

**Department of Materials Science and Engineering**  
**MSE 316 Materials Science & Engineering**  
**Mechanical Behavior of Materials (4 credits)**

**Catalog Description:**

Influence of structure on the mechanical properties of ideal and real solids. Mechanical behavior in metal and ceramic systems. Offered Sp.

**Prerequisites:** Junior standing in MSE.

**Textbooks:**

Engineering Materials 1- An Introduction to their Properties and Applications, by M.F. Ashby and D.R.H. Jones

The Structure and Properties of Materials, Volume III, Mechanical Behavior, by H.W. Hayden, W.G. Moffatt, and J. Wulff  
(out-of-print, reprinted by permission of publisher)

Various books on Reserve at Engineering Library

**Course Objectives**

The purposes of this course are to introduce the student to the importance of mechanical properties and performance of materials through the study of the following topics:

- Introduction to Engineering Materials and their Properties
- Factors governing Materials Usage
- Atomic Bonding and Packing
- Elastic Moduli and the factors which govern these properties
- Yield and Flow Behavior of Materials, Resilience, and Toughness
- Fracture and Fatigue
- Creep Deformation and Failure
- Friction and Wear

**Topics Covered**

1. Types of Engineering Materials and their attributes-how we select the right material for the job
2. Price and Availability- key factors in Materials Usage
3. Packing and Bonding of Atoms in Solids
4. Stiffness of Materials, and the Laws governing Stiffness; Young's Modulus, Shear Modulus, Bulk Modulus- Why these are Elastic Moduli
5. Anelasticity
6. Yield Strength, Tensile Strength, Ductility, Toughness, and Hardness
7. Dislocations and Yielding in Crystalline Materials; Strengthening Mechanisms and Plasticity; Deformation Mechanisms in Polymers
8. Introductory Continuum aspects of Plastic Flow-Plastic Instability, Formability
9. Introduction to Fracture Toughness, Fatigue

## 10. Creep and Creep Resistance

Practical examples, including case studies, will be cited throughout the course

### **Projects**

A list will be provided, from which, students will be able to select a topic (or draw lots for a topic). A survey paper, describing the important aspects of the topic, will be prepared (5-8 typed pages, with references), and a five-minute presentation will be presented to the class.

### **Laboratory**

The accompanying laboratory, MSE 319, provides hands-on experiences in mechanical behavior for the students.

### **Course Schedule**

Three, 50 minute lectures weekly

### **Contribution of course to program objectives**

This course introduces the mechanical properties of all classes of materials to the students. The full range of mechanical behavior is discussed, with a variety of practical examples and case studies. Specifically, this course focuses on objectives 1, 3, 4, 6 and 9.

### **Contribution of course to professional component**

This is a major course for our undergraduate materials engineers, in which they learn about mechanical behavior in a variety of materials systems, including metals, ceramics, polymers and composites. The general approach allows the student to develop their background knowledge which they then apply in their specialty courses in the senior year.

**Prepared by:** George Mayer, May 2001