MENG S280E, Mechanical Engineering Department, Yale University
Mechanical Engineering I: Strength and Deformation of Mechanical Elements
Summer 2025

Instructor: Michael P. Murrell, PhD Email: michael.murrell@yale.edu

Lectures: Time: MW 9:00-12:15 Location: *zoom*

Prerequisites: PHYS 180 or 200 and MATH 115

Textbook: Mechanical Behavior of Materials, Thomas H. Courtney

Objectives:

This course explores the mechanical behavior of materials and structural elements under various loading conditions. Students will learn about stress, strain, elasticity, plasticity, failure mechanisms, and design principles for mechanical components. The course emphasizes analytical methods, experimental techniques, and real-world applications in engineering design.

By the end of the course, students will be able to:

1. Analyze stress and strain in mechanical components.
2. Apply principles of elasticity and plasticity to engineering problems.
3. Evaluate failure mechanisms such as yielding, fatigue, fracture, and creep.
4. Design structural elements for strength, stiffness, and reliability.

Grading:

Test 1: 1/3
Test 2: 1/3
Homework: 1/3

The default grading rubric is as follows: A: 93-100, A-: 90-93, B+: 87-90, B: 83-87, B-: 80-83, C+: 77-80, C: 73-77, C-: 70-73, D+: 67-70, D: 63-67, D-: 60-63, F: below 60. It may be subject to change.

Due to the condensed nature of the class, attendance is mandatory to all sessions. Missing lecture will place you significantly behind

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Schedule (Subject to Change)

Wk	Date	Topic
1	5/26	**Introduction to Mechanical Behavior of Materials.** Stress and Strain Concepts, Types of Loading, Engineering vs True Strain, Elastic and Plastic Deformation
	5/28	**Stress and Strain Analysis**. Mohr's Circle for stress and strain, Principal stresses and strains, Poisson Ratio
2	6/2	**Material Properties and Failure Criteria**. Yield Criteria, VonMises, Tresca
	6/4	**Fracture Mechanics**. Griffiths theory, stress intensity factor, Ductile vs Brittle Fracture
3	6/9	**Exam 1**
	6/11	**Fatigue and Cyclic Loading**. Crack growth and Paris' Law
4	6/16	**Viscoelasticity**. Creep, Stress Relaxation
	6/18	**Structural Stability and Buckling**. Euler buckling theory
5	6/23	**Torsion and Bending in Mechanical Elements. Bending stress in beams.** Beam deflection and stiffness. Design of Beams /
	6/25	**Exam 2**