### Course Schedule—Fall 2006

**Materials Science & Engineering**

**MATERIALS SCIENCE AND ENGINEERING**

Note: Text highlighted in red indicates that a change has been made to the course listing. The red text indicates the current, updated information.

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<th>Credits</th>
<th>Prerequisites</th>
<th>Lab</th>
<th>Credit Hours</th>
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<tr>
<td>510.101 (E,N)</td>
<td><strong>INTRODUCTION TO MATERIALS CHEMISTRY (3)</strong> Katz</td>
<td>Limit 60 50</td>
<td>Basic principles of chemistry and how they apply to the behavior of materials in the solid state. The relationship between electronic structure, chemical bonding, and crystal structure is developed. Attention is given to characterization of atomic and molecular arrangements in crystalline and amorphous solids: metals, ceramics, semiconductors, and polymers (including proteins). Examples are drawn from industrial practice (including the environmental impact of chemical processes), from energy generation and storage (such as batteries and fuel cells), and from emerging technologies (such as biomaterials).</td>
<td>MTW 9</td>
<td>3</td>
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<tr>
<td>510.107 (E, N)</td>
<td><strong>MODERN ALCHEMY (3)</strong> Spicer</td>
<td></td>
<td>Can you really turn lead into gold? Converting common substances into useful materials that play important roles in today's technologies is the goal of many modern scientists and engineers. In this course, we will survey selected topics related to modern materials, the processes that are used to make them as well as the inspiration that led to their development. Topics will include the saga of electronic paper, the sticky stuff of gecko feet and the stretchy truth of metal rubber.</td>
<td>ThF 1-2:15</td>
<td>3</td>
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<tr>
<td>510.311 (E,N)</td>
<td><strong>STRUCTURE OF MATERIALS (3)</strong> Searson</td>
<td>Limit 50</td>
<td>First of the Introduction to Materials Science series, this course is devoted to study of the structure of materials. Lecture topics include bonding, atomic packing, crystal structure, imperfections in crystals, noncrystalline solids, and composite materials. Among the techniques treated are X-ray diffraction, stereographic projection, and optical and electron microscopy.</td>
<td>MTW 9</td>
<td>3</td>
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<tr>
<td>510.312 (E,N)</td>
<td><strong>PHYSICAL CHEMISTRY OF MATERIALS I: THERMODYNAMICS (3)</strong> Erlebacher</td>
<td>Limit 135 25</td>
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<td>MTW 11 10</td>
<td>3</td>
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<tr>
<td>510.316 (E,N)</td>
<td><strong>BIOMATERIALS I (3)</strong> Yu</td>
<td>Limit 50</td>
<td>Sixth of the Introduction to Materials Science series, this course offers an overview of principles and properties of biomedical materials. Topics include properties of materials used in medicine, synthesis and properties of polymeric materials, polymeric biomaterials, natural and recombinant biomaterials, biodegradable materials, hydrogels, stimuli-sensitive materials, and characterizations of biomaterials.</td>
<td>MTW 10 11</td>
<td>3</td>
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<tr>
<td>510.402 (E,N)</td>
<td><strong>STRUCTURAL MATERIALS ENGINEERING (3)</strong> Green</td>
<td>Limit 25</td>
<td>This course provides a detailed look at materials used in applications where mechanical properties (such as strength, stiffness, or toughness) are of primary importance. The perspective of the class is to show how a desired set of properties can be achieved through an understanding of structure-properties-processing relationships. Examples include heat treatment of steels, metallic alloys for orthopedic implants, ceramics for high temperature applications, and polymer composite materials.</td>
<td>MTW 11</td>
<td>3</td>
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<tr>
<td>510.428 (E,N)</td>
<td><strong>MATERIALS SCIENCE LAB I (3)</strong> Weihs</td>
<td>Limit 30</td>
<td>This course focuses on characterizing the microstructure and mechanical properties of structural materials that are commonly used in modern technology. A group of A1 alloys, Ti alloys, carbon and</td>
<td>Th 1-3</td>
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(W)
alloy steels, and composite materials that are found, for example, in actual bicycles will be selected for examination. Their microstructures will be studied using optical metallography, scanning electron microscopy, X-ray diffraction, and transmission electron microscopy. The mechanical properties of these same materials will be characterized using tension, compression, impact, and hardness tests. The critical ability to vary microstructure and therefore properties through mechanical and heat treatments will also be demonstrated and investigated in the above materials.

510.433 (E,N) 
SENIOR DESIGN RESEARCH (3) ● Hristova ● Limit 20 ● Perm. 
Req: 510.311-312, 510.428-429 ● Coreq: 510.803 ● This course is the first half of a two-semester sequence required for seniors majoring or double majoring in materials science and engineering. It is intended to provide a broad exposure to many aspects of planning and conducting independent research. During this semester, students join ongoing graduate research projects for a typical 10-12 hours per week of hands-on research.

