THE UNIVERSITY OF TEXAS-PAN AMERICAN

College of Engineering and Computer Science

Department of Mechanical Engineering

MECE 3321-02 Mechanics of Solids – 3 Credits – Spring 2011

Room: ENGR 1.242 **Time:** TR 7:45 – 9:00 am

Instructor: Dr. Constantine Tarawneh **Office:** ENGR 3.228 **Phone:** (956) 665-2607

Office Hours: MTWR 1:00 - 2:25 pm **Strict**, or by Appointment

Email: tarawneh@utpa.edu **Website:** http://mece.utpa.edu/~tarawneh/

Prerequisite: Statics (MECE 2303)

Co-requisite: Mechanical Engineering Analysis II (MECE 3450)

Prerequisite Knowledge:

- Calculus (integration and differentiation) and Linear Algebra (systems of equations)
- Vector Analysis (understanding of vector representations and operations)
- Statics (free body diagrams and equilibrium analysis)

Textbook:

R. C. Hibbeler, **Mechanics of Materials**, 7th Edition, Prentice Hall, Upper Saddle River, NJ, 2008. **[ISBN 978-0-13-220991-5]**

Course Description:

Internal forces and deformation in solids; stress and strain in elastic and plastic solids; applications to beams, columns, a variety of engineering problems and introduction to computer modeling.

Course Objectives:

- Introduce the fundamental concepts of stress analysis of common engineering machines and structures.
- Develop high quality skills in the areas of problem formulation, solution, and presentation.

Grading Policy:

There will be weekly homework assignments and quizzes (20%), three midterm exams (20% each), and a final exam (20%). Exams will be closed-book and notes except for one 8.5″×11″ formula sheet.

Homework:

A homework will be assigned every week. The homework problems will be posted on the Web Site. To ensure that students do their own work, one of the problems from each homework will be chosen for a ten minute quiz that will be administered after the homework is handed in. The student's performance on the quiz will be used in grading the homework assignment. Any discrepancy between the student's performance on the quiz and the homework assignment may result in loss of credit in the total homework grade. After the homework is graded and returned, solutions will be made available in a folder put outside the instructor's office.

In solving the homework assignment, the following four steps should be followed very carefully:

1. Briefly summarize the problem statement.
2. Provide a schematic diagram of the problem.
3. Solve the problem showing your work in detail by stating your assumptions and providing the equations you used and the numerical values you obtained.
4. Write a sentence or two discussing your findings.

Failure to follow the aforementioned four steps will result in points deducted from your homework assignment.

Topics Covered:

CHAPTER	TOPIC	SECTIONS COVERED
1	*Stress*	All
2	*Strain*	All
3	*Mechanical Properties of Materials*	All except 3.8
4	*Axial Load*	4.1 – 4.7
	EXAM 1	
5	*Torsion*	5.1 – 5.5
6	*Bending*	6.1 – 6.4 and 6.9
7	*Transverse Shear*	7.1 – 7.3
	EXAM 2	
12	*Deflection of Beams and Shafts*	12.1, 12.2, 12.5 – 12.7, 12.9
8	*Combined Loadings*	All
9	*Stress Transformation*	All
	EXAM 3	
11	*Design of Beams and Shafts*	11.1 – 11.2
13	*Buckling of Columns*	13.1 – 13.3
	FINAL EXAM	

Course Outcomes & Assessment: At the conclusion of this course, students will be able to:

1. Define the study of mechanics of materials and the concepts of internal loadings, normal and shear stress, and allowable stress (factor of safety); and design members subjected to an axial load or direct shear (Ch. 1) (H,Q,T,P).
2. Define the concepts of normal and shear strain and be able to calculate the normal and shear strain in a structure under axial loading (Ch. 2) (H,Q,T,P).
3. Define the concepts of the stress-strain diagram (including the difference of stress-stain diagrams between various materials) and Poisson's ratio (Ch. 3) (H,Q,T,P).
4. Design statically determinate and indeterminate axially loaded members including the case of thermal stresses (Ch. 4) (H,Q,T,P).
5. Design statically determinate and indeterminate torsional loaded members including noncircular shafts (Ch. 5) (H,Q,T,P).
6. Draw shear and bending moment diagrams for beams and shafts using the analytical and graphical method and calculate normal and shear stresses for straight members with symmetric cross sections subjected to bending loads (Ch. 6) (H,Q,T,P).
7. Calculate the shear stress in a beam having a prismatic cross section and made from homogeneous linear elastic material (Ch. 7) (H,Q,T,P).
8. Derive the equation of the elastic curve for deformation of a member via integration and superposition (including static indeterminate beams) and use this equation to find the deflection and/or slope at any point along the length of the member (Ch. 12) (H,Q,T,P).
9. Analyze members or structures where there are combinations of various different types of loadings (axial, torsion, bending and shear) applied simultaneously to a member or structure and solve for circumferential (or hoop) stress and longitudinal (or axial direction) stress in "thin" walled vessels under pressure (Ch. 8) (H,Q,T,P).
10. Define the concept of plane stress, be able to use the general equations of plane stress transformations and Mohr's circle to determine the shear stress at a point in a structure under a variety of loadings, and determine principal stresses and maximum in-plane stress shear stress (Ch. 9) (H,Q,T,P).

