MATERIALS SCIENCE (MS)

# Course numbers with the # symbol included (e.g. #400) have not
been taught in the last 3 years.

MS 830 - Mechanical Behavior Materials
Credits: 4
Elastic and inelastic behavior of materials in terms of micro- and
macro-mechanics. Stress, strain and constitutive relations related to
recent developments in dislocation theory and other phenomena on
the atomic scale and to the continuum mechanics on the macroscopic
scale. Elasticity, plasticity, viscoelasticity, creep, fracture, and damping.
Anisotropic and heterogeneous materials. Prereq: Mechanics II,
Introduction to Materials Science; or permission. Lab.

MS 831 - Fracture and Fatigue Engineering Materials
Credits: 4
Review of fundamentals of linear elastic fracture mechanics and strain
energy release rate analysis. Discusses basic methods of design for
prevention of failure by fast fracture and fatigue for metals, ceramics,
and polymers with attention to the effect of material properties and
subsequent property modification on each design approach. Prereq:
Mechanics II, Introduction to Materials Science; or permission. Lab.

MS 861 - Diffraction and Imaging Methods in Materials Science
Credits: 4
Introduction to x-ray diffraction and electron microscopy. Basic
crystallography; reciprocal lattice; x-ray and electron diffraction, x-ray
methods; transmission and scanning electron microscopy. Prereq:
General Chemistry, General Physics II, or permission. Lab.

MS 862 - Electronic Materials Science
Credits: 4
This course provides engineering and science students with a foundation
in the materials science of modern electronic devices. Topics include
bonding and structure of solids, electrical and thermal conduction,
elements of quantum mechanics, band theory of electrons in solids,
semiconductors, magnetism, dielectrics and superconductors. Examples
of applications are taken primarily from the fields of semiconductor
electronics and nanotechnology, and illustrate how the electrical and
optical properties of devices are obtained from their compositions,
crystal structures and microstructures. Permission of instructor required.

MS 895 - Special Topics
Credits: 2-4
New or specialized courses and/or independent study. May be repeated
for credit.

MS 898 - Master's Project
Credits: 3-4
The student works with a faculty member during one or two semesters on
a well-defined research and/or original design problem. A written report
and seminar are presented. IA (continuous grading) Cr/F.

MS 899 - Master's Thesis
Credits: 1-6
Cr/F.

MS 900 - Seminar
Credits: 1
Topics of interest to graduate students and faculty; reports of research
ideas, progress, and results; lectures by outside speakers. Continuing
course: instructor may assign IA (continuous grading) grade at the end of
one semester.

MS 905 - Macromolecular Synthesis
Credits: 3
Fundamentals of polymerization reaction mechanisms, kinetics, and
chain structures as they are developed from the different chemistries
available. Detailed discussions of the chemical mechanisms of step,
free radical, ionic, and ring opening polymerizations. Treatment of the
reaction parameters that control the rate of polymerization, molecular
weight and chemical composition of the polymer chains. Introduction to
stereo-chemical and catalytic polymerizations. Considerations of bulk,
solution, and dispersion polymerization systems. Permission of instructor
required. Open to Biochemistry, Chemical Engineering, Engineering:
Chemical, Chemistry, Mechanical Engineering, Engineering: Mechanical,
Materials Science, Engineering: Mat Science, and Physics majors only.

MS 910 - Macromolecular Characterization
Credits: 3
Molecular characterization of synthetic and natural macromolecules
in solution and in the solid state. Emphasis on the principles of various
analytical techniques designed to provide information on the chemical
composition, polymer chain size and structure in solution and in the
dry state. Extension to methods that measure the interaction and
association between polymer molecules. Interpretations of data from
important characterization techniques including liquid chromatography
(GPC), spectroscopy (FTIR, NMR, MS), microscopy (TEM, AFM, Confocal
Raman), thermal analysis (DSC), light scattering, sedimentation, and x-
ray diffraction. Permission of instructor required. (Also listed as BCHM
950). Open to Biochemistry, Chemical Engineering, Engineering: Chemical,
Chemistry, Chem: Chemistry Education, Mechanical Engineering,
Materials Science, Engineering: Mat Science, and Physics majors only.

MS 960 - Thermodynamics and Kinetics of Materials I
Credits: 3
Classical and statistical thermodynamics are used to establish the
conditions of equilibrium for simple and multi-component, heterogeneous
materials. Additionally, the thermodynamics of phase diagrams,
miscibility, interfaces, and defects are explored. Examples and problems
apply these concepts to various types of materials, including metals,
ceramics, and polymers.

MS 961 - Thermodynamics and Kinetics of Materials II
Credits: 3
Introduction to diffusion and phase transformations in materials, and
detailed descriptions of interfacial regions. Mechanisms of phase
separation by spinodal decomposition and homogeneous nucleation.
Kinetic processes leading to changes in phase structure driven by
chemical reaction, temperature and diffusive processes (e.g. Ostwald
ripening) are treated quantitatively. Applications to metals, ceramics and
polymers. Prereq: Thermodynamics and Kinetics of Materials I.

MS #965 - Advanced Surface and Thin Film Characterization
Credits: 4
Fundamentals of modern analytical techniques used to analyze the
surface region of materials. Prereq: Introduction to Materials, or
permission.

MS 995 - Graduate Special Topics
Credits: 2-4
Investigation of graduate-level problems or topics in Materials Science.

MS 999 - Doctoral Research
Credits: 0
Cr/F.