

MSE 2001– Principles and Applications of Engineering Materials

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Pre-requisites: D or better in Chem 1310 or Chem 1211K

Textbooks (via no-cost download):

- *Materials: Engineering, Science, Processing, and Design* by Ashby, et al. (2009).
E-Book: <https://learning.oreilly.com/library/view/materials-2nd-edition/9781856177436/>
(Sign in with your GT Email and verify with SSO)
- *Engineering Materials Science* by Ohring (1995).
E-Book: <https://www.sciencedirect.com/book/9780125249959/engineering-materials-science>

Other Required Tools:

- Canvas – Course announcements, class notes, and HW assignments will be posted on Canvas
- TurningPoint Responseware “Point Solutions.” – to participate in in-class polling for participation/discussion.

Course Evaluation

Based on mid-term/final exams (75%) and homework/class participation (25%). Exams are multiple choice and closed-book.

Course Purpose

MSE 2001 covers the fundamental principles of process-structure-property relations to design engineering materials, including metals, ceramics, polymers, semiconductors, and composites. Students will learn the “vocabulary” of materials science and engineering to facilitate technical communication, broaden design vision, and establish a foundation for further study of the subject area (if desired).

Course Objectives

By the end of this course, students should be able to:

- Use an understanding of material properties to discuss and predict material performance upon subjection to external stimuli including mechanical stress, heat, electrical voltage, electrochemical potentials, magnetic fields, and/or optical illumination.
- Describe the structure of materials at the atomic and microstructural levels and explain how different structural features impact material properties.
- Describe and predict how defects will alter the properties of a material.
- Apply thermodynamic and kinetic principles to design materials processing schemes to achieve desired materials structures using tools such as phase diagrams and TTT diagrams.

Tentative Course Outline

I. Introduction to Materials Science

History / How does materials science fit in with other disciplines?

II. Properties of Materials

General Classifications of Properties
Economics of Materials
Mechanical Properties
Thermal Properties
Electronic / Magnetic Properties
Optical Properties
Chemical Properties / Materials Degradation
Classifying Materials

III. Structure of Materials

Structure of an Atom
Atomic Bonding in Materials
Crystalline Solids / Crystal Structure
Close Packing

Lattice + Basis
Miller Indices
X-ray diffraction

Amorphous Solids

Structure of Polymers (amorphous & crystalline)

IV. Defects in Materials

Classifying Defects

Point Defects

Dislocations & Strength of Materials

Cracks and Materials Failure (Fracture)

V. Materials Processing

Phases & Phase Transformation

Phase Diagrams

TTT Diagrams