Materials Science and Engineering (MAT SCI)

Courses

MAT SCI 24 Freshman Seminar 1 Unit
Terms offered: Spring 2017, Spring 2016, Spring 2015
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.
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.

MAT SCI 102 Bonding, Crystallography, and Crystal Defects 3 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
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.
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

MAT SCI 103 Phase Transformations and Kinetics 3 Units
Terms offered: Spring 2017, Spring 2016, Spring 2015
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 2017, Spring 2016, Spring 2015
Physical and chemical characterization of materials: Diffraction, imaging, and spectroscopy using optical, electron, and X-ray methods for bulk and surface analysis. Measurement of mechanical and physical properties. Project laboratory focusing on mechanical, chemical, electrical, and magnetic properties of materials, and materials characterization. Field trips.
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 2017, Spring 2016, Spring 2015
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 (http://guide.berkeley.edu/search/?P=PHYSICS%207A)-7B-7C or PHYSICS 7A (http://guide.berkeley.edu/search/?P=PHYSICS%207A)-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 2017, Spring 2016, Spring 2015
Electrochemical theory of corrosion. Mechanisms and rates in relation to physiochemical and metallurgical factors. Stress corrosion and mechanical influences on corrosion. Corrosion protection by design, inhibition, cathodic protection, and coatings.
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

MAT SCI 113 Mechanical Behavior of Engineering Materials 3 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
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

MAT SCI 117 Properties of Dielectric and Magnetic Materials 3 Units
Terms offered: Spring 2017, Spring 2011, Fall 2010
Introduction to the physical principles underlying the dielectric and magnetic properties of solids. Processing-microstructure-property relationships of dielectric materials, including piezoelectric, pryoelectric, 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 (http://guide.berkeley.edu/search/?P=PHYSICS%207A)-7B-7C or PHYSICS 7A (http://guide.berkeley.edu/search/?P=PHYSICS%207A)-7B and consent of instructor; 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.

MAT SCI C118 Biological Performance of Materials 4 Units
Terms offered: Fall 2017, Fall 2015, Fall 2014
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.
Rules & Requirements

Prerequisites: Engineering 45; Chemisty C130/Mollecular Cell Biology C100A or Engineering 115 or equivalent; Bioengineering 102 & Bioengineering 104 recommended

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: Healy

Also listed as: BIO ENG C118

MAT SCI 120 Materials Production 3 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
Economic and technological significance of metals and other materials. Elementary geology (composition of lithosphere, mineralization). Short survey of mining and mineral processing techniques. Review of chemical thermodynamics and reaction kinetics. Principles of process engineering including material, heat, and mechanical energy balances. Elementary heat transfer, fluid flow, and mass transfer. Electrolytic production and refining of metals. Vapor techniques for production of metals and coatings.
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.

MAT SCI 121 Metals Processing 3 Units
Terms offered: Spring 2015, Spring 2014, Spring 2013
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.
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

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

MAT SCI 123 ELECTRONIC MATERIALS PROCESSING 4 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
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 (http://guide.berkeley.edu/search/?P=PHYSICS%207C) 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

MAT SCI 125 Thin-Film Materials Science 3 Units
Terms offered: Spring 2016, Spring 2015, Fall 2014
Deposition, processing, and characterization of thin films and their technological applications. Physical and chemical vapor deposition methods. Thin-film nucleation and growth. Thermal and ion processing. Microstructural development in epitaxial, polycrystalline, and amorphous films. Thin-film characterization techniques. Applications in information storage, integrated circuits, and optoelectronic devices. Laboratory demonstrations.
Rules & Requirements

Prerequisites: Upper division or graduate standing in engineering, physics, chemistry, and chemical engineering; Engineering 45 required; 111 or PHYSICS 141A (http://guide.berkeley.edu/search/?P=PHYSICS%20141A) 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

MAT SCI 130 Experimental Materials Science and Design 3 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
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.
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 2015, Fall 2011, Fall 2010
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.
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

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.
Rules & Requirements

Prerequisites: 102 or equivalent recommended; PHYSICS 7C (http://guide.berkeley.edu/search/?P=PHYSICS%207C) 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

MAT SCI C150 Introduction to Materials Chemistry 3 Units
Terms offered: Spring 2017, Spring 2016, Spring 2015
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.
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

MAT SCI 151 Polymeric Materials 3 Units
Terms offered: Spring 2017, Spring 2016, Spring 2015
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 polmyer 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.
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

MAT SCI H194 Honors Undergraduate Research 1 - 4 Units
Terms offered: Fall 2017, Summer 2017 8 Week Session, Spring 2017
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.
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. Course may be repeated for credit when topic changes.

