MIME 1650
Ch. 1

MIME 1650:
Materials Science & Engineering

Course Objective...

Introduce fundamental concepts in Materials Science

You will learn about:

- material structure
- how structure dictates properties
- how processing can change structure

This course will help you to:

- use materials properly
- realize new design opportunities with materials

LECTURES

Instructor: Dr. Sarit Bhaduri

Time: MW: 8:30 – 9:20

Location:Nitscheke

Activities:

- Students submit homework as they arrive
- Attendance taken
- Questions on reading assignment and/or homework answered
- Possible quiz questions on reading assignment
- New material presented
- Possible quiz questions on material just presented
- Announce next reading and homework assignments

• the bond strength will dictate properties

Office Hours

MW 10:00 – 11:00, or by appointment

Activities:

- Discuss homework, quizzes, exams
- Discuss lectures, book
- Pick up missed handouts

LABORATORY SECTIONS

Location: NE 1061

Purpose: To learn more about materials by relating lecture material with observations. Also to learn to properly formulate and write engineering reports.

GRADING

Midterm Exam 25%
Material covered: Chapters 1 – 5

Final 35%
Material covered: entire course

Lab Reports 20%

Quizzes 5%

Homework assignments 15%

Chapter 1 - Introduction

- What is materials science? The study of structure and prop
- Why should we know about it?

- Materials drive our society
  - Stone Age
  - Bronze Age
  - Iron Age
  - Now?
    - Silicon Age?
    - Polymer Age?

Material Science and Engineering

- Materials science is the study of the structure and properties of matter
- The focus for engineers is on how to use materials to make functional structures and devices
- In this course we will focus on
  - Metals
  - Ceramics
  - Polymers
  - Composites

Classes of Materials

- Metals and alloys
  - e.g. iron, copper, steel
- Polymers
  - e.g. polystyrene, nylon
- Ceramics and glasses
  - e.g. cement, concrete
- Composites mix of materials
  - E.g. fiberglass
- Semiconductors ex: silicon
- Biomaterials ex: implants
- Smart materials ex: sensors and actuators
- Nanotechnology
  ex. working on nano(microscopic) level

what we will focus on

have conductive and non-conductive properties

- Ceramic materials are harder than metals
  - not as tough
- metal matrix composite
  ceramic matrix composite
  polymer matrix
- If you mix ceramic w/ something very tough then it will become less hard.

Why study materials science and engineering?

- Essential that Engineers
  - know how to select materials that are suited to the structure or component being designed
  - understand material properties and limitations

What do we mean by material properties?

Material Properties

- Six main categories of properties of solid materials
  - Mechanical – relate deformation to load
    - e.g. density, strength, hardness, modulus
  - Electrical
  - Thermal
  - Magnetic
  - Optical
  - Deteriorative
    - e.g. corrosion, wear

Bulk non-mechanical properties

load
metals
ductile
deformation
fracture

- pull metal to test tension and it will stretch until it forces (ex. it's ductile)
- brittle and ductile are opposite

Material Properties

- Mechanical
- Electrical
- Thermal
- Magnetic
- Optical
- Deteriorative
- Price and availability
- Production properties – e.g. ease of manufacture and joining
- Aesthetic properties – e.g. texture, feel

Atomic and Crystalline Structure

CHEMISTRY

- Leads to ALL properties
- Most important are how the electrons in the material behave
- Bonding
- Structural Imperfections
- Grain Structures
- Molecular Diffusion

Encompasses chapters

ex. computer chip and lab: perfection does not depend on situation

how gases/solids will diffuse into another material
ex. welding

- how electrons are stacked determines bonding
- imperfections can be used to enhance strength