

University of Texas at Tyler - Department of Civil Engineering
CENG 3306-031 Mechanics of Materials
Spring 2020

Instructor: Shariful Huq
HEC A204
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Office Hours:
MTWR: 1:30PM-3:30PM or By Appointment

Lectures:

Monday/Wednesday/Friday: 8:00 AM-8:55AM, HEC A218

Course Website:

Canvas will be used when necessary to manage the course material for the semester. There you will find homework assignments, solutions, handouts and other material pertaining to the class.

Please check there regularly.

Catalog Description:

Stress and strain; uni-axially loaded members; normal and shear stresses; torsion; flexural behavior; beam deflections; buckling of columns; pressure vessels; combined loading; failure criteria; shear/moment diagrams.

Learning Objectives:

A. Block I: Fundamentals of Stress and Strain, Axial Loads

1. Determine internal forces (axial forces, shears, moments, & torques) in a structural member.
2. Analyze/design a centric axially loaded (2 force) member.
3. Plot / interpret normal stress-normal strain (σ vs ϵ) and shear stress-shear strain (τ vs γ) curves.
4. Given a state of stress at a point, determine the principle stresses (σ_1 & σ_2) and the maximum in-plane shear stress (τ_{max}), the angle to the principal plane (θ_p), and the state of stress on any plane through the point ($\sigma_{x'}$, $\sigma_{y'}$ & $\tau_{x'y'}$).
5. Given a state of strain at a point, determine the principle strains (ϵ_1 & ϵ_2) and the maximum in-plane shear strain (γ_{max}), the angle to the principal plane (θ_p), and the state of strain on any plane through the point ($\epsilon_{x'}$, $\epsilon_{y'}$ & $\gamma_{x'y'}$).
6. Determine the axial deformations (δ) and/or normal stress (σ) in a centric axially loaded (2 force) member due to applied loads and/or a change in temperature.
7. Analyze a statically indeterminate structure, based on compatibility of axial deformations (δ).

B. Block II: Torsion and Bending

8. Determine maximum stresses ($\sigma_{\max} = K \sigma_{\text{avg}}$) at stress concentrations due to geometric anomalies such as holes and fillets.
9. Use a stress-cycle (S - N) diagram to predict the fatigue life of a structure.
10. Determine longitudinal stress (σ_l) and hoop stress (σ_h) for a thin walled pressure vessel.
11. Analyze and design circular members in torsion, including calculating shear stresses (τ) and angles of twist (Φ).
12. Analyze a statically indeterminate torsional member, based on compatibility of torsional deformations (i.e., the angle of twist)
13. Draw shear and bending moment diagrams for a beam.
14. Determine normal flexure stresses (σ) for a beam.
15. Determine the maximum elastic internal bending moment (MME) for a beam.
16. For inelastic conditions, determine the partially-plastic internal bending moment (MPP) and the fully-plastic internal bending moment (MFP) for a beam.
17. Determine transverse shear stress (τ) at any point on a beam cross section.
18. Design a prismatic beam.

C. Block III: Beam Deflections and Buckling

19. Determine the elastic curve function for beam deflections.
20. Calculate beam deflections.
21. Analyze a statically indeterminate beam, based on compatibility of bending deformations.
22. Calculate stresses in a member subjected to combined loading due to axial, torsional, internal pressure (i.e., thin wall pressure vessels), and/or bending forces.
23. Analyze/design columns.

Prerequisite:

ENGR 2301: Engineering Statics

Required Text:

Textbook: Mechanics of Materials, Tenth Edition, R.C. Hibbeler, ISBN 978-0134319650

Recommended supplementary material (not required):

Mastering Engineering: Mechanics of materials online

Course Topics (Subject to Change):TOPICS

I. Fundamentals of Stress and Strain

Internal Forces
 Normal and Shear Stress
 Introduction to Design
 Strain
 Mechanical Properties of Materials
 Stress Transformation I
 Stress Transformation II
 Strain Transformation I
 Strain Transformation II

II. Axial Loads and Torsional Loads

Fatigue & Stress Concentrations
 Thin-Walled Pressure Vessels
 Axial Deformation I
 Axial Deformation II
 Elastic Torsion I
 Elastic Torsion II
 Theories of Failure
 Statically Indeterminate Torsion Members
 Inelastic Torsion

III. Bending

Shear and Bending Moment Diagrams I
 Shear and Bending Moment Diagrams II
 Elastic Bending I
 Elastic Bending II
 Inelastic Bending by Equilibrium
 Transverse Shear Stress I
 Transverse Shear Stress II
 Design of Prismatic Beams
 Combined Loading I
 Combined Loading II

IV. Beam Deflections and Buckling

Introduction to Beam Deflections
 Beam Deflection by Discontinuity Functions
 Beam Deflection by Superposition
 Column Buckling I
 Column Buckling II & Laboratory IV: Column Buckling
 Course Overview / Course Critique

Exams:

There will be 3 midterm examinations and one final examination. The exams are **TENTATIVELY** scheduled for:

Exam 1:	February 14 th
Exam 2:	March 6 th
Exam 3:	April 17 th
Final Exam:	April 28 th ~May 2 nd (To Be Confirmed When Schedule is Released)

Exams dates may be moved up or pushed back depending on the progress of the lectures. Exams are closed book. You can use a calculator and instructor approved reference material. **Solutions to exams may NOT be posted on Canvas. THERE ARE NO MAKE-UP EXAMS GIVEN WITHOUT AN EXCUSED ABSENCES.** A note from a medical professional is required for any absence due to illness.

