engineering.
Survey of Materials Science: Read More [+]

Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 4 hours of lecture per week

Additional Details

Subject/Course Level: Materials Science and Engineering/Graduate

Grading: Letter grade.

Survey of Materials Science: Read Less [-]

MAT SCI 201A Thermodynamics and Phase Transformations in Solids 4 Units
Terms offered: Fall 2022, Fall 2021, Fall 2020
Thermodynamics and Phase Transformations in Solids: Read More [+]

Rules & Requirements

Prerequisites: MAT SCI 102, MAT SCI 103, ENGIN 40, or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Materials Science and Engineering/Graduate

Grading: Letter grade.

Instructor: Ceder

Thermodynamics and Phase Transformations in Solids: Read Less [-]
MAT SCI 201B Thermodynamics, Phase Behavior and Transport Phenomena in Materials 4 Units
Terms offered: Fall 2021, Fall 2008, Spring 2002
This course will cover the laws of classical thermodynamics, principles of statistical mechanics, and laws governing the transport of mass and momentum in materials. Applications will include the construction of equilibrium and nonequilibrium phase diagrams and the kinetics of phase transformations in both soft and hard materials. Thermodynamics, Phase Behavior and Transport Phenomena in Materials: Read More [+]

Rules & Requirements
Prerequisites: 102, 103, Engineering 115 or consent of instructor. 201A is a prerequisite to 201B

Hours & Format
Fall and/or spring: 15 weeks - 4 hours of lecture per week

Additional Details
Subject/Course Level: Materials Science and Engineering/Graduate
Grading: Letter grade.
Instructor: Omar

Thermodynamics, Phase Behavior and Transport Phenomena in Materials: Read Less [-]

MAT SCI 202 Crystal Structure and Bonding 3 Units
Terms offered: Spring 2022, Spring 2020, Spring 2018
Regular, irregular arrays of points, spheres; lattices, direct, reciprocal; crystallographic point and space groups; atomic structure; bonding in molecules; bonding in solids; ionic (Pauling rules), covalent, metallic bonding; structure of elements, compounds, minerals, polymers. Crystal Structure and Bonding: Read More [+]

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Materials Science and Engineering/Graduate
Grading: Letter grade.
Instructor: Chrzan

Crystal Structure and Bonding: Read Less [-]

MAT SCI 204 Materials Characterization 3 Units
Terms offered: Spring 2022, Spring 2021, Spring 2020
This 3-unit course will cover basic principles and techniques used for the characterization of engineering materials. The course is designed to introduce graduate students to the basic principles of structural, chemical and property characterization techniques. The course is grounded in modern x-ray diffraction and electron microscopy techniques for characterization of the chemical and structural properties of a material. The course introduces the fundamental theoretical framework for diffraction, spectrometry and imaging methods. Materials Characterization: Read More [+]

Objectives & Outcomes
Course Objectives: Materials characterization lies at the heart of understanding the property-structure-processing relationships of materials. The goal of the course is to prepare graduate students from materials science to understand the basic principles behind material characterization tools and techniques. More specifically, this class will provide students (1) a thorough introduction to the principles and practice of diffraction, (2) introductory exposure to a range of common characterization methods for the determination of structure and composition of solids.

Student Learning Outcomes: A successful student will learn (1) the theory of x-ray and electron diffraction, (2) basic elements of electron microscopy, (3) basic aspects of spectroscopy.

Rules & Requirements
Prerequisites: MAT SCI 102 - a basic knowledge of structure, bonding and crystallography will be assumed

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Materials Science and Engineering/Graduate
Grading: Letter grade.
Instructors: Scott, Minor

Materials Characterization: Read Less [-]
MAT SCI 204D Materials Characterization 1 Unit
Terms offered: Spring 2022, Spring 2021, Spring 2020
This 1-unit course will introduce specialized techniques used for the characterization of engineering materials beyond routine x-ray diffraction and electron microscopy. The course is designed to complement a basic course in x-ray diffraction and electron microscopy by introducing graduate students to characterization methods such as ion beam analysis, magnetic measurements, synchrotron techniques, scanning probe techniques, neutron scattering, optical spectroscopy and dynamic characterization.

