

Tennessee Technological University
Department of Civil & Environmental Engineering
CEE 4190 (5190) – Advanced Mechanics of Materials
Elective
Fall Semester 2007

- 2007 Catalog Data: CEE 4190 (5190): Advanced Mechanics of Materials. Lecture 3. Credit 3. Advanced topics; fracture mechanics, elastic support, non-circular shafts, curved beams, thick-walled cylinders, introduction to plates, thin shells of revolution. Prerequisites: CEE 3110, Math 2120, or consent of instructor.
- Textbook: Boresi, Schmidt, and Sidebottom, *Advanced Mechanics of Materials*, 5th edition, Wiley, 1993.
- Reference: W.B. Bickford, *Advanced Mechanics of Materials*, Addison-Wesley, 1998.
- Coordinator: Y. J. Liu, Associate Professor of Civil Engineering
- Goal: The goal of CEE 4190 (5190) “Advance Mechanics of Materials” is a continuation of mechanics of materials (CEE 3110). The objective is to recognize situations where previously studied mechanics of materials solutions are not valid, and further, to formulate and apply solutions for these situations using the mechanics of materials approach or energy methods.

Course learning objectives:

1. The student is to realize the three-dimensional nature of stress and strain and the relationships between strain and displacement (kinematics) and stress and strain (constitutive behavior).
2. The student is to further develop concepts related to energy methods.
3. The student is to learn the relaxing of 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, curved beams, torsion of noncircular cross sections, plates and shells.
4. The student is to be prepared for graduate studies in solid mechanics.

Course measurable outcomes:

Students will be expected to:

1. relate loading and deformation states to the proper components of stress and strain;
2. relate displacement to strain using small strain theory and strain to stress using Hooke’s law;
3. identify principal stress directions and magnitudes;
4. apply traditional approaches to failure analysis;
5. apply Castigliano’s Second Theorem to straight and curved beams subjected to shear forces, normal forces, bending moments, and twisting moments; and
6. recognize the assumptions associated with M_y/I and $\alpha PL^3/EI$ for straight beams and applying alternate approaches when the straight beam assumptions are not satisfied (shear center, asymmetric bending, curved beam stresses, plates and shells).

Topics covered: (Three lecture classes per week, 55 minutes each)

1. Review: math and mechanics of materials (2 classes)
2. Theory of stress and strain (4 classes)
3. Stress transformation and principal stresses (4 classes)
4. Constitutive equations: isotropic, orthotropic, anisotropic materials (3 classes)
5. General failure theory: ductile yielding, brittle fracture, crack propagation (3 classes)
6. Energy method: strain energy (6 classes)
7. Application on deflections: statically determinate and indeterminate structures (3 classes)
8. Application on deflections: deflection of curved beam (3 classes)
9. Introduction to elastic stability of columns: elastic buckling (3 classes)
10. Bending: nonsymmetrical straight beam bending (3 classes)

11. Torsion: linear elastic solution with different cross-sections (3 classes)
12. Beams on elastic foundations (2 classes)
13. Tests (2 classes)

Contribution of the course to meeting professional component:

This course is a part of the engineering topics of the curriculum and is an elective.

ABET category content as estimated by faculty member who prepared this course description:

Engineering Science: 3 credits or 100%
 Engineering Design: 0 credits or 0%

Relation of course to program outcomes:

- Outcome 1: The graduates will have a broad understanding of the relevant principles of mathematics, science, and engineering.
- Outcome 2: The graduates will have a general comprehension of the four technical areas appropriate to civil engineering.
- Outcome 4: The graduates will be capable of design activities and have the ability to identify, formulate, and solve engineering problems.
- Outcome 8: The graduates will have the ability to use techniques, skills, and modern engineering tools needed for engineering practice.

Relation of course to ABET Criteria:

<u>General Criteria</u>	Bloom's Level of Achievement
(3a) Knowledge of math, science, engineering	3
(3e) Identify, formulate, and solve engineering problems	3
(3k) Techniques, skills, modern tools for engineering practice	3

<u>Program Criteria</u>	Bloom's Level of Achievement
1. Apply knowledge of math and sciences	3
2. Apply knowledge of four technical areas appropriate to civil engineering	3

Computer usage:

1. Students may be required to use a current computer language, such as, Maple, Mathcad, Fortran or Matlab.

Laboratory projects: None

Prepared by: Y. J Liu

Date: October, 2007