Exam Rules

Exams will be conducted according to the exam rules posted on Canvas.

Homework:

Homework will be assigned on regular basis. Homework is due on the date assigned at the beginning of lecture. **No late homework will be accepted. Homework Solutions will be posted on Canvas.**

Homework should be submitted on engineering paper (preferred) or graph paper. Solutions should be presented in a clear methodical manner. Follow the “homework submission guidelines” when completing your assignment. **Assignments which are not clearly presented may have 5 percentage points deducted from the overall grade of that assignment. Be sure that you use the correct edition/version of the textbook. Problems done from other edition/versions which do not match the assigned problems will not receive credit.**

Homework Submission Guidelines (Professionalism Requirements):

- Homework should be submitted using letter size (8 ½ x 11”) paper. Engineering paper is preferred but plain graph paper is allowed if you have no access to engineering paper.
- A title page should be included with the following:
 - Name of Student
 - Student Number
 - Course Number and Name
 - Homework Number
- The second page should be a written or typed summary of the assignment. This should include:
 - The type of problems being worked.
 - The principles and assumptions present in the equations used.
 - The applications and types of members these tools may be used for.

This summary should be one or two paragraphs, written in your own words.

4. There should be no more than 2 problems per page. This is to ensure that there is enough space on the paper for the grader to add comments.
5. Multiple sheets should be stapled at the top left corner of the page.
6. The submitted papers should be free of frail edges, stains, smudges and wrinkles.
7. All problems should include:
 - a. Problem Number
 - b. A diagram of the problem (draw all free body diagrams when necessary) -drawn by hand, do not simply photocopy problem from textbook.
 - c. A set of given quantities
 - d. A set of unknown quantities
 - e. A set of assumptions
8. All numbers and writing should be clear and readable.
9. When required to produce a graph, use a computer program such as excel or matlab to generate the plot. Do not draw it by hand!
10. The **final answer should be boxed** and at the bottom of the problem.

Homework Quizzes:

Homework quizzes will periodically be given announced or unannounced covering material from homework that is due that day. **Makeup homework quizzes will not be given.**

Grades:	Grade Scale:
Homework/Quizzes =20%	A: 90-100
Professional Practice = 10%	B: 80-89
Midterm Exams (3) = 45%	C: 70-79
Final Exam = 25%	D: 60-69
	F: <60

If necessary, I reserve the right to adjust the grade scale at the end of the semester to your benefit.

****NOTE:** There will be no makeup work or extra credit allowed/granted at the end of or during the semester unless allowed/granted to everyone by the instructor. All assignments must be turned in at the appropriate time to receive credit.

Laptops/PDAs/MP3 players/Cell Phones or other electronic devices

- The use of any electronic device, except an approved calculator, is not permitted during exams. Your exam will be collected and your grade will be a zero if you are caught using a non-approved electronic device/calculators. Any instances of a calculator inappropriately used during an exam will be the basis of alleging Academic Misconduct and may result in Failing (F) of the course at the determination of the course's instructor or the basis for a recommendation for expulsion from the University. Any Calculator used during an exam in this course must meet the requirements stated within the policy below.

- **Calculator Policy**

Only NCEES approved calculators will be permitted during tests and your test will be collected and your grade will be a zero if you are using a non-approved calculator.

The approved calculators include the following: (Please check the NCEES website for a complete listing, <https://ncees.org/exams/calculator/>. Below is an excerpt from the website:

Calculator policy

To protect the integrity of its exams, NCEES limits the types of calculators examinees may bring to exam sites. The list of approved calculators is reviewed annually.

The following calculator models are the only ones acceptable for use during the 2018 and 2019 exams:

- Casio: All fx-115 and fx-991 models (Any Casio calculator must have “fx-115” or “fx-991” in its model name.)
- Hewlett Packard: The HP 33s and HP 35s models, but no others
- Texas Instruments: All TI-30X and TI-36X models (Any Texas Instruments calculator must have “TI-30X” or “TI-36X” in its model name.)

Professional Practice:

Your professional practice grade will be computed based upon your attendance, the number of assignments you turn in, and performance in class.

Final day to withdraw:

The final day to withdraw from the course without penalty is March 30, 2020.