Materials Characterization: Read More [+]

Objectives & Outcomes
Course Objectives: Materials characterization lies at the heart of understanding the property-structure-processing relationships of materials. The goal of the course is to prepare graduate students from materials science and related disciplines to understand the basic principles behind ion beam analysis, magnetic measurements, synchrotron techniques, scanning probe techniques, neutron scattering, optical spectroscopy and dynamic characterization.

Rules & Requirements
Prerequisites: Graduate standing in engineering, physics or chemistry; MAT SCI 102; and concurrent enrollment in MAT SCI 204

Hours & Format
Fall and/or spring: 15 weeks - 1 hour of discussion per week

Additional Details
Subject/Course Level: Materials Science and Engineering/Graduate
Grading: Letter grade.
Instructors: Scott, Minor

MAT SCI 205 Defects in Solids 3 Units
Terms offered: Spring 2022, Spring 2020, Spring 2014
Many properties of solid state materials are determined by lattice defects. This course treats in detail the structure of crystal defects, defect formation and annihilation processes, and the influence of lattice defects on the physical and optical properties of crystalline materials. Defects in Solids: Read More [+]

Objectives & Outcomes
Defects in Solids: Read Less [-]

Rules & Requirements
Prerequisites: PHYSICS 7C or consent of instructor

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Materials Science and Engineering/Graduate
Grading: Letter grade.
Instructor: Ramesh

MAT SCI C208 Biological Performance of Materials 4 Units
Terms offered: Fall 2022, Fall 2021, Fall 2020
This course is intended to give students the opportunity to expand their knowledge of topics related to biomedical materials selection and design. Structure-property relationships of biomedical materials and their interaction with biological systems will be addressed. Applications of the concepts developed include blood-materials compatibility, biomimetic materials, hard and soft tissue-materials interactions, drug delivery, tissue engineering, and biotechnology.

Biological Performance of Materials: Read More [+]

Objectives & Outcomes
Course Objectives: The course is separated into four parts spanning the principles of synthetic materials and surfaces, principles of biological materials, biological performance of materials and devices, and state-of-the-art materials design. Students are required to attend class and master the material therein. In addition, readings from the clinical, life and materials science literature are assigned. Students are encouraged to seek out additional reference material to complement the readings assigned. A mid-term examination is given on basic principles (parts 1 and 2 of the outline). A comprehensive final examination is given as well. The purpose of this course is to introduce students to problems associated with the selection and function of biomaterials. Through class lectures and readings in both the physical and life science literature, students will gain broad knowledge of the criteria used to select biomaterials, especially in devices where the material-tissue or material-solution interface dominates performance. Materials used in devices for medicine, dentistry, tissue engineering, drug delivery, and the biotechnology industry will be addressed.

This course also has a significant design component (~35%). Students will form small teams (five or less) and undertake a semester-long design project related to the subject matter of the course. The project includes the preparation of a paper and a 20 minute oral presentation critically analyzing a current material-tissue or material-solution problem. Students will be expected to design improvements to materials and devices to overcome the problems identified in class with existing materials.

Student Learning Outcomes: Work independently and function on a team, and develop solid communication skills (oral, graphic & written) through the class design project.

- Develop an understanding of the social, safety and medical consequences of biomaterial use and regulatory issues associated with the selection of biomaterials in the context of the silicone breast implant controversy and subsequent biomaterials crisis.
- Design experiments and analyze data from the literature in the context of the class design project.
- Understanding of the origin of surface forces and interfacial free energy, and how they contribute to the development of the biomaterial interface and ultimately biomaterial performance.
- Apply math, science & engineering principles to the understanding of soft materials, surface chemistry, DLVO theory, protein adsorption kinetics, viscoelasticity, mass diffusion, and molecular (i.e., drug) delivery kinetics.
- Apply core concepts in materials science to solve engineering problems related to the selection biomaterials, especially in devices where the material-tissue or material-solution interface dominates performance.