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.

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 relevent literature, in consultion with appropriate faculty members.
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.

MAT SCI 198 Directed Group Studies for Advanced Undergraduates 1 - 4 Units
Terms offered: Fall 2017, Fall 2016, Spring 2016
Group studies of selected topics.
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.

MAT SCI 199 Supervised Independent Study 1 - 4 Units
Terms offered: Fall 2017, Summer 2017 8 Week Session, Spring 2017
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 when topic changes.

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.

MAT SCI 200A Survey of Materials Science 4 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
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.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Additional Details

Subject/Course Level: Materials Science and Engineering/Graduate

Grading: Letter grade.

MAT SCI 201A Thermodynamics and Phase Transformations in Solids 4 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
The laws of thermodynamics, fundamental equations for multicomponent elastic solids and electromagnetic media, equilibrium criteria. Application to solution thermodynamics, point defects in solids, phase diagrams. Phase transitions, Landau rule, symmetry rules. Interfaces, nucleation theory, elastic effects. Kinetics: diffusion of heat, mass and charge; coupled flows.
Rules & Requirements

Prerequisites: 102, 103, Engineering 115, or consent of instructor. 201A is 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.

MAT SCI 202 Crystal Structure and Bonding 3 Units
Terms offered: Spring 2017, Spring 2016, Spring 2014
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.
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

MAT SCI 204 Theory of Electron Microscopy and X-Ray Diffraction 3 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
Basic principles of techniques used in the characterization of engineering materials by electron microscopy, diffraction, and spectroscopy; emphasis on detailed analysis of defects responsible for materials properties. Modern electrical, optical and particle beam techniques for characterization of bulk single crystals and their crystalline and amorphous layers. Examples Hall effect, Deep Level Transient Spectroscopy, IR-Spectroscopy.
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

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.
Rules & Requirements

Prerequisites: PHYSICS 7C (http://guide.berkeley.edu/search/?P=PHYSICS%207C) 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 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.
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: Engineering 45; Chemistry C130/Molecular and Cell Biology C100A or Engineering 115 or equivalent; Bioengineering 102 and 104 recommended

Hours & Format

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

MAT SCI C211 Mechanics of Solids 3 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
Mechanical response of materials: Simple tension in elastic, plastic and viscoelastic members. Continuum mechanics: The stress and strain tensors, equilibrium, compatibility. Three-dimensional elastic, plastic and viscoelastic problems. Thermal, transformation, and dealloying stresses. Applications: Plane problems, stress concentrations at defects, metal forming problems.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Credit Restrictions: Students will receive no credit for 231 after taking 231A or 231B prior to Fall 1992.

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

MAT SCI C212 Deformation and Fracture of Engineering Materials 4 Units
Terms offered: Spring 2016, Spring 2015, Spring 2013
This course covers deformation and fracture behavior of engineering materials for both monotonic and cyclic loading conditions.
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

Also listed as: MEC ENG C225

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.
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

MAT SCI C214 Micromechanics 3 Units
Terms offered: Spring 2016, Spring 2014, Spring 2012
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.
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

MAT SCI 215 Computational Materials Science 3 Units
Terms offered: Fall 2017, Fall 2016, Fall 2014
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.
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

MAT SCI C216 Macromolecular Science in Biotechnology and Medicine 4 Units
Terms offered: Spring 2017, Spring 2015, Spring 2014
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.
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

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.
Rules & Requirements

Prerequisites: PHYSICS 7A (http://guide.berkeley.edu/search/?P=PHYSICS%207A)-7B-7C (or equivalent); PHYSICS 7A (http://guide.berkeley.edu/search/?P=PHYSICS%207A)-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

MAT SCI 223 Semiconductor Materials 3 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
Semiconductor purification and crystal growth techniques. Doping, radiation damage, and annealing. Metal-semiconductor interfaces and reactions. Interaction between defects and impurities during processing of devices. Major electronic and optical methods for the analysis of semiconductors.
Rules & Requirements

Prerequisites: PHYSICS 7C (http://guide.berkeley.edu/search/?P=PHYSICS%207C) 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

MAT SCI 224 Magnetism and Magnetic Materials 3 Units
Terms offered: Fall 2017, 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.
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.