Academic Misconduct:

Plagiarism of homework and cheating on examinations will be interpreted as academic misconduct and will not be tolerated. Please refer to the University of Texas at Tyler current Undergraduate Catalog for academic policies and Manual of Policies and Procedures for Student Affairs (MOPPS, Chapter 8) regarding academic integrity, cheating and plagiarism. Academic dishonesty will not be tolerated. Ignorance of the rules and policies provides no protection from the consequences. Academic or scholastic dishonesty includes cheating, plagiarism, collusion and/or falsifying academic records. University policy prohibits these acts and students suspected of academic dishonesty are subject to disciplinary proceedings. Therefore, cheating of any kind will not be tolerated. If you try to cheat, your course grade will be “F” and the incident will be reported to the University.

Collection of Student Work:

Throughout the semester I will collect student work (best, average, and worst) for the ABET course and outcomes notebooks. This will require me to make a copy of your work, keep your

original and return a copy of the graded work to you. I will not draw attention as to what level of work you accomplished.

Students Rights and Responsibilities: To know and understand the policies that affect your rights and responsibilities as a student at UT Tyler, please follow this link:
<http://www.uttyler.edu/wellness/StudentRightsandResponsibilities.html>

Grade Replacement/Forgiveness: **If you are repeating this course for a grade replacement, you must file intent to receive grade forgiveness with the registrar by the 12th day of class.** Failure to do so will result in both the original and repeated grade being used to calculate your overall grade point average. Undergraduates will receive grade forgiveness (grade replacement) for only three course repeats; graduates, for two course repeats during his/her career at UT Tyler.

State-Mandated Course Drop Policy: Texas law prohibits a student who began college for the first time in Fall 2007 or thereafter from dropping more than six courses during their entire undergraduate career. This includes courses dropped at another 2-year or 4-year Texas public college or university. For purposes of this rule, a dropped course is any course that is dropped after the 12th day of class (See Schedule of Classes for the specific date). Exceptions to the 6-drop rule include, but are not limited to, the following: totally withdrawing from the university; being administratively dropped from a course; dropping a course for a personal emergency; dropping a course for documented change of work schedule; or dropping a course for active duty service with the U.S. armed forces or Texas National Guard.

Petitions for exemptions must be submitted to the Registrar's Office and must be accompanied by documentation of the extenuating circumstance. Please contact the Registrar's Office if you have any questions.

Disability/Accessibility Services: In accordance with Section 504 of the Rehabilitation Act, Americans with Disabilities Act (ADA) and the ADA Amendments Act (ADAAA) the University of Tyler at Texas offers accommodations to students with learning, physical and/or psychological disabilities. If you have a disability, including non-visible a diagnosis such as a learning disorder, chronic illness, TBI, PTSD, ADHD, or you have a history of modifications or accommodations in a previous educational environment, you are encouraged to visit <https://hood.accessiblelearning.com/UTTyler> and fill out the New Student application. The **Student Accessibility and Resources** (SAR) office will contact you when your application has been submitted and an appointment with an Accessibility Case Manager. For more information, including filling out an application for services, please visit the SAR webpage at <http://www.uttyler.edu/disabilityservices>, the SAR office located in the University Center, # 3150 or call 903.566.7079.

Student Absence due to Religious Observance: Students who anticipate being absent from class due to a religious observance are requested to inform the instructor of such absences by the second class meeting of the semester.

Student Absence for University-Sponsored Events and Activities: If you intend to be absent for a university-sponsored event or activity, you (or the event sponsor) must notify the instructor

at least two weeks prior to the date of the planned absence. At that time the instructor will set a date and time when make-up assignments will be completed.

Social Security and FERPA Statement: It is the policy of The University of Texas at Tyler to protect the confidential nature of social security numbers. The University has changed its computer programming so that all students have an identification number. The electronic transmission of grades (e.g., via e-mail) risks violation of the Family Educational Rights and Privacy Act; grades will not be transmitted electronically.

Emergency Exits and Evacuation: Everyone is required to exit the building when a fire alarm goes off. Follow your instructor's directions regarding the appropriate exit. If you require assistance during an evacuation, inform your instructor in the first week of class. Do Not re-enter the building unless given permission by University Police, Fire department, or Fire Prevention Services

UT Tyler A Tobacco-Free University:

Beginning August 15, 2016, all forms of tobacco will not be permitted on the UT Tyler main campus, branch campuses, and any property owned by UT Tyler. This applies to all members of the University community, including students, faculty, staff, University affiliates, contractors, and visitors. Forms of tobacco not permitted include cigarettes, cigars, pipes, water pipes (hookah), bidis, kreteks, electronic cigarettes, smokeless tobacco, snuff, chewing tobacco, and all other tobacco products. There are several cessation programs available to students looking to quit smoking, including counseling, quit lines, and group support. For more information on cessation programs please visit www.uttyler.edu/tobacco-free.