C-ID Descriptor
Materials Science and Engineering

Descriptor Details

- **Descriptor Title**: Materials Science and Engineering
- **C-ID Number**: 140
- **Suffix**:
  - Lab and Lecture (B)
- **Units**: 4
- **Date of Last Revision**: 10/12/2017 11:44:08 PM GMT+0000

General Description

This course presents the internal structures and resulting behaviors of materials used in engineering applications, including metals, ceramics, polymers, composites, and semiconductors. The emphasis is upon developing the ability both to select appropriate materials to meet engineering design criteria and to understand the effects of heat, stress, imperfections, and chemical environments upon material properties and performance. Laboratories provide opportunities to directly observe the structures and behaviors discussed in the course, to operate testing equipment, to analyze experimental data, and to prepare reports.

Prerequisites

1 semester college-level general chemistry (e.g., CHEM 110 General Chemistry for Science Majors I, with Lab)

1 semester calculus-based physics (e.g., PHYS 205 Calculus-Based Physics for Scientists and Engineers: A)

Corequisites

None

Advisories

None

Content

- Atomic structure and bonding
- Crystal structures and crystallography
- Imperfections in crystals, including polycrystalline, semi-crystalline, and amorphous solids
- Diffusion
- Elastic and plastic deformation in metals
- Strengthening and toughening in metals
- Mechanical properties and testing
- Stress-strain analysis
- Mechanical failure: fracture, fatigue, creep
- Phase diagrams
- Phase transformations
- Iron-Carbon system, heat treatment of steels
- Metals and Metal Alloys
- Forming and Fabrication
- Thermal, electrical and magnetic properties, including semiconductors
- Chemical properties, including corrosion
- Structure and properties of polymers
- Structure and properties of ceramics
- Structure and properties of composites, including wood and concrete (optional)
- Selection of materials in engineering design (optional)

Lab Activities

Laboratory activities should cover a range of topics from the course content above, and should include evaluating properties and behavior of materials based upon various standard materials testing techniques (e.g., hardness, tension, compression,

impact, fatigue, creep) and processing treatments (e.g., strain hardening, recrystallization, Jominy, precipitation hardening, etc.).

Objectives

At the conclusion of the lecture component of this course, the student should be able to:

1. Explain the relationship between the internal structure of materials and their macroscopic properties.
2. Explain methods (intentional or unintentional) of altering the structure of materials by mechanical, chemical, or thermal means in order to change material properties.
3. Illustrate the various systems for classifying materials, and compare differences in properties among material classes that derive from differences in structure.
4. Gather data from reference sources regarding the properties, processing, and performance characteristics of materials, and use it as a basis to recommend appropriate material(s) to meet engineering design criteria.

Laboratory Course Objectives: *At the conclusion of the laboratory component of this course, the student should be able to:*

1. Measure material properties and/or evaluate processing treatments using standard materials testing equipment and techniques.
2. Write laboratory reports that communicate the collection, analysis, and interpretation of experimental data according to professional engineering standards.

Evaluation Methods

Examinations which include problem-solving exercises, quizzes, tests, projects, laboratory reports.

*Note that not all of the methods listed are required.

Textbooks

Callister, William. *Materials Science and Engineering: An Introduction.*

Messler, Robert W., Jr. *The Essence of Materials for Engineers*.

Shackelford, James. *Introduction to Materials Science for Engineers*.

Ashby, Michael; Shercliff, Hugh; Cebon, David. *Materials: engineering, science, processing, and design*.

Askeland, Donald R.; Wight,Wendelin. *Essentials of Materials Science and Engineering*.

Typical Lab Manuals:

Laboratory manuals typically developed on-site