

# Materials Science (MTS)

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## MTS 601 - NATURE OF MATERIALS

Semester Hours: 3

Fundamental chemistry and structure of metals, ceramics, semiconductors, and polymers. Mol%, wt%, ppx, number densities, and polymer molecular weights. Covalent, ionic, metallic, and intermolecular bonding. Crystallography and disorder. Point, line, and volume defects. Phase diagrams.

## MTS 602 - PROPERTIES OF MATERIALS

Semester Hours: 3

Properties of metals, ceramics, semiconductors, and polymers. Elastic or plastic deformation, fracture, and strengthening. Oxidation and corrosion. Dielectrics, semiconductors, and conductors. Thermal conductivity and heat capacity. Transmission, adsorption, and reflection. Magnetic susceptibility. Prerequisites: MTS 601.

## MTS 603 - STRUC COMP PROP MATLS I

Semester Hours: 3

How structure and composition determine a materials mechanical properties and performance. Topics covered include bonding and crystal structure, disorder, defects, phase diagrams, phase transitions, diffusion and other kinetic processes, deformation, fraction mechanics, strengthening processes as applied to metals, ceramics, semiconductors, polymers and composites.

## MTS 604 - STRUC COMP PROP MATLS II

Semester Hours: 3

How reactive, electronic, magnetic, thermal and optical properties of metals, ceramics, semiconductors, and polymers are influenced by their structure and composition. Topics considered include corrosion, oxidation, degradation process, band structure, electrical and optical dielectric constants, magnetic susceptibility, electrical and thermal conductivity and superconductivity.

## MTS 607 - MAT PROCESSING IN SPACE

Semester Hours: 3

Extensive review of solidification physics with emphasis on the role of fluid transport and its effects on the process in order to develop rationales for processing materials in space.

## MTS 613 - SYNTHESIS & PROC OF MATL

Semester Hours: 3

Metals, semiconductors, polymers, ceramics and composite materials are included.

## MTS 646 - THERMODYNAMICS OF MATRLS

Semester Hours: 3

Fundamental thermodynamic review, phase equilibrium, chemical reaction equilibrium, free energy, binary and ternary phase transformations, solution models and selected topics.

## MTS 649 - POLYMER SYNTHESIS & CHARACTERI

Semester Hours: 3

Synthesis of commercially relevant and novel polymers. Polymer characterization and discussion of the structural dependence of polymer properties.

## MTS 650 - PRINC LIQUID/SOLID INTER

Semester Hours: 3

Applies basic principles in thermodynamics and kinetics to characterize surfaces and surface phenomena. Fundamental properties of gas-liquid, liquid-liquid, solid-liquid, and solid-gas interfaces and phenomena occurring at these interfaces.

## MTS 651 - INTRO QUANTUM MECH I

Semester Hours: 3

Waves and particles; Bohr's model of the atom; de Broglie waves, wave-packets and the uncertainty principle; postulates of quantum mechanics; Schrodinger's equation; simple systems in one, two and three dimensions; the hydrogen atom.

## MTS 652 - INTRO QUANTUM MECH II

Semester Hours: 3

Angular momentum and spin; atomic structure and spectrum; time-independent perturbation theory, variational methods; time-dependent perturbation theory and interactions of light with matter; scattering theory; electronic structure of solids; relativistic quantum mechanics. Prerequisite: PH 551 or CH 553.

MTS 660 - INTRO SOLID ST PHY I

Semester Hours: 3

Crystal binding and crystal structure. Crystal structure determination. Phonons and lattice vibrations. Free electron gas. Electronic energy band theory. Prerequisite: PH 551 or CH 553 or MTS 651 or OSE 555.

MTS 661 - INTRO SOLID ST PHY II

Semester Hours: 3

Thermal properties of solids. Electronic properties, optical properties, electronic properties in a magnetic field, semiconductor devices, magnetism, superconductivity, defects and alloys, dislocations and crystal growth, non-crystalline solids, surfaces and interfaces. Prerequisite: MTS 660 or PH 560.

MTS 690 - SP TPS/MATERIAL SCIENCE

Semester Hours: 3

Advanced selected topics of interest in such areas as materials processing, properties, analysis and testing. Prerequisites: MTS 501 and MTS 502.

MTS 699 - MASTER'S THESIS

Semester Hours: 3-6

Required each semester that a student is enrolled and receiving direction on a master's thesis. Minimum of two semesters required.

MTS 701 - FUND SOLID ST MAT PREP I

Semester Hours: 3

Equilibrium concepts and applications. Overview of solid state preparation (crystal growth) techniques. Treats appropriate thermodynamics, chemical equilibrium solid-liquid-vapor phase diagrams and application in materials preparation; segregation and applications (doping, normal freezing, zone refining, macro and micro distributions).

MTS 721 - FUND ELECTRON/X-RAY OPTICS

Semester Hours: 3

Fundamentals of materials characterization using electron and x-ray techniques. Topics include advanced crystallography, electron optics, and interactions of energetic electrons with solids. Some applications of x-ray diffraction (SRD) will be addressed.

MTS 722 - ELECT MICROSCOPIES/X-RAY DIFF

Semester Hours: 4

Applications of materials characterization using electron and x-ray techniques. Topics include imaging and x-ray spectroscopy (EDXA) using scanning electron microscopy (SEM); imaging, diffraction, and x-ray spectroscopy using transmission electron microscopy (TEM); and advanced x-ray diffraction (XRD) techniques.

MTS 723 - ELECTRON SPECTROSC SUR CHAR

Semester Hours: 4

Principles and operation of electron spectroscopies used in surface characterization. Techniques covered include Auger electron spectroscopy (AES), x-ray photoelectron spectroscopy (XPS), and other photoemission spectroscopies, such as ultraviolet photoelectron spectroscopy (UPS) and the use of synchrotron radiation. Students will carry out analysis of samples, prepare a written report, and present the results orally as part of the laboratory assignment.

MTS 724 - INSTR METH/BIO-MTLS CHARACTERI

Semester Hours: 3

MTS 747 - POLYMER PHYSICAL CHEM

Semester Hours: 3

Introduction to structure, properties and processing of polymers. Structural types, structure property relationships, thermodynamics and kinetics of polymerization and depolymerization, polymer characterization, thermodynamics of polymer solutions and blends, and mechanical evaluation of polymers. Prerequisite: CH 540.

MTS 780 - MATERIALS SCIENCE SEMINAR

Semester Hour: 1

Required of doctoral students during each semester of residence. This course may not be used to meet minimum degree requirements.

MTS 790 - SPECIAL TOPICS/MTS

Semester Hours: 3

Offered upon demand. Advanced selected topics of interest in materials science in such areas as materials processing, materials properties and analysis, testing.

MTS 799 - DOCTORAL DISSERTATION

Semester Hours: 3-9

Required each semester student is enrolled and receiving direction on a doctoral dissertation. A minimum of 18 hours is required.