

## **MSE 3005: Mechanical Behavior of Materials (required)**

### **Catalog Description:** (3-0-3)

Prerequisites: MSE 2001 Principles and Applications of Engineering Materials and COE 3001 Deformable Bodies

The correlation of mechanical properties with atomic bonding, microstructure, and micromechanics, for applications relevant to materials selection and design, mechanical forming, and failure of materials.

**Textbook:** Marc Meyers and Krishan Chawla, *Mechanical Behavior of Materials*, 2<sup>nd</sup> Edition, Cambridge University Press., New York

**Prepared by:** Christopher Muhlstein

### **Topics Covered:**

1. Elasticity and viscoelasticity
2. Plasticity
3. Imperfections: point, line, and volume defects
4. Strengthening mechanisms
5. Fracture
6. Fatigue
7. Creep
8. Environmental degradation

### **Course Outcomes:**

Outcome 1: The student will possess the fundamental knowledge and skills to function effectively in materials science and engineering- related positions in industry and government, or to successfully pursue advanced studies.

- 1.1 The student will demonstrate a basic understanding of the relationships between structure, chemistry, and mechanical properties of materials (e.g., elastic modulus, strength, ductility, and fracture toughness)
- 1.2 The student will demonstrate an understanding of the fundamental principles of linear elastic fracture mechanics.
- 1.3 The students will demonstrate an understanding of material degradation mechanisms

Outcome 2: The student will demonstrate technical competence using current engineering techniques, skills and tools.

- 2.1 The student will demonstrate a basic understanding of the relationships between structure, chemistry, and mechanical properties of materials (e.g., elastic modulus, strength, ductility, and fracture toughness)
- 2.2 The student will demonstrate an understanding of the fundamental principles of linear elastic fracture mechanics.

Outcome 3: The student will demonstrate an ability to identify, formulate, and solve engineering problems

3.1 The student will demonstrate the ability to perform basic stress analyses and evaluate the performance of the design (e.g., stiffness, strength, fatigue resistance).

**Correlation between Course Outcomes and Student Outcomes:**

Course Outcomes	Student Outcomes										
	a	b	c	d	e	f	g	h	i	j	k
1.1 The student will demonstrate a basic understanding of the relationships between structure, chemistry, and mechanical properties of materials (e.g., elastic modulus, strength, ductility, and fracture toughness)	X				X						
1.2 The student will demonstrate an understanding of the fundamental principles of linear elastic fracture mechanics.	X				X						
1.3 The students will demonstrate an understanding of material degradation mechanisms	X				X						
2.1 The student will demonstrate a basic understanding of the relationships between structure, chemistry, and mechanical properties of materials (e.g., elastic modulus, strength, ductility, and fracture toughness)	X				X						X
3.1 The student will demonstrate the ability to perform basic stress analyses and evaluate the performance of the design (e.g., stiffness, strength, fatigue resistance).	X				X						X
<b>Entire Course</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>

**0 = None or insignificant; 1 = Some; 2 = Moderate; 3 = Strong**

**School of Materials Science and Engineering Student Outcomes:**

- (a) an ability to apply knowledge of mathematics, science and engineering
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data
- (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- (d) an ability to function on multidisciplinary teams
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (i) a recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice