MAE 131B
Fundamentals of Solid Mechanics II (4 units)

Class/Laboratory Schedule: four hours of lecture, eight hours outside preparation.
12 hours/week total

Course Coordinator(s): Nicholas Boechler, Michael Frazier, Maziar Ghazinejad,

Textbooks/Materials:

1. A.C. Ugural and S.K. Fenster, Advanced Strength and Applied Elasticity (4th Edition), Prentice Hall, 2003

Catalog Description: Continuous mechanics of solids and its application to the mechanical response of machine and structural elements. Stress and strain in indicial notation; field equations and constitutive relations. Linear elastic stress analysis in torsion, plane stress and plane strain; stress concentrations; fracture mechanics. Extremum principles and structural stability. Viscoelasticity, plasticity, and failure criteria. Theorems of plastic limit analysis.

Prerequisites: MAE 131A or SE 110A and MAE 105. Enrollment restricted to Engineering majors only

Course Type: Technical Elective Course / Can be used as a substitution for MAE 160

Performance Criteria:
Homework: 20%
Midterm exam: 30%
Final exam: 50%

Course Objectives:
Objective 1
1.1 Students will demonstrate that they can apply the equilibrium conditions to determine the distribution of internal forces in a structure
1.2 Students will demonstrate that they can distinguish between normal and shear stresses, dilatational and shear strains, and the corresponding material properties

Objective 2
2.1 Students will demonstrate that they can recognize the qualitative features of the stresses, strains, material properties and area properties associated with axial loading, torsion and bending

2.2 Students will demonstrate that they can solve for stresses in a structural component under axial loading, torsion, and bending, acting individually or in combination
2.3 Students will demonstrate that they can solve for the deformation of a structural component due to axial loading, torsion, and bending loads, acting individually or in combination

Objective 3
3.1 Students will demonstrate that they can solve for the principal stresses in structural components subjected to a combined state of loading, including non-beam-like solids using techniques such as Airy stress functions
3.2 Students will demonstrate that they can recognize, formulate and solve statically indeterminate structural components

Objective 4
4.1 Students will demonstrate that they can solve for the response of viscoelastic materials
4.2. Students will demonstrate that they can solve for the response and failure threshold of elastoplastic materials

ABET Student Outcomes Satisfied:
(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
(4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
(ME8) an ability to work professionally in mechanical systems areas.
(ME10) an ability to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations).
(ME11) an ability to model, analyze, design, and realize physical systems, components or processes.

Course Topics:
1. Stress and Equilibrium
2. Displacement and Strain
3. Stress-Strain Relations
4. Problems in Elasticity
5. Failure Criteria & Viscoelasticity

6. Energy Methods
7. Bending of Beams
8. Torsion of Prismatic Bars
9. Stability and Buckling

Last Updated: 22nd July 2019