Rules & Requirements
Prerequisites: MAT SCI 45; and CHEM C130 / MCFI U BL C100A or consent of instructor

Work independently and function on a team; and determine how to proceed to seek out additional reference material to complement the readings assigned. A comprehensive final examination is given as well.
MAT SCI C211 Mechanics of Solids 3 Units
Terms offered: Fall 2022, Fall 2021, Fall 2020
Mechanics of Solids: Read More [+]

Rules & Requirements
Prerequisites: Graduate standing or consent of instructor
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Materials Science and Engineering/Graduate
Grading: Letter grade.
Instructor: Govindjee
Also listed as: CIV ENG C231
Mechanics of Solids: Read Less [-]

MAT SCI C212 Deformation and Fracture of Engineering Materials 4 Units
Terms offered: Spring 2022, Spring 2021, Spring 2020
This course covers deformation and fracture behavior of engineering materials for both monotonic and cyclic loading conditions.
Deformation and Fracture of Engineering Materials: Read More [+]

Rules & Requirements
Prerequisites: Civil Engineering 130, Engineering 45
Hours & Format
Fall and/or spring: 15 weeks - 4 hours of lecture per week
Additional Details
Subject/Course Level: Materials Science and Engineering/Graduate
Grading: Letter grade.
Instructors: Ritchie, Pruitt, Komvopoulos
Formerly known as: Materials Science and Engineering C212, Mechanical Engineering C225
Also listed as: MEC ENG C225
Deformation and Fracture of Engineering Materials: Read Less [-]

MAT SCI C213 Environmental Effects on Materials Properties and Behavior 3 Units
Terms offered: Fall 2014, Fall 2013, Fall 2012
Review of electrochemical aspects of corrosion; pitting and crevice corrosion; active/passive transition; fracture mechanics approach to corrosion; stress corrosion cracking; hydrogen embrittlement; liquid metal embrittlement; corrosion fatigue; testing methods.
Environmental Effects on Materials Properties and Behavior: Read More [+]

Rules & Requirements
Prerequisites: MSE 112 or equivalent
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Materials Science and Engineering/Graduate
Grading: Letter grade.
Instructor: Devine
Environmental Effects on Materials Properties and Behavior: Read Less [-]

MAT SCI C214 Micromechanics 3 Units
Terms offered: Spring 2022, Spring 2018, Spring 2016
Basic theories, analytical techniques, and mathematical foundations of micromechanics. It includes 1. physical micromechanics, such as mathematical theory of dislocation, and cohesive fracture models; 2. micro-elasticity that includes Eshelby's eigenstrain theory, comparison variational principles, and micro-crack/micro-cavity based damage theory; 3. theoretical composite material that includes the main methodologies in evaluating overall material properties; 4. meso-plasticity that includes meso-damage theory, and the crystal plasticity; 5. homogenization theory for materials with periodic structures.
Micromechanics: Read More [+]

Rules & Requirements
Prerequisites: Consent of instructor
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Materials Science and Engineering/Graduate
Grading: Letter grade.
Instructors: Govindjee, Li
Formerly known as: Materials Science and Engineering C214, Mechanical Engineering C225
Also listed as: MEC ENG C225, MEC ENG C225
Micromechanics: Read Less [-]
MAT SCI 215 Computational Materials Science 3 Units
Terms offered: Fall 2021, Fall 2019, Spring 2019
Introduction to computational materials science. Development of atomic scale simulations for materials science applications. Application of kinetic Monte Carlo, molecular dynamics, and total energy techniques to the modeling of surface diffusion processes, elastic constants, ideal shear strengths, and defect properties. Introduction to simple numerical methods for solving coupled differential equations and for studying correlations.
Computational Materials Science: Read More [+]  
Rules & Requirements  
Prerequisites: Graduate standing in engineering or sciences, or consent of instructor  
Hours & Format  
Fall and/or spring: 15 weeks - 3 hours of lecture per week  
Additional Details  
Subject/Course Level: Materials Science and Engineering/Graduate  
Grading: Letter grade.  
Instructors: Chrzan, Asta, Ceder, Sherburne  
Computational Materials Science: Read Less [-]  

