MATL 8020 - Mechanical Properties of Materials

Fall 2026 Syllabus, Section 01, CRN 43996,

Credit hours: 3

Instructor

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Public Instructor Information

Instructor Title: Associate Professor

Professional Qualifications:
PhD, Mechanical Engineering, Iowa State University
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Course Description

8020. Mechanical Properties of Materials. This course addresses the mechanical behavior of materials, assuming knowledge of elasticity, plasticity, fracture and creep, and aims to provide a robust analytical treatment of these topics across size scales and material types. The course is split into three sections: (a) Continuum mechanics, (b) Advanced phenomena in mechanics of materials, and (c) Case studies focused on the design and processing of materials. Prereq.: MATL 8010. 3 s.h.

Course Readings

Group	Title	Author	ISBN
Required	Selected journal articles and instructor-provided notes.		
Choose One	Mechanical Behavior of Materials.	Norman E. Dowling	
Choose One	Mechanical Behavior of Materials.	Thomas H. Courtney	
Optional	Mechanical Metallurgy	George E. Dieter	
Optional	Deformation and Fracture Mechanics of Engineering Materials	Richard W. Hertzberg	

The course readings are subject to change in the event of extenuating circumstances, research developments, current events, and/or to ensure better learning.

Required Texts:
1. Norman E. Dowling, Mechanical Behavior of Materials.
2. Thomas H. Courtney, Mechanical Behavior of Materials.
Recommended References:
1. George E. Dieter, Mechanical Metallurgy.
2. Richard W. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials.
3. Selected journal articles and instructor-provided notes.

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Schedule of Topics and Assignments

Day	Date	Proposed Topic	Due/To Prepare for Class
Tue	8/25	Course Introduction and Scope	
Thu	8/27	Stress, Strain, and Mechanical Response	
Tue	9/1	Atomic Bonding and Elastic Properties	
Thu	9/3	Elastic Constants and Anisotropy	
Tue	9/8	Crystal Structures and Slip Systems	
Thu	9/10	Dislocations and Crystal Defects	
Tue	9/15	Yielding and Plastic Deformation	
Thu	9/17	True Stress–Strain Behavior	
Tue	9/22	Strain Hardening and Recovery	
Thu	9/24	Strengthening Mechanisms	
Tue	9/29	Fracture Fundamentals	
Thu	10/1	Stress Concentration and Crack Initiation	
Tue	10/6	Fracture Toughness and Crack Growth	
Thu	10/8	Ductile vs Brittle Failure	
Tue	10/13	Fatigue Fundamentals	
Thu	10/15	Fatigue Failure and Engineering Design	
Tue	10/20	Midterm Examination	
Thu	10/22	Creep and High-Temperature Properties	
Tue	10/27	Viscoelasticity	
Thu	10/29	Mechanical Properties of Polymers	
Tue	11/3	Mechanical Properties of Ceramics	
Thu	11/5	Toughening Mechanisms and Thermal Shock	
Tue	11/10	Composite Materials Fundamentals	
Thu	11/12	Composite Failure Mechanisms	
Tue	11/17	Additive Manufacturing and Nanomaterials	
Thu	11/19	Environmental Effects and Material Degradation	
Tue	11/24	Mechanical Testing Techniques and Material Selection	
Thu	11/26	Engineering Failure Case Studies / Student Presentations	
Tue	12/1	Project report/ presentation	
Thu	12/3	Review	
Tue	12/8	Final Week	
Thu	12/10	Final Week	

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