Mechanics of Materials – ENGR 332
Abilene Christian University
Fall 2015

Catalog Description
This course is a study of the internal effects of stresses and strains on solid bodies subjected to external loading. **Prerequisites: ENGR 220 and Math 186. Credit hours: 3**

Class Meeting Times and Location
This class meets on Tuesday and Thursday from 8:00 a.m. to 9:20 a.m. in Foster Science Building 355, but changes in time and location may occur with changes in department scheduling.

Required Text and Software
Text: Mechanics of Materials, 9th Edition, R. C. Hibbeler, Pearson Prentice Hall. ISBN 978-0133-25442-6.
Software: Mastering Engineering, Pearson Prentice Hall; software access is provided with the text.

Contact Information

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Intended Audience
This course is required for all engineering majors and will normally be taken in the third year of the engineering degree program. Prerequisite skills require completion of ENGR 220 and MATH 186 or its equivalent.

The mission of ACU
To educate students for Christian service and leadership throughout the world.

The mission of the College of Arts and Sciences
To educate students for worldwide Christian service and leadership through programs of study and other learning experiences that blend a liberal arts education with professional and career education.

The mission of the Engineering and Physics Department
The ACU engineering program strongly supports the university's mission of educating students for Christian service and leadership throughout the world. In support of this mission, ACU engineering graduates will attain:

-A deep and broad understanding of engineering principles and practices as evidenced by professional employment, continued professional development, and graduate study in engineering or other professional fields.
- An extensive knowledge of the innovative design processes unique to engineering professionals as demonstrated by using critical thinking skills to contribute to the scientific and technical literature, patents and intellectual property, professional societies, and creative designs.
-A thorough understanding of Christian service and leadership as shown in their commitments to professionalism, ethics, and service and leadership within the engineering profession, the church and society.

Teaching Philosophy
Engineering and physics are respected professions. The public places great trust in these professionals as honest, competent, and ethical individuals. Many codes of ethics for these fields indicate that a commitment to protecting the health, safety, and welfare of the public is of paramount importance. These values are in harmony with Christian principles and ideals as exhibited in passages from the Bible. Christian engineers should be honest (Matthew 5:37), work hard to ensure competency (Colossians 3:23), and put the interest of the public ahead of his or her own (Luke 6:31). In keeping with these principles this course will be taught so that students may gain an appreciation for the professional nature of engineering and physics. The instructor encourages the discussion of topics that relate to the integration of faith and professional responsibilities.

Class Format
Class time will usually be spent in lecture and discussion that builds on the treatment in the text of engineering mechanics principles. Class participation will not be graded formally, but active engagement by students will enhance the learning process. Reading before class will make the discussions more useful. Preparation should also be made so that a student is ready to assist in derivation and solution work if invited to do so. As students study example problems they should work to understand the reasons for problems being solved in a particular way. Developing the ability to understand why a solution step is appropriate is part of the process of gaining the skill for design decisions that will be made as an engineer.

Learning Objectives
This courses provides significant direct focus on the following ABET Student Program Outcomes:

(a) An ability to apply knowledge of mathematics, science, and engineering
(e) An ability to identify, formulate, and solve engineering problems
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

These program outcomes are promoted and actualized through instruction, graded homework assignments and examinations.

Competencies and Measurements

	Competency	Measurement
1	Calculate the effects of stresses and strains on solid bodies under axial, torsional, and bending loads.	Homework; Exams 1 and 2
2	Examine shear flow and the effects of combined loadings	Homework; Exams 2 and 3
3	Recognize and apply basic stress and strain transformations	Homework; Exam 3
4	Identify and apply methods for design and analysis of beams and shafts	Homework; Exams 3 and 4
5	Solve column design and buckling	Homework; Exam 4

Course Policies

Academic Integrity
Academic integrity involves completion of assigned academic work for each class by the individual or group responsible for the work. Violations of academic integrity and other forms of cheating include the intention to deceive, mislead, or misrepresent, and are therefore a form of lying. Such actions are contrary to behavioral norms that flow from the nature of God. Academic misconduct includes, but is not limited to: failing to give credit to sources used in a work in an attempt to present the work as one's own; submitting papers or projects obtained from another source as one's own; falsifying information orally or in writing; and receiving, giving, or using unauthorized aid on examinations or quizzes. An example of academic misconduct might be copying an instructor's solution without permission and sharing the solution with classmates; all participants in this activity would be guilty of academic misconduct. Such actions may result in, but are not limited to, a zero grade for the assignment and/or a failing grade in the course. The department chairman, the Dean of the College of Arts and Sciences and the Dean of Student Life will also be notified of this activity. The full university policy, including the process for appealing a decision, may be found at the link: http://www.acu.edu/academics/provost/policies/index.html.