MAT SCI C216 Macromolecular Science in Biotechnology and Medicine 4 Units
Terms offered: Spring 2022, Spring 2021, Spring 2020, Spring 2019
Overview of the problems associated with the selection and function of polymers used in biotechnology and medicine. Principles of polymer science, polymer synthesis, and structure-property-performance relationships of polymers. Particular emphasis is placed on the performance of polymers in biological environments. Interactions between macromolecular and biological systems for therapy and diagnosis. Specific applications will include drug delivery, gene therapy, tissue engineering, and surface engineering.
Macromolecular Science in Biotechnology and Medicine: Read More [+]  
Rules & Requirements  
Prerequisites: BIO ENG 115. Open to seniors with consent of instructor  
Hours & Format  
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week  
Additional Details  
Subject/Course Level: Materials Science and Engineering/Graduate  
Grading: Letter grade.  
Instructor: Healy  
Also listed as: BIO ENG C216  
Macromolecular Science in Biotechnology and Medicine: Read Less [-]  

MAT SCI 217 Properties of Dielectric and Magnetic Materials 3 Units
Terms offered: Spring 2021, Fall 2020, Spring 2017
Introduction to the physical principles underlying the dielectric and magnetic properties of solids. Processing-microstructure-property relationships of dielectric materials, including piezoelectric, pyroelectric, and ferroelectric oxides, and of magnetic materials, including hard- and soft ferromagnets, ferrites and magneto-optic and -resistive materials. The course also covers the properties of grain boundary devices (including varistors) as well as ion-conducting and mixed conducting materials for applications in various devices such as sensors, fuel cells, and electric batteries.
Properties of Dielectric and Magnetic Materials: Read More [+]  
Rules & Requirements  
Prerequisites: PHYSICS 7A, PHYSICS 7B, and PHYSICS 7C; or PHYSICS 7A, PHYSICS 7B, and consent of instructor; MAT SCI 111 is recommended  
Hours & Format  
Fall and/or spring: 15 weeks - 3 hours of lecture per week  
Additional Details  
Subject/Course Level: Materials Science and Engineering/Graduate  
Grading: Letter grade.  
Instructor: Martin  
Properties of Dielectric and Magnetic Materials: Read Less [-]
**MAT SCI 218 Optical Materials and Devices 3 Units**

Terms offered: Fall 2021, Fall 2020, Fall 2019

This course provides an overview of the fundamental physics, processing and device applications of optical materials, including conventional and van der Waals semiconductors, plasmonic materials, metamaterials, etc. This course gives graduate students an introduction of the recent developments in the research fields of optical materials and nanophotonics. Topics covered include:

- Metamaterials: negative refraction, super-resolution imaging and optical invisibility.

Objectives & Outcomes

- **Course Objectives:** This course is designed to give graduate students an introduction of the recent developments in the research fields of optical materials and nanophotonics.

Rules & Requirements

- **Prerequisites:** Graduate standing in engineering, physics or chemistry

Hours & Format

- **Fall and/or spring:** 15 weeks - 3 hours of lecture per week

Additional Details

- **Subject/Course Level:** Materials Science and Engineering/Graduate
- **Grading:** Letter grade.
- **Instructor:** Yao

Optical Materials and Devices: Read More [+]

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**MAT SCI 223 Semiconductor Materials 3 Units**

Terms offered: Fall 2022, Fall 2021, Fall 2020


Semiconductor Materials: Read More [+]

Rules & Requirements

- **Prerequisites:** PHYSICS 7C or consent of instructor

Hours & Format

- **Fall and/or spring:** 15 weeks - 3 hours of lecture per week

Additional Details

- **Subject/Course Level:** Materials Science and Engineering/Graduate
- **Grading:** Letter grade.
- **Instructors:** Dubon, Wu

Semiconductor Materials: Read Less [-]

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**MAT SCI 224 Magnetism and Magnetic Materials 3 Units**

Terms offered: Fall 2018, Fall 2016, Fall 2014

This course covers the fundamentals of magnetism and magnetic materials in the first two-thirds of the class. Topics include magnetic moments in classical versus quantum mechanical pictures, diamagnetism, paramagnetism, crystal field environments, dipolar and exchange interactions, ferromagnetism, antiferromagnetism, magnetic domains, magnetic anisotropy, and magnetostriiction. Magnetic materials covered include transition metals, their alloys and oxides, rare earths and their oxides, organic and molecular magnets. Throughout the course, experimental techniques in magnetic characterization will be discussed. The second part of the course will focus on particular magnetic materials and devices that are of technological interest (e.g., magneto resistive and magneto-optical materials and devices). Additional topics include biomagnetism and spin glasses.