If time allows:

11. Design beams able to resist both bending and shear loads (Ch. 11) (H,Q,T,P).
12. Define the concept of instability in long members that are axially loaded (columns) and be able to apply Euler's formula for finding critical loads and critical stresses (Ch. 13) (H,Q,T,P).

Key: H - Homework, Q - Quiz, T - Test, P - Project

Contribution of Course Outcomes to Program Outcomes

	1	2	3	4	5	6	7	8	S1	S2	S3	E1	E2	E3	E4	E5
1	X		X		X											
2	X		X		X											
3	X		X		X											
4	X		X		X						X					
5	X		X		X						X					
6	X		X		X											
7	X		X		X											
8	X		X		X											
9	X		X		X											
10	X		X		X											
11	X		X		X											
12	X		X		X											

Program Educational Outcomes

It will be demonstrated that the student:

1. Is able to use knowledge of mathematics, basic sciences and engineering to analyze (identify, formulate, and solve) problems in mechanical engineering.
2. Is able to design and conduct experiments and interpret the results.
3. Is able to design mechanical devices, systems or processes that meet given specifications.
4. Is able to function in multi-disciplinary teams.
5. Is able to communicate ideas effectively in graphical, oral and in written media.
6. Understands the professional responsibility of an engineer and how engineering solutions impact safety, economics, ethics, politics, and societal, cultural and contemporary issues.
7. Understands the need for life long learning to keep abreast of current practice.
8. Is able to use state of the art computational hardware and software for analysis, design and documentation (techniques, skills, and modern engineering tools necessary for engineering practice).

Program Specific Outcomes for Mechanical Engineering

Fundamentals in Science and Mathematics: It will be demonstrated that the student:

S1) Has knowledge of chemistry and calculus-based physics with depth in at least one.

S2) Has the ability to apply advanced mathematics to problems involving thermal and mechanical systems.

S3) Has the ability to apply statistics and linear algebra to problems involving thermal and mechanical systems.

Fundamentals in Engineering: It will be demonstrated that the student:

E1) Has the ability to create and annotate two-dimensional drawings, and generate three dimensional computer based solid models of mechanical components.

E2) Has the ability to design and analyze components and systems for mechanical and energy performance.

E3) Has the ability to specify and evaluate materials and manufacturing steps for mechanical components.

E4) Has the ability to conceive and conduct experiments to measure the performance of materials, components and systems and to communicate the results.

E5) Has the ability to acquire new skills and specialized knowledge from published sources.

Mechanical Engineering Department Classroom Policies

Attendance:

1. Attendance will be taken every time the class meets. Any student arriving to class **5 minutes** after the class has started will not be allowed in class. Students will be allowed a **maximum** of 5 absences for the whole semester for classes meeting three times a week, 3 absences for classes meeting twice a week, and 2 absences for classes meeting once a week. A **point** will be deducted from the total (100%) for each **unexcused** absence exceeding the maximum allowable.
2. Students **will not** be permitted to leave the classroom during lectures and exams except for **extreme emergencies**.

Homework and Exams:

1. **Absolutely** no assignments will be accepted late.
2. Make-ups for in-class exams for **extreme emergencies** will be scheduled at the end of the semester.

Plagiarism:

Any instance of cheating or plagiarism will result in **loss of credit** for the work, and will be reported to the Chair of the ME Department and/or the Dean of Students for appropriate action which may include **loss of credit** for the course or **dismissal** from the University.

Drop Policy:

Students can withdraw from a course through the *Office of the Registrar* on or prior to:

- February 2nd, 2011, Wednesday: Twelfth class day (Census date), courses dropped by this date do not count toward six course drop limit.
- February 16th, 2011, Wednesday: Last day to change course to non-credit.
- April 8th, 2011, Friday: Last day to drop courses or withdraw from the University with a grade of "DR" or "W" recorded. After this date, student remains enrolled in course(s) and receives whatever letter grade(s) he/she earns.

American Disabilities Act Statement:

If you have a documented disability which will make it difficult for you to carry out the work as I have outlined and/or if you need special accommodations/assistance due to a disability, please contact the Office of Services for Persons with Disabilities (OSPD), Emilia Ramirez-Schunior Hall, Room 1.101 immediately, or the Associate Director at MAUREEN@UTPA.EDU, 316-7005. Appropriate arrangements/accommodations can be arranged.

ACKNOWLEDGEMENT OF RECEIPT OF SYLLABUS

By signing below, I hereby affirm that I have received a copy of the syllabus for **MECE 3321 Mechanics of Solids** and have been informed by the **Instructor** that it is my responsibility to **carefully** read and understand this document and abide by all its content.

_____

Student ID Number

_____

Printed Name

_____

Signature

_____

Date