# MATERIALS PHYS. & ENGINEERING (MPEN)

**MPEN 6290 Computation Material Sci & Eng (3 Credit Hours)**
**Prerequisite(s):** PHYS 2350 and 2360.

**MPEN 6350 Kinetics of Material Systems (3 Credit Hours)**
This course covers all aspects of kinetics in material systems. Topics include thermodynamics, steady state and time dependent diffusion, phase transformations, statistical mechanics, structure evolution, boundaries and interfaces, solidification, and precipitation effects.

**MPEN 6360 Structure of Materials (3 Credit Hours)**
The properties of matter depend on which of the about 100 different kinds of atoms they are made of and how they are bonded together in different crystal structures; specifically, the atomic structure primarily affects the chemical, physical, thermal, electrical, magnetic, and optical properties of materials. Metals behave differently than ceramics, and ceramics behave differently than polymers. Students will learn the different states of condensed matter and develop a set of tools for describing the crystalline structure of all of them. They will gain a better understanding of the principles of structure common to all materials. Key concepts, such as symmetry theory will be introduced introduced and applied to provide a common viewpoint for describing structures of ceramic, metallic, and polymeric materials and the latter includes optical microscopy, electron optics, x-ray diffraction and some surface analytical techniques. Structure-sensitive properties of real materials will also be introduced.

**MPEN 6370 Processing of Biomaterials (3 Credit Hours)**
Processing of biomaterials gives an overview of the most advanced techniques to process biomaterials into structures that satisfy next generation applications. All materials classes will be covered including polymers, ceramics, metals, composites and cells and tissues. In each case, the material-specific processing and the properties and potential applications will be covered.

**MPEN 6380 Materials for Energy (3 Credit Hours)**
The course begins with a history of our understanding and utilization of different sources of energy and a review of thermodynamics. In all cases, the most effective materials used are discussed as well as the relevant fundamental equations used and approaches for improving the figure-of-merit. The 5 different forms of energy are introduced - mechanical, electromagnetic, thermal, chemical, and nuclear - and discussed. Materials and techniquesused for energy applications are discussed including thermoelectrics, fossil fuels, nanoparticles, different approaches for energy storage, fuel cells, nuclear energy (fission and fusion), energy biological systems - from cellular scale and ATP and catabolism/anabolism to biomass conversion, and magnetohydrodyanmics. Techniques for energy conversion, biomimetics, energy and the environment and material issues for energy transformation are discussed. The sun is also discussed as a source of energy for photosynthesis, photovoltaics, and photothermal power generation.

**MPEN 6560 Photonic Materials & Devices (3 Credit Hours)**
This course will cover the theory, design, fabrication, characterization, and application of photonic materials and devices. The course will start with a review of the fundamentals of photonics, including ray optics, wave optics, and nanophotonics/quantum optics. The course will then focus on light-matter interactions and photonic materials, including dielectrics, semiconductors, metals, metamaterials, and photonic crystals. Using these principles and materials, we will explore a number of device architectures, including LEDs, lasers, photodetectors, photovoltaics, etc. We will then discuss fabrication methods for making these materials and devices and common optoelectronic characterization techniques. The course will conclude with exploration of cutting edge topics in photonics research. Prerequisites: PHYS 2350 and PHYS 2360 (or equivalent) or instructor approval.

**MPEN 6620 MicroFab and Nanotech (3 Credit Hours)**
Nano/micro-electromechanical devices (N/MEMS) require knowledge of a broad range of disciplines, from the fundamental physics of mechanics and electromagnetism to practical nano/microfabrication processes and techniques. This course is opened for the intr

**MPEN 6660 Special Topics (1-3 Credit Hours)**
Special Topics.

**MPEN 6720 Mechanic Behavior of Materials (3 Credit Hours)**
The course covers the general foundations of elasticity and plasticity theory, dislocation theory, and strengthening mechanisms. Basics of materials forming processes are studied. An overview for non-destructive testing of materials is taught. The course emphasis is on destructive mechanical testing of materials including; tension, torsion, hardness, fatigue and creep tests, in addition to fracture mechanics and failure analysis.

**MPEN 6760 Thermodynamics of Materials (3 Credit Hours)**
The course covers the general foundation of both statistical thermodynamics and classical thermodynamics, including thermodynamics laws, auxiliary functions, and behavior of gases and solutions. In addition, special attention is dedicated to equilibria of reactions and phase diagrams of materials. Computer-based programs will be used to solve thermodynamics problems for complicated materials.

**MPEN 6950 Engineers for Int'l Deve (1 Credit Hour)**
Engineers for International Development at Tulane University exists for students to participate in community-driven development programs worldwide through the design and implementation of sustainable engineering projects, while fostering responsible leadership. We work both internationally and locally to build and educate communities about their basic infrastructure systems such as drinking water, sanitation, and safe homes.

**MPEN 7910 Research I (3 Credit Hours)**

**MPEN 7920 Research II (3 Credit Hours)**

**MPEN 7930 Research III (3 Credit Hours)**

**MPEN 7940 Research IV (3 Credit Hours)**

**MPEN 7951 Advanced Research I (3 Credit Hours)**

**MPEN 7952 Advanced Research II (3 Credit Hours)**