Magnetism and Magnetic Materials: Read More [+]

Rules & Requirements

- **Prerequisites:** 111 or equivalent or consent of instructor; 117 recommended

Hours & Format

- **Fall and/or spring:** 15 weeks - 3 hours of lecture per week

Additional Details

- **Subject/Course Level:** Materials Science and Engineering/Graduate
- **Grading:** Letter grade.

Magnetism and Magnetic Materials: Read Less [-]
MAT SCI C225 Thin-Film Science and Technology 3 Units
Terms offered: Fall 2022, Fall 2021, Spring 2020
Thin-Film Science and Technology: Read More [+]

Rules & Requirements

Prerequisites: Graduate standing in engineering, physics, chemistry, or chemical engineering

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Materials Science and Engineering/Graduate

Grading: Letter grade.

Instructors: Wu, Dubon

Also listed as: AST C225

Thin-Film Science and Technology: Read Less [-]

MAT SCI C226 Photovoltaic Materials; Modern Technologies in the Context of a Growing Renewable Energy Market 3 Units
Terms offered: Fall 2015, Spring 2013, Spring 2011
This technical course focuses on the fundamentals of photovoltaic energy conversion with respect to the physical principals of operation and design of efficient semiconductor solar cell devices. This course aims to equip students with the concepts and analytical skills necessary to assess the utility and viability of various modern photovoltaic technologies in the context of a growing global renewable energy market.
Photovoltaic Materials; Modern Technologies in the Context of a Growing Renewable Energy Market: Read More [+]

Rules & Requirements

Prerequisites: Material Science and Mineral Engineering 111 or 123 or equivalent. Should have a firm foundation in electronic and optical props of semiconductors and basic semiconductor device physics

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Materials Science and Engineering/Graduate

Grading: Letter grade.

Instructors: Gronsky, Minor

Also listed as: ENE,RES C226

Photovoltaic Materials; Modern Technologies in the Context of a Growing Renewable Energy Market: Read Less [-]

MAT SCI 241 Electron Microscopy Laboratory 4 Units
Terms offered: Spring 2022, Spring 2021, Fall 2020
This course covers the basic principles of techniques used in the characterization of engineering materials by electron microscopy, diffraction, and spectroscopy. In addition to lectures on the theory of electron diffraction and microscopy, there is a hands-on laboratory that offers detailed practical training in the operation of the transmission electron microscope (TEM) in all of its major functional diffraction and imaging modes.
Electron Microscopy Laboratory: Read More [+]

Rules & Requirements

Prerequisites: MAT SCI 104

Hours & Format
Fall and/or spring: 15 weeks - 4 hours of laboratory and 3 hours of lecture per week

Additional Details

Subject/Course Level: Materials Science and Engineering/Graduate

Grading: Letter grade.

Instructors: Gronsky, Minor

Electron Microscopy Laboratory: Read Less [-]

MAT SCI 242 Advanced Spectroscopy 3 Units
Terms offered: Spring 2021, Spring 2020, Spring 2019
Advanced structural and functional characterization of materials using spectroscopic methods. Techniques to be discussed include state of the art optical, x-ray and ion-beam spectroscopies used for characterization of advanced materials and devices.
Advanced Spectroscopy: Read More [+]

Rules & Requirements

Prerequisites: MAT SCI 204 or MAT SCI 205; or consent of instructor

Hours & Format
Fall and/or spring: 15 weeks - 2 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Materials Science and Engineering/Graduate

Grading: Letter grade.

Advanced Spectroscopy: Read Less [-]
MAT SCI C250 Nanomaterials in Medicine 3 Units
Terms offered: Fall 2022, Fall 2021, Fall 2020
The course is designed for graduate students interested in the emerging field of nanomedicine. The course will involve lectures, literature reviews and proposal writing. Students will be required to formulate a nanomedicine research project and write an NIH-style proposal during the course. The culmination of this project will involve a mock review panel in which students will serve as peer reviewers to read and evaluate the proposals.

Objectives & Outcomes
Course Objectives: To review the current literature regarding the use of nanomaterials in medical applications; (2) To describe approaches to nanomaterial synthesis and surface modification; (3) To understand the interaction of nanomaterials with proteins, cells and biological systems; (4) To familiarize students with proposal writing and scientific peer review.

