MATERIAL SCIENCE (MTSC)

MTSC 615. Structure of Solids. 3 Credits.
Crystalllography, reciprocal lattices, Bloch waves, band structure, electronic wave functions, phonons, thermal expansion. Superlattice structures, including liquid crystals. Overview of properties of ceramic, amorphous, polymeric, and composite materials.
Grading status: Letter grade.

MTSC 715. Visualization in the Sciences. 3 Credits.
Computational visualization applied in the natural sciences. For both computer science and natural science students. Available techniques and their characteristics, based on human perception, using software visualization toolkits. Project course.
Grading status: Letter grade
Same as: COMP 715, PHYS 715.

MTSC 720. Materials Fabrication. 3 Credits.
Permission of the department. Introduction to materials fabrication and characterization techniques. Includes single crystal growth, thin film deposition, synthesis of quantum dots and nanotubes/nanowires, dielectric and electron emissive materials, nanocomposites, bioceramics, and energy storage materials.
Grading status: Letter grade.

MTSC 730. Statistical Thermodynamics. 3 Credits.
Grading status: Letter grade.

MTSC 735. Techniques in Materials Science. 3 Credits.
Permission of the department. Lecture and laboratory in materials analysis techniques, including microscopy, X-ray diffraction and fluorescence, magnetic resonance, thermal analysis, XPS, channeling and RBS, mechanical properties, optical spectroscopy.
Repeat rules: May be repeated for credit.
Grading status: Letter grade.

MTSC 740. Advanced Biomaterials. 3 Credits.
Medical or dental implants or explants are highlighted from textbooks, scientific literature, and personal accounts.
Requisites: Prerequisite, BMME 510; Permission of the instructor for students lacking the prerequisite.
Grading status: Letter grade
Same as: BMME 740.

MTSC 750. Kinetics, Diffusion, and Phase Transitions of Materials. 3 Credits.
Grading status: Letter grade.

MTSC 755. Polymer Processing and Properties. 3 Credits.
How does one process ultrahigh molecular weight polyethylene into ultra-strong fibers or how would you design a polymer shape-memory actuator? Polymer chemistry is important but equally important is the way how polymers are processed. In this course we will discuss the relationship between polymer chemistry, processing and the final, after processing, properties. We will discuss different processing methods that are currently in use) and which parameters play a role in controlling the final properties.
Grading status: Letter grade.

MTSC 760. Complex Fluids: Theory and Applications. 3 Credits.
Complex fluids are materials we encounter everyday such as pastes, gels, foams, blood, and tissue, yet ones that cannot be categorized within the traditional three states of matter (solid/gas/liquid). In this course, we introduce the main physical and mathematical concepts of the continuum mechanics of complex fluids and follow with microscopic approaches. The course is designed to focus on both theory and applications with hands-on activities and examples.
Grading status: Letter grade.

MTSC 765. Electronic Materials and Devices - Organic and Inorganic. 3 Credits.
The course introduces the electronic and optical processes in organic molecules and polymers that govern the behavior of practical organic optoelectronic devices. The course begins with an overview of fundamental science of electronic materials and devices. We then discuss their optoelectronic properties of organic molecules, including topics from photophysics, charge transport and injection. Emphasis will be equally placed on the use of both inorganic and organic electronic materials in organic electronic devices.
Grading status: Letter grade.

MTSC 810. Device Physics and Electronic Properties of Solids. 3 Credits.
Survey of crystal structure, bandstructure, transport. Overview of FETs, heterostructures, light emission, dissipation, noise, integrated circuits, solar cells, and ceramics. Emphasis on physical sources of device behavior.
Requisites: Prerequisites, APPL 470 or PHYS 573, MTSC 615, and 730; permission of the instructor for students lacking the prerequisites.
Grading status: Letter grade.

MTSC 820. Optical Properties of Solids. 3 Credits.
Reflection, waveguides, nonlinear optics, optical switching, photorefraction, optical storage. Optical coupling to electronic states, device applications, optical computing.
Requisites: Prerequisites, APPL 470 or PHYS 573, and PHYS 415; permission of the instructor for students lacking the prerequisites.
Grading status: Letter grade.

MTSC 830. Ion-Solid Interactions. 3 Credits.
Interatomic potentials, range distribution, radiation damage, annealing, secondary defects, analytical techniques, silicon-based devices, implantation in compound semiconductors, and buried layer synthesis. Ion implantation in metals, ceramics, polymers, and biomaterials.
Requisites: Prerequisite, APPL 470 or PHYS 573; permission of the instructor for students lacking the prerequisites.
Grading status: Letter grade.

MTSC 840. New Technologies and Device Architecture. 3 Credits.
Requisites: Prerequisites, APPL 470 or PHYS 573, MTSC 615, and 730; permission of the instructor for students lacking the prerequisites.
Grading status: Letter grade.
MTSC 871. Solid State Physics. 3 Credits.
Equivalent experience for students lacking the prerequisite. Topics considered include those of PHYS 573, but at a more advanced level, and in addition a detailed discussion of the interaction of waves (electromagnetic, elastic, and electron waves) with periodic structures, e.g., X-ray diffraction, phonons, band theory of metals and semiconductors.
Requisites: Prerequisite, PHYS 321.
Grading status: Letter grade
Same as: PHYS 871.

MTSC 872. Solid State Physics. 3 Credits.
Topics considered include those of PHYS 573, but at a more advanced level, and in addition a detailed discussion of the interaction of waves (electromagnetic, elastic, and electron waves) with periodic structures, e.g., X-ray diffraction, phonons, band theory of metals and semiconductors.
Requisites: Prerequisite, PHYS 321.
Grading status: Letter grade
Same as: PHYS 872.

MTSC 891. Special Topics in Material Science. 1-3 Credits.
Permission of the department. Current topics in materials science, including electronic and optical materials, polymers, and biomaterials.
Grading status: Letter grade.

MTSC 992. Master’s (Non-Thesis). 3 Credits.

MTSC 993. Master’s Research and Thesis. 3 Credits.
Permission of the department.
Repeat rules: May be repeated for credit.

MTSC 994. Doctoral Research and Dissertation. 3 Credits.
Permission of the department.
Repeat rules: May be repeated for credit.