Attendance Policy
Attendance with prompt arrival is expected for all class sessions. Absence or tardiness will negatively affect participation, homework, and quiz grades. Classes will typically involve the presentation and discussion of new material, discussion of reading assignments from the text, or the consideration of problem solutions. Students are required to attend at least 80% of class meetings in order to receive credit for the course. Absences cannot exceed 6 times regardless of the reason. A student who misses more than 20% of the scheduled classes will be dropped from the class with a grade of WF, which is averaged in the students GPA as a grade of F.

Grading Policy

Course Assignments	Due Date	Weight
Homework assignments and due dates are included in the Daily Schedule. Homework will use the software package Mastering Engineering that is provided by the textbook publisher. Each homework problem will have points assigned based upon the level of effort that is required to solve the problem, and the student will see the number of points for each problem when the assignment is started.	**Shown on the Daily Schedule**	**50%**

Although this package will provide the primary mechanism for the submittal and grading of homework, it is expected that students will develop necessary engineering skills by solving problems manually using conventional methods of computation and sketching. For this reason some homework problems will be submitted on engineering computation paper following the guidelines listed below. Homework will be due at the beginning of class on the date shown on the Daily Schedule. **No late homework will be accepted.** Students are encouraged to allocate time in advance of the due date to start on the homework, and to visit with the instructor when difficulties are encountered with particular problems. Working together on problems is also encouraged, but all solutions presented for credit must be defensible by the student submitting them for credit. Care should be exercised in becoming too dependent on a study partner because the study partner will not be available for assistance during exams. The final homework grade will be calculated as a percentage ratio of the number of points awarded to the number of points possible. **Manual Homework Guidelines:** • All manual homework must be submitted on Engineering Computation Paper, using only one side of the page and with one problem per page. This paper is available in the ACU Bookstore. • Homework must be neat and legible. • The problem statement must be shown. • Sign conventions and assumptions must be clearly stated or shown for each problem. • Free body diagrams or other drawings must be complete and well labeled. • All work that is needed to reach an answer or conclusion must be shown to receive full credit. • Proper units must be included with final answers identified clearly with a box or circle.		
Regular Exams Four examinations are scheduled for this class, with dates and times for the exams shown on the Daily Schedule. Each exam will focus on material covered during the period immediately preceding the exam, but each exam will build on concepts and skills that have been developed in the course until that time. All students are expected to take each exam at the scheduled times. Each student will be allowed to bring one single-sided 8½ X 11 sheet of handwritten notes to the exam containing content that is selected by the student.	**Exam 1 – 9/18** **Exam 2 – 10/21** **Exam 3 – 11/13** **Exam 4 – 12/4**	**10%** **10%** **10%** **10%**
Final Exam The final examination will be comprehensive and will cover material from throughout the period of the course.	**12/11**	**10%**

Calculation of Final Course Grade*

90% and above . . . . . A
80% - 89% . . . . . B
70% - 79% C
60% - 69% . . . . . D
59% and below . . . . . F

*Instructor reserves the right to decrease the lower bound for grade cut-offs.

ADA Compliance Statement

Abilene Christian University is dedicated to removing barriers and opening access for students with disabilities in compliance with ADA and Section 504 of the Rehabilitation Act. The Alpha Scholars Program facilitates disability accommodations in cooperation with instructors. In order to receive accommodations, a student must be registered with Alpha Scholars Program, and must complete a specific request for each class in which he or she needs accommodation. If a student has a documented disability and wishes to discuss academic accommodations, he or she may call the office directly at 325-674-2667.

Planned Course Schedule

Every effort will be made to closely follow this schedule, but the instructor reserves the right to alter the schedule as needed to best achieve the objectives of the class.

Class	Date	Day	Chapter	Class Agenda	Homework from Lecture *Problems solved manually and submitted	HW Due Today
1	8/26	Tu	1	• Introductions • Course Policy Statement • 1.1-5 Equilibrium of a Deformable Body Stress Average Normal Stress in Axially Loaded Bar Average Shear Stress	1--Introduction to Mastering Engineering 2--Review of Statics 3--Equilibrium and Stress ***1-19; 1-66**	
2	8/28	Th	1-2	• 1.5-7 Allowable Stress Design (ASD) Limit State Design • 2.1-2 Deformation Strain	4--ASD and LRFD 5--Deformation and Strain ***1-94; 2-21**	1, 2
3	9/2	Tu	3	• 3.1-5 Tension and Compression Test Stress-Strain Diagram Stress-Strain of Ductile and Brittle Materials Hooke's Law Strain Energy	6--Stress-Strain Diagram and Shear Energy ***3-21**	3, 4, 5 **1-19** **1-66**
4	9/4	Th	3	• 3.6-8 Poisson's Ratio Shear Stress-Strain Diagram Failure Due to Creep and Fatigue	7--Poisson's Ratio and Shear Stress-Strain ***3-26**	6 **1-94** **2-21**
5	9/9	Tu	4	• 4.1-3 Saint Venant's Principle Elastic Deformation of Axially Loaded Members Principle of Superposition	8--Elastic Deformation of Axially Loaded Members ***4-20**	7 **3-21**
6	9/11	Th	4	• 4.4-6 Statically Indeterminate Axial Loaded Member Force Method for Axial Loaded Members Thermal Stress	9--Statically Indeterminate Axial Loading and Thermal Stress ***4-43**	8 **3-26**