Student Learning Outcomes: Students should be able to (1) identify the important properties of metal, polymer and ceramic nanomaterials used in healthcare; (2) understand the role of size, shape and surface chemistry of nanomaterials in influencing biological fate and performance; (3) understand common methods employed for surface modification of nanomaterials; (4) comprehend the range of cell-nanomaterial interactions and methods for assaying these interactions; (5) read and critically review the scientific literature relating to nanomedicine; (6) formulate and design an experimental nanomedicine research project; (7) understand the principles of the peer review system.

Rules & Requirements
Prerequisites: Graduate Standing

MAT SCI 251 Polymer Surfaces and Interfaces 3 Units
Terms offered: Spring 2022, Fall 2020, Fall 1999
The course is designed for graduate students to gain a fundamental understanding of the surface and interfacial science of polymeric materials. Beginning with a brief introduction of the principles governing polymer phase behavior in bulk, it develops the thermodynamics of polymers in thin films and at interfaces, the characterization techniques to assess polymer behavior in thin films and at interfaces, and the morphologies of polymer thin films and other dimensionally-restricted structures relevant to nanotechnology and biotechnology. Field trips to national user facilities, laboratory demonstrations and hands-on experiments, and guest lectures will augment the courses lectures.

Objectives & Outcomes
Prerequisites: Chemistry 1A or Engineering 5; Material Science and Engineering 151 recommended

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Materials Science and Engineering/Graduate
Grading: Letter grade.
Instructor: Xu

MAT SCI 260 Surface Properties of Materials 3 Units
Terms offered: Fall 2020, Spring 2019, Spring 2018
Thermodynamics of surfaces and phase boundaries, surface tension of solids and liquids, surface activity, adsorption, phase equilibria, and contact angles, electrochemical double layers at interfaces, theory, and applications.

Objectives & Outcomes
Prerequisites: Graduate Standing

Rules & Requirements
Prerequisites: Graduate Standing

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details
Subject/Course Level: Materials Science and Engineering/Graduate
Grading: Letter grade.
Instructor: Salmeron
Formerly known as: Mineral Engineering 260
MAT SCI C261 Introduction to Nano-Science and Engineering 3 Units
Terms offered: Spring 2015, Spring 2013, Spring 2012
A three-module introduction to the fundamental topics of Nano-Science and Engineering (NSE) theory and research within chemistry, physics, biology, and engineering. This course includes quantum and solid-state physics; chemical synthesis, growth fabrication, and characterization techniques; structures and properties of semiconductors, polymer, and biomedical materials on nanoscales; and devices based on nanostructures. Students must take this course to satisfy the NSE Designated Emphasis core requirement.
Introduction to Nano-Science and Engineering: Read More [+]
Rules & Requirements
Prerequisites: Major in physical science such as chemistry, physics, etc., or engineering; consent of advisor or instructor
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Materials Science and Engineering/Graduate
Grading: Letter grade.
Instructors: Gronsky, S.W. Lee, Wu
Also listed as: BIO ENG C280/NSE C201/PHYSICS C201
Introduction to Nano-Science and Engineering: Read Less [-]

MAT SCI C286 Modeling and Simulation of Advanced Manufacturing Processes 3 Units
Terms offered: Spring 2022, Spring 2021, Spring 2020
This course provides the student with a modern introduction to the basic industrial practices, modeling techniques, theoretical background, and computational methods to treat classical and cutting edge manufacturing processes in a coherent and self-consistent manner.
Modeling and Simulation of Advanced Manufacturing Processes: Read More [+]
Objectives & Outcomes
Course Objectives: An introduction to modeling and simulation of modern manufacturing processes.
Rules & Requirements
Prerequisites: An undergraduate course in strength of materials or 122
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week
Additional Details
Subject/Course Level: Materials Science and Engineering/Graduate
Grading: Letter grade.
Instructor: Zohdi
Also listed as: MEC ENG C201/NUC ENG C226
Modeling and Simulation of Advanced Manufacturing Processes: Read Less [-]
MAT SCI C287 Computational Design of Multifunctional/Multiphysical Composite Materials 3 Units
Terms offered: Spring 2012
The course is self-contained and is designed in an interdisciplinary manner for graduate students in engineering, materials science, physics, and applied mathematics who are interested in methods to accelerate the laboratory analysis and design of new materials. Examples draw primarily from various mechanical, thermal, diffusive, and electromagnetic applications.
Computational Design of Multifunctional/Multiphysical Composite Materials: Read More [+]

