

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

**Instructor:** Shariful Huq  
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**Office Hours via Zoom (use 3306 zoom ID)**  
Mo/We/Fr: 12:15PM-1:30PM or by Appointment

**Online Synchronous Lectures via Zoom:**

Mo/We/Fr: 11:15AM-12:10PM

**Important Covid-19 Information for Classrooms and Laboratories**

Students are required to wear face masks covering their nose and mouth, and follow social distancing guidelines, at all times in public settings (including classrooms and laboratories), as specified by [Procedures for Fall 2020 Return to Normal Operations](#). The UT Tyler community of Patriots views adoption of these practices consistent with its [Honor Code](#) and a sign of good citizenship and respectful care of fellow classmates, faculty, and staff.

Students who are feeling ill or experiencing symptoms such as sneezing, coughing, or a higher than normal temperature will be excused from class and should stay at home and may join the class remotely. Students who have difficulty adhering to the Covid-19 safety policies for health reasons are also encouraged to join the class remotely. Students needing additional accommodations may contact the Office of Student Accessibility and Resources at University Center 3150, or call (903) 566-7079 or email [saroffice@uttyler.edu](mailto:saroffice@uttyler.edu).

**Recording of Class Sessions**

Class sessions may be recorded by the instructor for use by students enrolled in this course. Recordings that contain personally identifiable information or other information subject to FERPA shall not be shared with individuals not enrolled in this course unless appropriate consent is obtained from all relevant students. Class recordings are reserved only for the use of students enrolled in the course and only for educational purposes. Course recordings should not be shared outside of the course in any form without express permission.

**Course Website:**

Canvas will be used to manage the course material for the semester. There you will find homework assignments, HW/Quiz solutions, handouts, and other material pertaining to the class. [Collected homework graded for completion only](#). The online live synchronous lectures are recorded and posted on canvas. On canvas the recorded lessons are located within module “[Zoom Recordings](#)”. [Please check canvas 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 of beams.

**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 ( $\sigma$  vs  $\epsilon$ ) and shear stress-shear strain ( $\tau$  vs  $\gamma$ ) curves.
4. Given a state of stress at a point, determine the principle stresses ( $\sigma_1$  &  $\sigma_2$ ) and the maximum in-plane shear stress ( $\tau_{\max}$ ), the angle to the principal plane ( $\theta_p$ ), 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 ( $\epsilon_1$  &  $\epsilon_2$ ) and the maximum in-plane shear strain ( $\gamma_{\max}$ ), the angle to the principal plane ( $\theta_p$ ), and the state of strain on any plane through the point ( $\epsilon_{x'}$ ,  $\epsilon_{y'}$  &  $\gamma_{x'y'}$ ).
6. Determine the axial deformations ( $\delta$ ) and/or normal stress ( $\sigma$ ) 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 ( $\delta$ ).

**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 ( $\sigma_l$ ) and hoop stress ( $\sigma_h$ ) for a thin walled pressure vessel.
11. Analyze and design circular members in torsion, including calculating shear stresses ( $\tau$ ) and angles of twist ( $\Phi$ ).
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 ( $\sigma$ ) 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 ( $\tau$ ) 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 978-0-13-431965-0

**Recommended supplementary material (not required):**

Mastering Engineering: Mechanics of materials online

**Course Topics (Subject to Change):**

TOPICS

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**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 Moment-Curvature Functions  
 Beam Deflection by Superposition  
 Column Buckling  
 Course Overview / Course Critique

#### Homework:

Homework will be assigned on a regular basis. Homework **will be collected and graded for completion only**. It is strongly recommended that you work on the home work problems to grasp the concepts thoroughly. Homework Solutions will be posted on Canvas.

#### Exams:

There will be 3 examinations for this course.

The exams are **TENITATIVELY** scheduled for:

Exam 1:	September 25 <sup>th</sup>
Exam 2:	October 16 <sup>th</sup>
Exam 3:	November 20 <sup>th</sup>
Final Exam:	TBD

Exams dates may be moved up or pushed back depending on the progress of the lectures. **THERE ARE NO MAKE-UP EXAMS GIVEN WITHOUT AN EXCUSED MEDICAL ABSENSES. A note from a medical professional is required for any absence due to illness.**

#### Exam Rules

The exam rules are re-produced here for completeness. You are **only allowed to use** the FE packet and an NCEES approved calculator. **You are NOT allowed to work with anyone on the exam. You must work independently. No use of the internet, textbook, notes or any other resources. Carry through all units in the problem. Any student found in violation of these rules and as such in violation of UT-Tyler student code of conduct will be subjected to penalties ranging from receiving a zero grade on the respective exam or suspension or expulsion from the university.**

#### 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

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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 2020 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.)

<b>Grades:</b>	<b>Grade Scale:</b>
Homework / Quizzes = 20%	A: 90-100
Attendance / Professional Practice = 10%	B: 80-89
Midterm Exams (3) = 3*15% = 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.

### **Professional Practice:**

Your professional practice grade will be computed based upon your attendance, the number of assignments you submit, the quality of your work and your participation in class.

