

Engineering Materials

TCSU ENGR 110

A. Description

This course is a one-semester introductory course on the properties of engineering materials and how the properties relate to internal structure. Topics include: atomic structure and bonding; crystal structure; phases and phase diagrams; properties (mechanical, electrical, magnetic, optical) and structure of metals, polymers, ceramics and composites; mechanical deformation and fracture; taxonomy systems; corrosion and processing methods.

B. Prerequisites

Chemistry I with lab

C. Minimum Unit Requirement

3 semester units

D. Course Topics

1. Atomic Structure & Bonding
 - a. Crystal Structures, Directions and Planes, Structural Defects
 - b. Diffusion
 - c. Mechanical Properties of Metals
 - d. Dislocations and Plastic Deformation
 - e. Strengthening Mechanisms
 - f. Recovery, Recrystallization and Grain Growth
 - g. Fracture
 - h. Fatigue
 - i. Creep
 - j. Phase Diagrams
2. Iron-Carbon System
3. Phase Transformations
 - a. Transformation of Iron-Carbon Alloys
 - b. Annealing
 - c. Heat Treatment of Steels
 - d. Precipitation Hardening
 - e. Metal Fabrication
 - f. Ferrous Alloys
 - g. Nonferrous Alloys
 - h. Corrosion of Metals
 - i. Structure and Properties of Ceramics
4. Structure and Properties of Polymers
5. Structure and Properties of Composites

E. Student Learning Objectives and Outcomes

Objectives:

1. A fundamental understanding of material properties, structure and their relationship
2. A fundamental understanding of material behavior in response to stimuli (load, temperature, chemistry)
3. An understanding of the failure mechanisms of materials
4. An understanding of the mechanism of diffusion and its role in material behavior
5. An understanding the role of phase and ITT diagrams in thermal processing of alloys
6. An understanding of the role of material selection in engineering design
7. An ability to make appropriate selections of material for an application

Outcomes:

1. Know the types of atomic bonding and crystal structures;
2. Know how diffusion operates and relates to defects and vacancies in material structure;
3. Know the important engineering properties of materials (mechanical, electrical, optical) and how they relate to internal structure;
4. Know the causes and underlying mechanisms of the failure modes of fatigue, fracture, and creep;
5. Be able to read and use phase diagrams; and
6. Know the common thermal processing methods for alloys, their underlying mechanisms, and their effect on material properties.

F. CAN Equivalent

CAN ENGR 4 (Equivalency ends Spring 2011)