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 2019, Spring 2018, Spring 2017
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 required.

Freshman Seminar: Read Less [-]

MAT SCI 45 Properties of Materials 3 Units
Terms offered: Spring 2019, Fall 2018, Spring 2018
Application of basic principles of physics and chemistry to the engineering properties of materials. Special emphasis devoted to relation between microstructure and the mechanical properties of metals, concrete, polymers, and ceramics, and the electrical properties of semiconducting materials. Sponsoring Department: Materials Science and Engineering

Properties of Materials: Read More [+]

Rules & Requirements
Prerequisites: Physics 7A (may be taken concurrently)

Credit Restrictions: Students will receive no credit for MSE 45 after taking E45

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.

Properties of Materials: Read Less [-]

MAT SCI 45L Properties of Materials Laboratory 1 Unit
Terms offered: Spring 2019, Fall 2018, Spring 2018
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 2018, Fall 2017, Fall 2016
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: Engineering 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 2019, Spring 2018, Spring 2017
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: 102 and Engineering 115

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.

MAT SCI 104 Materials Characterization 4 Units
Terms offered: Spring 2019, Spring 2018, Spring 2017

Rules & Requirements
Prerequisites: 102

Hours & Format
Fall and/or spring: 15 weeks - 3 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.
Instructor: Gronsky

MAT SCI 111 Properties of Electronic Materials 4 Units
Terms offered: Spring 2019, Spring 2018, Spring 2017
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.

Rules & Requirements
Prerequisites: Physics 7A-7B-7C or Physics 7A-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

MAT SCI 112 Corrosion (Chemical Properties) 3 Units
Terms offered: Spring 2019, Spring 2018, Spring 2017

Rules & Requirements
Prerequisites: Engineering 45 and Engineering 115

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 2018, Fall 2017, Fall 2016
This course covers elastic and plastic deformation under static and dynamic loads. Prediction and prevention of failure by yielding, fracture, fatigue, wear and environmental factors are addressed. Design issues pertaining to materials selection for load bearing applications are discussed. Case studies of engineering failures are presented. Topics include engineering materials, structure-property relationships, materials selection for design, mechanical behavior of polymers and design of plastic components, complex states of stress and strain, elastic deformation and multiaxial loading, plastic deformation and yield criteria, dislocation plasticity and strengthening mechanisms, creep, effects of stress concentrations, fracture, fatigue, and contact stresses.
Rules & Requirements
Prerequisites: C30/Mechanical Engineering C85 and Engineering 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 [-]
MAT SCI C118 Biological Performance of Materials 4 Units
Terms offered: Fall 2018, Fall 2017, Fall 2015
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: 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: Engin 45; BioE 103 or equivalent; BioE 102 and BioE 104 recommended

MAT SCI 120 Materials Production 3 Units
Terms offered: Fall 2018, Fall 2017, Fall 2016

Materials Production: Read Less [-]

Rules & Requirements

Prerequisites: Engineering 115, Mechanical Engineering 40, Chemical Engineering 141, Chemistry 120B or equivalent thermodynamics course

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 Production: Read Less [-]

MAT SCI 121 Metals Processing 3 Units
Terms offered: Spring 2019, Spring 2015, Spring 2014
The principles of metals processing with emphasis on the use of processing to establish microstructures which impart desirable engineering properties. The techniques discussed include solidification, thermal and mechanical processing, powder processing, welding and joining, and surface treatments.

Materials Processing: Read More [+]

Rules & Requirements

Prerequisites: Engineering 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: Gronsky

Metals Processing: Read Less [-]
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.

**Rules & Requirements**

**Prerequisites:** Engineering 45, 115

**Hours & Format**

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

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

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

Ceramic Processing: Read More [+]

MAT SCI 123 ELECTRONIC MATERIALS PROCESSING 4 Units
Terms offered: Spring 2019, Fall 2018, Fall 2017
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.

**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:** MSE 111 or Physics 7C or consent of instructor

**Hours & Format**

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

**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: Spring 2016, Spring 2015, Fall 2014
Thin-Film Materials Science: Read More [+]

Rules & Requirements
Prerequisites: Upper division or graduate standing in engineering, physics, chemistry, and chemical engineering; Engineering 45 required; 111 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 130 Experimental Materials Science and Design 3 Units
Terms offered: Fall 2018, Fall 2017, Fall 2016
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.

Experimental Materials Science and Design: Read Less [-]

MAT SCI 136 Materials in Energy Technologies 4 Units
Terms offered: Fall 2017, Fall 2015, Fall 2011
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 2015, Spring 2013, Spring 2012
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: 102 or equivalent recommended; Physics 7C and Engineering 45 required

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.
Instructor: Minor
Nanomaterials for Scientists and Engineers: Read Less [-]
MAT SCI C150 Introduction to Materials Chemistry 3 Units
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: 104A; 104B 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.
Also listed as: CHEM C150
Introduction to Materials Chemistry: Read Less [-]

MAT SCI 151 Polymeric Materials 3 Units
Terms offered: Spring 2019, Spring 2018, Spring 2017
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 gels, 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: Chemistry 1A or Engineering 5. 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 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.
Rules & Requirements
Prerequisites: Upper division standing in Engineering

MAT SCI 199 Supervised Independent Study
1 - 4 Units
Terms offered: Spring 2019, Fall 2016, Spring 2016
Supervised independent study. Enrollment restrictions apply; see the Introduction to Courses and Curricula section of this catalog.
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.