MAT SCI C225 Thin-Film Science and Technology 3 Units
Terms offered: Spring 2017, Spring 2016, Spring 2015
Thin-film nucleation and growth, microstructural evolution and reactions. Comparison of thin-film deposition techniques. Characterization techniques. Processing of thin films by ion implantation and rapid annealing. Processing-microstructure-property-performance relationships in the context of applications in information storage, ICs, micro-electromechanical systems and optoelectronics.
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

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 2012
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.
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

MAT SCI 241 Electron Microscopy Laboratory 2 Units
Terms offered: Spring 2017, Spring 2016, Fall 2015
Basic techniques and operations of transmission, and scanning, electron microscopy; x-ray microanalysis, energy loss spectroscopy; specimen preparation, interpretation of data; individual projects in materials science.
Rules & Requirements

Prerequisites: 204 (can be taken concurrently)

Hours & Format

Fall and/or spring: 15 weeks - 6 hours of laboratory per week

Additional Details

Subject/Course Level: Materials Science and Engineering/Graduate

Grading: Letter grade.

Instructors: Gronsky, Minor

MAT SCI 242 Advanced Characterization Techniques 3 Units
Terms offered: Spring 2017, Spring 2005, Spring 2003
Advanced electrical, optical, magnetic and ion beam characterization techniques including deep level transient spectroscopy. Photo-luminescence, electron paramagnetic resonance, and Rutherford backscattering, are used to characterize crystalline materials (with emphasis on semi-conductors).
Rules & Requirements

Prerequisites: 204 or 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.

MAT SCI C250 Nanomaterials in Medicine 3 Units
Terms offered: 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.
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

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.
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

MAT SCI 260 Surface Properties of Materials 3 Units
Terms offered: Spring 2015, Spring 2013, Spring 2011
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.
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.
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 when topic changes.

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

MAT SCI C286 Modeling and Simulation of Advanced Manufacturing Processes 3 Units
Terms offered: Spring 2017, Spring 2016, Spring 2015
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.
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

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.
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

MAT SCI 290A Special Topics in Materials Science 3 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
Lectures and appropriate assignments on fundatmental or applied topics of current interest in materials science and engineering.
Rules & Requirements

Prerequisites: Graduate standing

Repeat rules: Course may be repeated for credit when topic changes.

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

MAT SCI 290M Special Problems in Materials Science 3 Units
Terms offered: Spring 2009, Spring 2008, Spring 2006
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.
Rules & Requirements

Prerequisites: 201A-201B or consent of instructor

Repeat rules: Course may be repeated for credit when topic changes.

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

MAT SCI 296A Independent Research for Five-Year BS/MS Program 1 - 2 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
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.
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.

MAT SCI 296B Independent Research for Five-Year BS/MS Program 1 - 2 Units
Terms offered: Spring 2017, Spring 2016, Spring 2015
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.
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.

MAT SCI 298 Group Studies, Seminars, or Group Research 1 - 8 Units
Terms offered: Fall 2017, Spring 2017, Fall 2016
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.
Rules & Requirements

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

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.

MAT SCI 299 Individual Study or Research 1 - 12 Units
Terms offered: Fall 2017, Summer 2017 8 Week Session, Summer 2017 First 6 Week Session
Individual investigation of advanced materials science problems.
Rules & Requirements

Prerequisites: Graduate standing in engineering

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

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.

MAT SCI 375A Science and Engineering Pedagogy 2 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
Discussion and research of pedagogical issues. Supervised practice teaching in materials science and engineering.
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

MAT SCI 375B Supervised Teaching of Materials Science and Engineering 1 Unit
Terms offered: Prior to 2007
Disucssion and research of pedagogical issues. Supervised practice teaching in Materials and Science and Engineering.
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

MAT SCI 601 Individual Study for Master's Students 1 - 8 Units
Terms offered: Fall 2017, Spring 2017, Fall 2016
Individual study for the comprehensive or language requirements in consultation with the field adviser.
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. Course may be repeated for credit when topic changes.

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.

MAT SCI 602 Individual Study for Doctoral Students 1 - 8 Units
Terms offered: Fall 2017, Spring 2017, Fall 2016
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).

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. Course may be repeated for credit when topic changes.

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.