Materials Science and Technology (MSTC)

Courses

MSTC 231. Fundamentals of Materials in Technology I. 4 Credits.
Fundamental principles necessary to understand structure-property relations in materials. Key concepts from physics, general chemistry, and mathematics are covered to instill core materials science subject matter and introduce knowledge of challenges in technology requiring innovation in modern materials. Included are thermodynamic concepts of structure from bonding to microstructure, and how to apply these interrelationships between structure and properties in technology relevant materials, diffusion processes, and gain competency in modern programming languages for data analysis. Sequence with MSTC 232.
Requisites: Coreq: CH 224H, MATH 251Z.

MSTC 232. Fundamentals of Materials in Technology II. 4 Credits.
Continuation of fundamental principles necessary to understand structure-property relations in materials. In this second course (of the two-course sequence), the student will develop a fundamental understanding of defects in solids and how those, along with structure and bonding, govern, mechanical, thermal, electrical, optical, magnetic, and chemical properties of materials used in key technological applications such as computing, energy, and communications, and those used in structural and mechanical engineering. Sequence with MSTC 231.
Requisites: Prereq: CH 224H, MATH 251Z, MSTC 231.

MSTC 431. Thermal Physics of Advanced Materials. 4 Credits.
This course is the first one in a two-course sequence that teaches and applies a foundational understanding of thermodynamics, kinetics, and transport to understand how materials are formed and what governs the time evolution of materials processes. This course focuses on the thermodynamic properties of materials, i.e. how concepts of energy minimization determine the equilibrium phases and properties.
Requisites: Prereq: MATH 256; MATH 281; MSTC 232; [PHYS 351, PHYS 352] or [CH 411, CH 412].

MSTC 432. Kinetics and Transport in Advanced Materials. 4 Credits.
This course is the first one in a two-course sequence that teaches and applies a foundational understanding of thermodynamics, kinetics, and transport to understand how materials are formed and what governs the time evolution of materials processes. Begins with concepts of thermodynamically reversible and irreversible process and how those relate to entropy and entropy production. Transport by diffusion, rates of chemical reactions, and materials processes nucleation and growth and morphological evolution in solids are covered.
Requisites: Prereq: MSTC 431.

MSTC 441. Electronic, Optical and Magnetic Properties of Materials I. 4 Credits.
In the first part of this two-course sequence, the student will study the significant role played by geometry and chemical composition in determining general material properties and explore how this structure conspires with quantum physics to govern the mechanical, thermal, and electrical properties of condensed matter, including the emergence of semiconducting behavior and superconductivity.
Requisites: Prereq: PHYS 253, MATH 256, MATH 282, MSTC 431; pre- or coreq: MATH 341.

MSTC 442. Electronic, Optical and Magnetic Properties of Materials II. 4 Credits.
In this course, the second part of a sequence, the student will extend their knowledge to magnetic, dielectric, and optical properties, and apply this knowledge to understand semiconductor devices (transistors, photovoltaics, diode lasers, etc.), nuclear magnetic resonance (NMR), spin-based quantum bits, and nanomaterials.
Requisites: Prereq: MSTC 441; pre- or coreq: MATH 341.