Lectures: Mon. Wed. 5:00 - 6:20 p.m., SEC 210

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Course Description: students will learn atomic/molecular level structures of fundamental materials, i.e., metals, ceramics, polymers and composites. Properties, such as mechanical properties, are understood in terms of the microstructure of materials. Focus is placed on the relationship between the structure (controlled by a processing method) and the properties of materials.

Course Objectives: students are expected to understand: (1) microstructures of materials, (2) differences between metals, ceramics, and polymers, (3) properties in terms of the microstructures of materials, and (4) processing of materials for applications.


Assessment: Exam 1: 30%, Exam 2: 30%, Term Paper (presentation): 30%, Quizzes: 10%

Course Content:

I. Introduction:
   Material Science Approach

II. Cohesion in Materials:
   Thermodynamics (kinetics), State of Matter
   Bonding (ionic, covalent, metallic, van der Waals, hydrogen bonds)
   Crystal Structure (crystal systems, Miller indices)

III. Processing and Structure of Engineering Materials:
   Metals (HCP, FCC, BCC structures, alloys and phase diagrams)
   Ceramics (crystalline ceramics, glass transition, glass, minerals)
   Polymers (crystalline polymers, amorphous polymers, elastomers)
   Composites (particulate, fibrous and laminated composites)
IV. Properties of Materials:

- Typical stress-strain behavior of metals/ceramics/polymers
- Elastic Properties of Crystalline Materials
- Rubber Elasticity
- Plastic Deformation of Crystalline Materials
- Plastic Deformation of Polymers

ABET Outcomes and Assessment:

Program outcomes achieved in this course

| (a) an ability to apply knowledge of mathematics, science and engineering; | (e) an ability to identify, formulate and solve engineering problems; |
| (i) a recognition of the need for, and an ability to engage in life-long learning; and | (j) a knowledge of contemporary issues. |

The achievement of outcomes (a), (e), (i) and (j) will be assessed in this course as follows:

**Outcome (a):** an ability to apply knowledge of mathematics, science and engineering

Problems in quizzes and exams will check the students’ ability to apply knowledge of mathematics, science and engineering in problem solving.

**Outcome (e):** an ability to identify, formulate and solve engineering problems

Problems in exams will require students to formulate, identify, and solve engineering problems.

**Outcome (i):** a recognition of the need for, and an ability to engage in life-long learning

A term paper will involve research, thinking, and analyzing engineering problems, which will be presented as a written report and as an oral presentation. This will help students develop an ability to engage in life-long learning.

**Outcome (j):** a knowledge of contemporary issues

A term paper will require the identification of important issues in modern materials engineering.