Mechanical Engineering Dept. Department

Syllabus
ME 487: Mechanics of Materials (3-0-3)

Course Catalog Description:

Analysis of stress and strain in two and three dimensions. Equilibrium, compatibility and stress-strain relations. Analysis of torsion: non-circulation sections, Saint Venant's theory, membrane analogy, hollow sections. Thick walled cylinders. Membrane stresses in thin shells. Bending of flat plates. Energy theorems.

Course Pre-requisites:

- ME 301: Machine Design I

Course Objectives:

1. This course is designed to introduce the students to the theoretical formulations for the calculation stresses and strains in structural members subjected to various load types.
2. Students will learn how to use the energy theorems to obtain solutions to elasticity problems.
3. Students shall be able to carry out multi-axis stress analysis and determine linear and torsional deflections in various types structural members/machine elements .
4. Students shall be able to select an appropriate failure criteria for a given mechanical component.

Course Learning Outcomes:

CLO1. Understand and know the general concepts and definitions of stress and strain.

CLO2. Analyze a structural or mechanical system subjected to loads

CLO3. To select and evaluate proper failure criteria

CLO4. Formulate and establish mathematically the deflection based on an understanding of the mechanics of the problem for selected structural element

Learning Resources:

- A. Boresi and R. Schmidt, Advanced Mechanics of Materials, 6th Edition, John Wiley & Sons, Inc., 2003
- Ugural and Fenster, Advanced Strength and Applied Elasticity, Elsevier, New York, 1977.

Lecture Assessment Plan:

Assessment Task	Week Due	Weight
Term Project	15	15.0%
Final	16	35.0%
Midterm	9	25.0%
Quizes	After each unit	10.0%
Homeworks	After each unit	15.0%

Lecture Weekly Schedule:

Week#	Topics
1	Analysis of stress and stress tensors, equilibrium equations, principal stresses, stress boundary conditions
2	Analysis of strain, strain-displacement relations, compatibility equations, generalized Hooke’s Law
3	Two-dimensional problems in elasticity; plain strain and plane stress problems; airy stress functions
4	Two-dimensional problems in elasticity; plain strain and plane stress problems; airy stress functions (Continue)
	Torsion of prismatic bars; Saint Venant’s theory, Prandtl’s membrane analogy, open thin-walled members, multiple-connected thin-walled sections, separation of variables for rectangular sections.
5	Torsion of prismatic bars; Saint Venant’s theory, Prandtl’s membrane analogy, open thin-walled members, multiple-connected thin-walled sections, separation of variables for rectangular sections. (Continue)
6	Torsion of prismatic bars; Saint Venant’s theory, Prandtl’s membrane analogy, open thin-walled members, multiple-connected thin-walled sections, separation of variables for rectangular sections. (Continue)
	Axisymmetrically loaded members, thick-walled cylinders, maximum tangential stress, compound cylinders
7	Axisymmetrically loaded members, thick-walled cylinders, maximum tangential stress, compound cylinders (Continue)
8	Axisymmetrically loaded members, thick-walled cylinders, maximum tangential stress, compound cylinders (Continue)
	Bending of thin plates, stress-curvature-moment relations, deflection equations, boundary conditions, simply supported rectangular plates, axisymmetrically loaded circular plates
9	Bending of thin plates, stress-curvature-moment relations, deflection equations, boundary conditions, simply supported rectangular plates, axisymmetrically loaded circular plates (Continue)

Week#	Topics
10	Bending of thin plates, stress-curvature-moment relations, deflection equations, boundary conditions, simply supported rectangular plates, axisymmetrically loaded circular plates (Continue)
11	Thin shells, simple membrane action, symmetrically loaded shells of revolution, cylindrical shells
12	Thin shells, simple membrane action, symmetrically loaded shells of revolution, cylindrical shells (Continue)
13	Energy methods, work done in deformation, strain energy, the reciprocity theorem, the principle of virtual work.
14	Energy methods, work done in deformation, strain energy, the reciprocity theorem, the principle of virtual work. (Continue)
15	Crotti-Engresser Theorem, statically indeterminate systems, the Rayleigh-Ritz method