510.456 (E,N) 
INTRODUCTION TO SURFACE SCIENCE (3) Cammarata ● Limit 20 ● 
Prereq: 510.311-315 or permission of instructor ● Introduction to the structure and properties of solid surfaces. ● Topics include Gibbsian and gradient thermodynamics of surfaces; crystallography and structure of free solid surfaces; characterization methods; surface mobility and phase transitions; gas-solid interactions; crystal growth; electronic structure; solid-solid surfaces; thin film epitaxy.

510.501 
RESEARCH 
Student participation in ongoing research activities. Research is conducted under the supervision of a faculty member and often in conjunction with other members of the research group.

510.503 
INDEPENDENT STUDY 
Individual programs of study are worked out between students and the professor supervising their independent study project. Topics selected are those not formally listed as regular courses and include a considerable design component.

510.601 
STRUCTURE OF MATERIALS Hufnagel ● Limit 30 ● Prereq: Basic Chemistry, Physics and Calculus or Perm. Req:d ● An introduction to the structure of inorganic and polymeric materials. Topics include the atomic scale structure of metals, alloys, ceramics, and semiconductors; structure of polymers; crystal defects; elementary crystallography; tensor properties of crystals; and an introduction to the uses of diffraction techniques (including X-ray diffraction and electron microscopy) in studying the structure of materials.

510.602 
THERMODYNAMICS OF MATERIALS Mi Erlebacher ● Limit 25 Prereq: Basic Chemistry, Physics and Calculus or Perm. Req:d & * & * & * & * & * An introduction to the classical and statistical thermodynamics of materials. Topics include the zeroth law of thermodynamics; the first law (work, internal energy, heat, enthalpy, heat capacity); the second law (heat engines, Carnot cycle, Clausius inequality, entropy, absolute temperature); equilibrium of single component systems (free energy, thermodynamic potentials, virtual variations, chemical potential, phase changes); equilibrium of multicomponent systems and chemical thermodynamics; basics of statistical physics (single and multiple particle partition functions, configurational entropy, third law; statistical thermodynamics of solid solutions); and equilibrium composition-temperature phase diagrams.

510.606 
CHEMICAL AND BIOLOGICAL PROPERTIES OF MATERIALS Yu Hristova ● Limit 25 ● Prereq: Basic Biology and Chemistry ● An introduction to the chemical and biological properties of organic and inorganic materials. Topics include an introduction to polymer science, polymer synthesis, chemical synthesis, and modification of inorganic materials; biomaterialization, biosynthesis, and properties of natural materials (proteins, DNA, and polysaccharides), structure-property relationships in polymeric materials (synthetic polymers and structural proteins), and materials for biomedical applications.

510.611 
SOLID STATE PHYSICS Poehler ● Limit 20 ● An introduction to solid state physics for advanced undergraduates and graduate students in physical science and engineering. Topics include crystal structure of solids; band theory; thermal, optical, and electronic properties; transport and magnetic properties of metals, semiconductors, and insulators; and superconductivity. The concepts and applications of solid-state principles in modern electronic, optical, and structural materials are discussed.
510.624  THEORY OF X-RAY DIFFRACTION  Hufnagel  Limit 30  Prereqs:  510.601 An introduction to diffraction theory and the uses of diffraction in structural characterization of materials. Topics include X-ray scattering by atoms, kinematic theory, Fourier series methods, diffraction from single crystals and polycrystalline materials, diffraction from multilayers, scattering by liquids and amorphous solids, small-angle scattering, dynamic theory.  Sec. 01  MTW 9 10

510.656  INTRODUCTION TO SURFACE SCIENCE  Cammarata  Limit 20  Prereq: 510.311-315 or permission of instructor  Meets with 510.456  Sec. 01  MT 12-1:15

510.733  SPECIAL TOPICS IN ELECTRONICS/OPTICAL MATERIALS INTERACTION  Spicer  Limit 20  Topics in this course concentrate on the understanding of interactions of electromagnetic fields with materials. These interactions range from the absorption of optical frequency waves to the excitation of materials using low-frequency electromagnetic waves in the sub-megahertz regime. Emphasis is on studying representations and the corresponding analytical techniques used to model electromagnetic interactions with materials. Additionally, transduction techniques for the measurement of these interactions are discussed.  Course canceled 5/08/06  Sec. 01  TBA

510.739  SURFACE CHEMISTRY SEMINAR  Searson  Limit 10  Perm. Req'd.  Topics in surface chemistry and materials chemistry are discussed. The seminar covers various topics in these fields, including a review of the current literature.  Sec. 01  Th 12:30-1:30

510.801  MATERIALS RESEARCH SEMINAR  Cammarata  Sec. 01  W 2-3:30

510.803  MATERIALS SCIENCE SEMINAR  Cammarata  Green  Sec. 01  W 3:30-5

510.807  GRADUATE RESEARCH IN MATERIALS SCIENCE  Cammarata  Sec. 01  TBA