### **Final day to withdraw:**

The final day to withdraw from the course without penalty is **November 2<sup>nd</sup>, 2020**.

**Census dates:**

The university requires that instructors to report the attendance to the register at various points in the semester. Therefore, on **September 4<sup>th</sup>, 2020** I will be taking attendance. Please make sure you are there for class on that date or notify ahead if you will not be there.

**UT Tyler Honor Code:**

Every member of the UT Tyler community joins together to embrace: Honor and Integrity that will not allow me to lie, cheat, or steal, nor to accept the actions of those who do.

**Student Standards of Academic Conduct:** Disciplinary proceedings may be initiated against any student who engages in scholastic dishonesty, including, but not limited to, cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts.

- i. "Cheating" includes, but is not limited to:
  - copying from another student's test paper;
  - using, during a test, materials not authorized by the person giving the test;
  - failure to comply with instructions given by the person administering the test;
  - possession during a test of materials which are not authorized by the person giving the test, such as class notes or specifically designed "crib notes". The presence of textbooks constitutes a violation if they have been specifically prohibited by the person administering the test;
  - using, buying, stealing, transporting, or soliciting in whole or part the contents of an un-administered test, test key, homework solution, or computer program;
  - collaborating with or seeking aid from another student during a test or other assignment without authority;
  - discussing the contents of an examination with another student who will take the examination;
  - divulging the contents of an examination, for the purpose of preserving questions for use by another, when the instructors has designated that the examination is not to be removed from the examination room or not to be returned or to be kept by the student;
  - substituting for another person, or permitting another person to substitute for oneself to take a course, a test, or any course-related assignment;
  - paying or offering money or other valuable thing to, or coercing another person to obtain an un-administered test, test key, homework solution, or computer program or information about an un-administered test, test key, home solution or computer program;
  - falsifying research data, laboratory reports, and/or other academic work offered for credit;
  - taking, keeping, misplacing, or damaging the property of The University of Texas at Tyler, or of another, if the student knows or reasonably should know that an unfair academic advantage would be gained by such conduct; and
  - misrepresenting facts, including providing false grades or resumes, for the purpose

- of obtaining an academic or financial benefit or injuring another student academically or financially.
- ii. “Plagiarism” includes, but is not limited to, the appropriation, buying, receiving as a gift, or obtaining by any means another’s work and the submission of it as one’s own academic work offered for credit.
  - iii. “Collusion” includes, but is not limited to, the unauthorized collaboration with another person in preparing academic assignments offered for credit or collaboration with another person to commit a violation of any section of the rules on scholastic dishonesty.
  - iv. All written work that is submitted will be subject to review by plagiarism software.

### **UT Tyler Resources for Students:**

- [UT Tyler Writing Center](http://www.uttyler.edu/writingcenter) (903.565.5995), [writingcenter@uttyler.edu](mailto:writingcenter@uttyler.edu)
- [UT Tyler Tutoring Center](http://www.uttyler.edu/tutoring) (903.565.5964), [tutoring@uttyler.edu](mailto:tutoring@uttyler.edu)
- The Mathematics Learning Center, RBN 4021, this is the open access computer lab for math students, with tutors on duty to assist students who are enrolled in early-career courses.
- UT Tyler Counseling Center (903.566.7254)

### **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 and Census Date Polices:** Students repeating a course for grade forgiveness (grade replacement) must file a Grade Replacement Contract with the Enrollment Services Center (ADM 230) on or before the Census Date of the semester in which the course will be repeated. Grade Replacement Contracts are available in the Enrollment Services Center or at <http://www.uttyler.edu/registrar>. Each semester’s Census Date can be found on the Contract itself, on the Academic Calendar, or in the information pamphlets published each semester by the Office of the Registrar. Failure to file a Grade Replacement Contract will result in both the original and repeated grade being used to calculate your overall grade point average. Undergraduates are eligible to exercise grade replacement for only three course repeats during their career at UT Tyler; graduates are eligible for two grade replacements. Full policy details are printed on each Grade Replacement Contract.

The Census Date is the deadline for many forms and enrollment actions that students need to be aware of. These include:

- Submitting Grade Replacement Contracts, Transient Forms, requests to withhold directory information, approvals for taking courses as Audit, Pass/Fail or Credit/No Credit.

- Receiving 100% refunds for partial withdrawals. (There is no refund for these after the Census Date)
- Schedule adjustments (section changes, adding a new class, dropping without a “W” grade)
- Being reinstated or re-enrolled in classes after being dropped for non-payment
- Completing the process for tuition exemptions or waivers through Financial Aid.

**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 census date (See Academic Calendar for the specific date).

Exceptions to the 6-drop rule may be found in the catalog. Petitions for exemptions must be submitted to the Enrollment Services Center and must be accompanied by documentation of the extenuating circumstance. Please contact the Enrollment Services Center 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.utt Tyler.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](http://www.uttyler.edu/tobacco-free).

**Campus Carry**

We respect the right and privacy of students 21 and over who are duly licensed to carry concealed weapons in this class. License holders are expected to behave responsibly and keep a handgun secure and concealed. More information is available at <http://www.uttyler.edu/about/campus-carry/index.php>