Rules & Requirements
Prerequisites: An undergraduate degree in the applied sciences or engineering
Hours & Format
Fall and/or spring: 15 weeks - 3-3 hours of lecture and 0-1 hours of discussion per week
Additional Details
Subject/Course Level: Materials Science and Engineering/Graduate
Grading: Letter grade.
Instructor: Zohdi
Also listed as: MEC ENG C202
Computational Design of Multifunctional/Multiphysical Composite Materials: Read Less [-]

MAT SCI 290A Special Topics in Materials Science 3 Units
Terms offered: Fall 2016, Fall 2015, Fall 2014
Lectures and appropriate assignments on fundamental or applied topics of current interest in materials science and engineering.
Special Topics in Materials Science: Read More [+]

Rules & Requirements
Prerequisites: Graduate standing
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Materials Science and Engineering/Graduate
Grading: Letter grade.
Formerly known as: 290M
Special Topics in Materials Science: Read Less [-]

MAT SCI 290M Special Problems in Materials Science 3 Units
Selected topics in the thermodynamic, kinetic or phase transformation behavior of solid materials. Topics will generally be selected based on student interest in Mat Sci 201A-201B. The course provides an opportunity to explore subjects of particular interest in greater depth.
Special Problems in Materials Science: Read More [+]

Rules & Requirements
Prerequisites: MAT SCI 201A and MAT SCI 201B; or consent of instructor
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Materials Science and Engineering/Graduate
Grading: Letter grade.
Instructor: Morris
Special Problems in Materials Science: Read Less [-]

MAT SCI 296A Independent Research for Five-Year BS/MS Program 1 - 2 Units
Terms offered: Fall 2022, Fall 2021, Fall 2020
This is the first semester of a two-course sequence for those majors in the five year BS/MS program. Students are expected to formulate, develop and initiate an independent research project under the supervision of a research advisor. This course will meet once at the beginning of the semester to outline the expectations of the course. Periodic meetings covering topics such as maintaining a lab notebook, effective oral communication, and writing a journal publication will be scheduled. Students will be expected to keep a laboratory notebook outlining their progress during the semester. A progress report will be due at the end of Materials Science and Engineering 296A. Students will also be expected to give an oral presentation, describing their research project and progress toward their goals in front of their peers at the end of the semester.
Independent Research for Five-Year BS/MS Program: Read More [+]

Rules & Requirements
Prerequisites: Acceptance into the five year BS/MS program
Hours & Format
Fall and/or spring: 15 weeks - 1-2 hours of independent study per week
Additional Details
Subject/Course Level: Materials Science and Engineering/Graduate
Grading: Offered for satisfactory/unsatisfactory grade only.
Independent Research for Five-Year BS/MS Program: Read Less [-]
**MAT SCI 296B Independent Research for Five-Year BS/MS Program 1 - 2 Units**

Terms offered: Spring 2022, Spring 2021, Spring 2020

This is the second semester of a two-course sequence for those majors in the five year BS/MS program. Students are expected to complete an independent research project under the supervision of a research advisor initiated in Materials Science and Engineering 296A. This course will meet once at the beginning of the semester to outline the expectations of the course. Periodic meetings covering topics such as data analysis and design of experiment will be scheduled. Students will be expected to keep a laboratory notebook outlining their progress during the semester. A final report in journal publication form will be due at the end of the semester. Each student will also give a final presentation on his/her research project at the end of the semester.

Independent Research for Five-Year BS/MS Program: Read More [+]

**Rules & Requirements**

Prerequisites: 296A

**Hours & Format**

Fall and/or spring: 15 weeks - 1-2 hours of independent study per week

**Additional Details**

Subject/Course Level: Materials Science and Engineering/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

Independent Research for Five-Year BS/MS Program: Read Less [-]

**MAT SCI 298 Group Studies, Seminars, or Group Research 1 - 8 Units**

Terms offered: Fall 2022, Spring 2022, Fall 2021

Advanced study in various subjects through special seminars on topics to be selected each year, informal group studies of special problems, group participation in comprehensive design problems or group research on complete problems for analysis and experimentation.