7	9/16	Tu	4	• 4.7-9 Stress Concentrations Inelastic Axial Deformation Residual Stress • Review for Test	10--Stress Concentrations and Inelastic Axial Deformation	9 **4-20**
8	9/18	Th		**EXAM ONE** MECHANICS OF MATERIALS – CHAPTERS 1-4		10 **4-43**
9	9/23	Tu	5	• 5.1-3 Torsional Deformation of Circular Shaft Torsion Formula Power Transmission	11--Torsion and Power Transmission ***5-20; *5-34**	
10	9/25	Th	5	• 5.4-8 Angle of Twist Statically Indeterminate Torque Loaded Members Solid Noncircular Shafts Stress Concentration	12--Angle of Twist and Statically Indeterminate Torques ***5-54; 5-91**	11 **5-20** **5-34**
11	9/30	Tu	6	• 6.1-2 Shear and Moment Diagrams Graphical Method for Shear and Moment Diagrams	13--Shear and Moment Diagrams ***6-4; 6-24**	12 **5-54** **5-91**
12	10/2	Th	6	• 6.3-4 Bending Deformation of Straight Member Flexure Formula Moment of Inertia and Product of Inertia	14--Bending and Beam Flexure ***6-69;** **6-100**	13 **6-4** **6-24**
13	10/7	Tu	6	• 6.5-9 Unsymmetric Bending Composite Beams Stress Concentrations	15--Unsymmetric Bending and Composite Beams ***6-112; 6-128**	14 **6-69** **6-100**
14	10/9	Th	7	• 7.1-2 Shear in Straight Members Shear Formula	16--Shear Formula ***7-2**	15 **6-112** **6-128**
15	10/14	Tu	7	• 7.3-5 Shear Flow in Built-Up Members Shear Flow in Thin-Walled Members Shear Center for Open Thin-Walled Members	17--Shear Flow ***7-33; 7-60**	16 **7-2**

16	10/16	Th	8	• 8.1-2 Thin-Walled Pressure Vessels State of Stress Caused by Combined Loadings • Review for Test	18—Thin-Wall Pressure Vessels and Combined Loading ***8-3; 8-27**	17 **7-33** **7-60**
17	10/21	Tu		**EXAM TWO** MECHANICS OF MATERIALS – CHAPTERS 5-7		
18	10/23	Th	9	• 9.1-3 Plane-Stress Transformation General Equations of Plane-Stress Transformation Principle Stress and Maximum In-Plane Shear Stress	19—Plane Stress Transformation and Principle Stresses ***9-3; 9-24**	18 **8-3** **8-27**
19	10/28	Tu	9	• 9.4-5 Mohr's Circle—Plane Stress Absolute Maximum Shear Stress	20—Mohr's Circle-Plane Stress and Max Shear Stress ***9-44; 9-83**	19 **9-2** **9-24**
20	10/30	Th	10	• 10.1-3 Plane Strain General Equations of Plane-Strain Transformation Mohr's Circle—Plane Strain		20 **9-44** **9-83**
21	11/4	Tu	10	• 10.4-7 Absolute Maximum Shear Strain Strain Rosettes Material Property Relationships Theories of Failure		
22	11/6	Th	11	• 11.1-4 Basis for Beam Design Prismatic Beam Design Fully Stressed Beams Shaft Design • Review for Test		
23	11/11	Tu	12	• 12.1-4 Elastic Curve Slope and Displacement by Integration Discontinuity Functions Slope and Displacement by Moment-Area Method		
24	11/13	Th		**EXAM THREE** MECHANICS OF MATERIALS – CHAPTERS 8-11		
25	11/18	Tu	12	• 12.5-9 Method of Superposition Statically Indeterminate Beams and Shafts—Method of		

				Integration Statically Indeterminate Beams and Shafts—Moment-Area Method Statically Indeterminate Beams and Shafts—Method of Superposition		
26	11/20	Th	13	• 13.1-3 Critical Load Ideal Column with Pin Supports Columns Having Various Types of Supports Secant Formula		
27	11/25	Tu	13	• 13.4-7 Inelastic Buckling Design of Columns for Concentric Loading Design of Columns for Eccentric Loading		
28	12/2	Tu		• Prep for Test Four and Final Exam		
29	12/4	Th		• **EXAM FOUR** • MECHANICS OF MATERIALS – CHAPTERS 11-13		
30	12/11	Th		• MECHANICS OF MATERIALS • FINAL EXAM 8:00-9:45 AM		