ME(CEE) 4190(5190) Advanced Mechanics of Materials

2007 Catalog Data: ME(CEE) 4190(5190). Advanced Mechanics of Materials. Lec. 3. Credit 3.
Prerequisites: CEE 3110, Math 2120 or consent pf instructor. Advanced topics; fracture mechanics, elastic support, noncircular shafts, curved beams, thick-walled cylinders, introduction to plates, thin shells of revolution. [Elective Course]

Prerequisites by Topic: Mechanics of materials

Textbook and Resources:
Advanced Mechanics of Materials, 6th Ed., A.P. Boresi, et al.
Course notes and resource material listed below.
Advanced Mechanics of Materials, R.D. Cook and W.C. Young
Roark's Formulas for Stress and Strain, 6th Ed., W.C. Young
Mechanics of Materials, 3rd Ed., R.C. Hibbeler

Course Objectives: The objectives of this course are: (a) to understand the three-dimensional nature of stress and strain and the relationships between strain and displacement (kinematics) and stress and strain (constitutive behavior), (b) to further develop concepts related to energy methods, (c) to relax traditional mechanics of materials assumptions for bars, beams, and shafts so that solutions can be found for straight beams with asymmetric cross sections and out of plane loads, elastic foundations, curved beams ,torsion of noncircular cross sections, plates, shells, and pressure vessels with thick walls, (d) to introduce fracture mechanics and compare it to more traditional approaches to failure analysis, and (e) to prepare students for graduate studies in solid mechanics.

Course Topics:

T1. Three-dimensional stress and strain	(10%)
T2. Traditional failure theories, stress concentrations, and fracture mechanics	(20%)
T3. Energy methods	(10%)
T4. Enhanced straight beam analysis (shear centers, asymmetric bending, elastic foundations)	(20%)
T5. Curved beam stresses and deflections	(10%)
T6. Plates and shells	(10%)
T7. Thick-walled cylinders	(10%)
T8. Torsion of noncircular sections	(10%)

Class/Lab Schedule: Minimum student contact time - 2200 minutes

Course Outcomes: Upon completion of this course, successful students will be able to:

C1. Relate load and deformation states to the proper components of stress and strain. [a,b,e]
C2. Relate displacement to strain using small strain theory and strain to stress using Hooke's law. [a,b,e]
C3. Identify and calculating principal stress directions and magnitudes. [a,b,e,k]
C4. Apply traditional approaches to failure analysis. [a,b,e,k]
C5. Apply energy methods to straight and curved beams. [a,e,k]
C6. Recognize the assumptions associated with My/I and $\alpha PL^3/EI$ for straight beams and applying alternate approaches when the straight beam assumptions are not satisfied (shear centers, asymmetric bending, curved beam theory, elementary plate theory). [a,b,e,k]
C7. Recognize the assumptions associated with Tr/J and applying alternate approaches for noncircular cross sections in torsion. [a,k]
C8. Recognize the assumptions associated with pr/t and applying alternate approaches for thick-walled cylinders and noncircular membranes (shells). [a,b,k]
C9. Recognize the significance and use of stress concentration factors and fracture mechanics (notch versus crack) [a,e,k]

Professional Component: This course is an elective course available for all Mechanical Engineering and Civil Engineering students. It contains advanced materials pertinent to both mechanical systems (machine design) and to structural mechanics.

Contribution of Course to Meeting the Professional Component:

Math and Basic Science:
General Education:
Engineering: 3 credit hours
Other:

Relation to Program Objectives: Many of our graduates need to understand mechanics of materials at a higher level than provided in a single undergraduate course. This course bridges the gap between a first course in mechanics of materials and graduate level courses in elasticity, plates and shells, and fracture mechanics.

5000-Level Credit: Students registered for 5000-level credit will be given additional assignments commensurate with a graduate-level course. The exact nature of these assignments will be specified by the instructor in the Course Policy for that semester.

Course Coordinator: Undergraduate Program Committee (dual-listed with CEE Department)

Prepared by: Christopher D. Wilson **Date:** 1-15-08