Group Studies, Seminars, or Group Research: Read More [+]

**Rules & Requirements**

Repeat rules: Course may be repeated for credit without restriction.

**Hours & Format**

Fall and/or spring: 15 weeks - 1-8 hours of seminar per week

**Additional Details**

Subject/Course Level: Materials Science and Engineering/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

Group Studies, Seminars, or Group Research: Read Less [-]

**MAT SCI 299 Individual Study or Research 1 - 12 Units**

Terms offered: Fall 2022, Summer 2022, Summer 2022 10 Week Session

Individual investigation of advanced materials science problems.

Individual Study or Research: Read More [+]

**Rules & Requirements**

Prerequisites: Graduate standing in engineering

Repeat rules: Course may be repeated for credit without restriction.

**Hours & Format**

Fall and/or spring: 15 weeks - 1-12 hours of independent study per week

Summer: 6 weeks - 1-12 hours of independent study per week
8 weeks - 1-12 hours of independent study per week

**Additional Details**

Subject/Course Level: Materials Science and Engineering/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

Individual Study or Research: Read Less [-]

**MAT SCI 375A Science and Engineering Pedagogy 2 Units**

Terms offered: Fall 2016, Fall 2015, Fall 2014

Discussion and research of pedagogical issues. Supervised practice teaching in materials science and engineering.

Science and Engineering Pedagogy: Read More [+]

**Rules & Requirements**

Prerequisites: Graduate standing and appointment, or interest in appointment, as a graduate student instructor

**Hours & Format**

Fall and/or spring: 15 weeks - 1-2 hours of seminar per week

**Additional Details**

Subject/Course Level: Materials Science and Engineering/Professional course for teachers or prospective teachers

Grading: Offered for satisfactory/unsatisfactory grade only.

Instructor: Gronsky

Formerly known as: Material Science and Engineering 300

Science and Engineering Pedagogy: Read Less [-]
MAT SCI 375B Supervised Teaching of Materials Science and Engineering 1 Unit
Terms offered: Prior to 2007
Discussion and research of pedagogical issues. Supervised practice
teaching in Materials and Science and Engineering.
Supervised Teaching of Materials Science and Engineering: Read More [+]

Rules & Requirements
Prerequisites: Graduate standing and appointment, or interest in
appointment, as a graduate student instructor

Hours & Format
Fall and/or spring: 15 weeks - 1-2 hours of seminar per week

Additional Details
Subject/Course Level: Materials Science and Engineering/Professional
course for teachers or prospective teachers
Grading: Offered for satisfactory/unsatisfactory grade only.
Formerly known as: Material Science and Engineering 300
Supervised Teaching of Materials Science and Engineering: Read Less [-]

MAT SCI 601 Individual Study for Master's Students 1 - 8 Units
Terms offered: Spring 2022, Spring 2021, Spring 2020
Individual study for the comprehensive or language requirements in
consultation with the field adviser.
Individual Study for Master's Students: Read More [+]

Rules & Requirements
Prerequisites: Graduate standing in engineering
Credit Restrictions: Course does not satisfy unit or residence
requirements for master's degree.
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 1-8 hours of independent study per week

Additional Details
Subject/Course Level: Materials Science and Engineering/Graduate
examination preparation
Grading: Offered for satisfactory/unsatisfactory grade only.
Individual Study for Master's Students: Read Less [-]

MAT SCI 602 Individual Study for Doctoral Students 1 - 8 Units
Terms offered: Spring 2022, Spring 2021, Spring 2020
Individual study in consultation with the major field adviser, intended to
provide an opportunity for qualified students to prepare themselves for
the various examinations required of candidates for the Ph.D. (and other
doctoral degrees).
Individual Study for Doctoral Students: Read More [+]

Rules & Requirements
Prerequisites: Graduate standing in engineering
Credit Restrictions: Course does not satisfy unit or residence
requirements for doctoral degree.
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 0 hours of independent study per week

Additional Details
Subject/Course Level: Materials Science and Engineering/Graduate
examination preparation
Grading: Offered for satisfactory/unsatisfactory grade only.
Individual Study for Doctoral Students: Read Less [-]