MECH 210: Materials Science and Engineering

Catalog description: 3.0 units

Processing, structure, properties, and performance of engineering materials. Applied knowledge of material properties as engineering design parameters. Advanced manufacturing processes, including microfabrication. 1.0 hour discussion, 3.0 hours laboratory, 2.0 hours activity. Special fee required; see *The Class Schedule*. CAN ENGR 4.

Prerequisites: CHEM 111 (may be taken concurrently), PHYS 2044A

Course objectives: For students to

1. Understand how microstructure and macrostructure affect material properties
2. Become familiar with test methods for determining material properties
3. Understand how processing methods affect material structure and properties
4. Learn major interactions between materials and the environment
5. Understand the role of materials in engineering design

Course outcomes: Students shall be able to

1. Describe crystal and molecular structures of materials
2. Describe major types of structural defects and how they affect material properties
3. Know Fick's Laws (steady-state and nonsteady-state) of solid-state diffusion
4. Describe at least two strengthening methods of materials
5. Describe at least two types and constructions of composite materials
6. Know deformation behavior of metals, polymers, ceramics, and composites
7. Use phase diagrams to determine phase equilibrium and microstructural development
8. Describe kinetics of phase transformations
9. Perform tensile test, hardness test, and impact test of materials
10. Perform differential thermal analysis of materials
11. Prepare samples for microscopic examination
12. Know the fundamentals of fracture mechanics
13. Describe electrochemical corrosion and kinetics of oxidation
14. Describe kinetics of corrosion reactions and methods of corrosion prevention
15. Calculate corrosion rate
16. Describe at least two processing methods of engineering materials
17. Know effects of processing methods on material properties
18. Describe at least two fabrication processes of composite materials

Topics covered

1. Solid crystal structures
2. Imperfections in solids
3. X-ray diffraction
4. Solid-state diffusion mechanisms: steady-state and nonsteady-state
5. Engineering stress, engineering strain, true stress, true strain
6. Mechanical testing: tensile, hardness, impact, creep, fatigue

7. Fatigue, crack initiation, crack propagation, fracture
8. Fracture mechanics
9. Strengthening mechanisms
10. Recovery, recrystallization, grain growth
11. Equilibrium phase diagrams, Gibbs phase rule
12. Microstructural and property changes in alloys
13. Types, fabrication, thermal processing of metals
14. Polymer structures, polymer chemistry
15. Polymer mechanical and thermomechanical characteristics
16. Glass transition and polymer processing
18. Microfabrication and MEMs
19. Reinforced composites
20. Processing of composites
21. Electrochemical corrosion and oxidation
22. Corrosion rates, corrosion prevention

Class/Laboratory schedule

One hundred minutes of lecture, one hundred minutes of activity, and one hundred fifty minutes of laboratory per week

Contribution of course to meet the professional component

This course aids in the student's ability to design mechanical systems.

Relationship of course to Mechatronic Engineering Program Outcomes

This course contributes to Program Outcomes A and B.