MAT SCI 200A Survey of Materials Science 4 Units
Terms offered: Fall 2018, Fall 2017, Fall 2016
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.

MAT SCI 201A Thermodynamics and Phase Transformations in Solids 4 Units
Terms offered: Fall 2018, Fall 2017, Fall 2016

MAT SCI 201A Thermodynamics and Phase Transformations in Solids 4 Units
Terms offered: Fall 2018, Fall 2017, Fall 2016

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Terms offered: Fall 2018, Fall 2017, Fall 2016

MAT SCI 201A Thermodynamics and Phase Transformations in Solids 4 Units
Terms offered: Fall 2018, Fall 2017, Fall 2016
MAT SCI 202 Crystal Structure and Bonding 3 Units
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: Fall 2018, Fall 2017, Fall 2016
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 electron microscopy and x-ray diffraction techniques for characterization of the chemical and structural properties of a material. Other structural characterization techniques such as ion beam analysis, infrared spectroscopy and atom probe tomography will also be covered. The course will also cover the characterization of materials properties such as mechanical properties, electronic properties, optical properties, and functional properties of a material.

Materials Characterization: Read More [+]

Rules & Requirements
Prerequisites: 102, 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/Graduate
Grading: Letter grade.
Instructors: Gronsky, Minor

Materials Characterization: Read Less [-]

MAT SCI 205 Defects in Solids 3 Units
Terms offered: Spring 2014, Spring 2013, Spring 2011
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 [+]

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

Defects in Solids: Read Less [-]
MAT SCI C208 Biological Performance of Materials 4 Units
Terms offered: Fall 2018, Fall 2017, Fall 2015
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-mater ials compatibility, biomimetic materials, hard and soft tissue-materials interactions, drug delivery, tissue engineering, and biotechnology.

Objectives

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: Engineering 45; Chemistry C130/Molecular and Cell Biology C100A or Engineering 115 or equivalent; Bioengineering 102 and 104 recommended.
MAT SCI 213 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 2018, Spring 2016, Spring 2014
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
Also listed as: CIV ENG C236
Micromechanics: Read Less [-]

MAT SCI 215 Computational Materials Science 3 Units
Terms offered: Spring 2019, Fall 2017, Fall 2016
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
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: Bioengineering 115 or equivalent; 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 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-7B-7C (or equivalent); Physics 7A-7B (or equivalent) and consent of instructor; MSE 111 (or equivalent) 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 222 Semiconductor Materials 3 Units**

Terms offered: Fall 2018, Fall 2017, Fall 2016


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 [-]

**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 magnetostriction. 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., magnetoresistive 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**


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.

MAT SCI 241 Electron Microscopy Laboratory 4 Units

Terms offered: Spring 2019, Spring 2018, Spring 2017
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.

MAT SCI 242 Advanced Characterization Techniques 3 Units

Terms offered: Spring 2019, Spring 2017, Spring 2005
Advanced electrical, optical, magnetic and ion beam characterization techniques including deep level transient spectroscopy, photoluminescence, electron paramagnetic resonance, and Rutherford backscattering, are used to characterize crystalline materials (with emphasis on semi-conductors).

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

Prerequisites: MATSCI 104 or equivalent

Prerequisites: MATSCI 104 or equivalent

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.

Also listed as: ENE,RES C226

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

Electron Microscopy Laboratory: Read Less [-]

Advanced Characterization Techniques: Read Less [-]

Instructors: Gronsky, Minor

Electron Microscopy Laboratory: Read Less [-]
MAT SCI C250 Nanomaterials in Medicine 3 Units
Terms offered: Fall 2018, Fall 2017, Fall 2016, Fall 2015
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.
Nanomaterials in Medicine: Read More [+]

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

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: Messersmith

Also listed as: BIO ENG C250

Nanomaterials in Medicine: Read Less [-]

MAT SCI 251 Polymer Surfaces and Interfaces 3 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
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.
Polymer Surfaces and Interfaces: Read More [+]

Rules & Requirements

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

Polymer Surfaces and Interfaces: Read Less [-]

MAT SCI 260 Surface Properties of Materials 3 Units
Terms offered: Spring 2019, Spring 2018, Spring 2015
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.
Surface Properties of Materials: Read More [+]

Rules & Requirements

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

Surface Properties of Materials: Read Less [-]
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 2019, Spring 2018, Spring 2017
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
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: 201A-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 2018, Fall 2017, Fall 2016
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 2019, Spring 2018, Spring 2017
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: Spring 2019, Fall 2018, Spring 2018
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: Spring 2019, Fall 2018, Summer 2018 8 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 2019, Fall 2018, Spring 2018
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 2019, Fall 2018, Spring 2018
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 [-]