MAE 2312-004: Solid Mechanics

Fall 2020
Instructor Information

Instructor(s):
Ashfaq Adnan

Office Number:
315B Woolf Hall

Office Telephone Number:
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817-272-5010 (fax)

Email Address:
aadnan@uta.edu

Faculty Profile:
https://mentis.uta.edu/explore/profile/ashfaq-adnan

Office Hours: Tu-Th 3.30 pm – 5.00 pm or by appointment

Course Information

Section Information: MAE 2312-004
Time and Place of Class Meetings: Online Synchronous, Classroom - TBA
Tu-Th 12.30 pm – 1.50 pm

Description of Course Content: This course covers the relationships between stresses and strains in elastic bodies and the tension, compression, shear, bending, torsion, and combined loadings which produce them. It also covers the deflections and elastic curves, shear and bending moment diagrams for beams, and column theory.

Course Prerequisites: MAE 1312 Engineering Statics

The text book will be used as reference, and for some reading and homework assignments.

Student Learning Outcomes: The course is intended to provide students with a clear and thorough presentation of both the theory and application of the fundamental principles of mechanics of materials for mechanical design. Students will develop an understanding of the meaning of stress and strain, and the relation between them. They will learn how to analyze the distribution of internal loads, deformation, stresses and strains in structural elements (e.g. bars, beams) due to application of external loading. They will also learn the basic concepts and analysis techniques of structural stability emphasizing the buckling of columns.

Course Content: The topics listed below will be covered during this course.
1. Stress and Strain
2. Mechanical Properties of Materials
3. Axial Load
4. Torsion
5. Shear Force and Bending Moments
6. Beam Bending and Shear
7. Analysis of Stress and Strain and Transformation
8. Plane Stress, Strain and Combined Loading
9. Beam Deflection
10. Buckling of Columns

There will be 12 homework assignments, two midterm exams and one final exam.

Grading Policy:

<table>
<thead>
<tr>
<th>Component</th>
<th>Points</th>
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<tbody>
<tr>
<td>Exam 1</td>
<td>150</td>
</tr>
<tr>
<td>Exam 2</td>
<td>150</td>
</tr>
<tr>
<td>Home Works</td>
<td>50</td>
</tr>
<tr>
<td>Final Exam</td>
<td>150</td>
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<table>
<thead>
<tr>
<th>Component</th>
<th>Points</th>
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<tbody>
<tr>
<td>Semester Total</td>
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Tentative Grading Scale

<table>
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<tr>
<th>Points</th>
<th>Letter Grade</th>
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<tbody>
<tr>
<td>450 or above</td>
<td>A</td>
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<tr>
<td>401 – 449</td>
<td>B</td>
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<td>351 – 400</td>
<td>C</td>
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<td>301 – 350</td>
<td>D</td>
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<td>000 – 300</td>
<td>F</td>
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Important Dates:

Exam 1: Tuesday October 13, 2020, 12:30 pm – 1:45 pm.
Syllabus: All class materials, solved problems, homework and reading assignments that are covered to date.

Exam 2: Tuesday November 24, 2020, 12:30 pm – 1:45 pm.
Syllabus: All class materials, solved problems, homework and reading assignments that are covered between Exam 1 and to date.

Homework: Assigned weekly during the Thursday class and due before the following Thursday class unless otherwise stated.

Final Exam:
The final exam schedule can be found here:

https://www.uta.edu/records/Fall%202020%20Final%20Exam%20Dates3.pdf

As of August 16, 2020, the final exam for this class is scheduled as follows:

Tuesday, Dec 15 11 – 1:30 p.m.
The final exam is comprehensive and covers all class materials including homework, solved problems, reading assignments and midterm exams.
Important Note:

• All homework assignments should be prepared on instructor-approved papers and turned in with a coversheet. All papers should be properly stapled. The template for the coversheet will be uploaded to Blackboard before the 1st HW assignment is due. Any Homework Assignments submitted without following instructions above will be returned without grade. [NO EXCEPTIONS]
• Homework turned in LATE will receive a 20% penalty per day until solution for that Homework is posted. Solutions to HWs will be posted within one week from the due date.
• No LATE home work will be accepted after the solution is made available to students. [NO EXCEPTIONS]
• UTA regulations permitting, missed midterms and/or final exams can only be rescheduled when missed due to major health problems or circumstances beyond the student’s control.
• With instructor’s discretion, students will be required to reschedule the missed exams at the earliest time possible.

Course Schedule
<table>
<thead>
<tr>
<th>Thursday, August 27, 2020</th>
<th>Lecture 1</th>
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<table>
<thead>
<tr>
<th>Tuesday, September 1, 2020</th>
<th>Lecture 2</th>
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<tr>
<th>Thursday, September 3, 2020</th>
<th>Lecture 3</th>
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<tr>
<td>Tuesday, September 8, 2020</td>
<td>Lecture 4</td>
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<tr>
<td>Thursday, September 10, 2020</td>
<td>Lecture 5</td>
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<tr>
<td>Tuesday, September 15, 2020</td>
<td>Lecture 6</td>
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<tr>
<th>Thursday, September 17, 2020</th>
<th>Lecture 7</th>
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<tr>
<th>Tuesday, September 22, 2020</th>
<th>Lecture 8</th>
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<tr>
<td>Thursday, September 24, 2020</td>
<td>Lecture 9</td>
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<tr>
<td>Tuesday, September 29, 2020</td>
<td>Lecture 10</td>
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**Chapter 1**
- Statics Review.
- Normal Stress and Strain.
- Mechanical Properties of Materials.
- Elasticity, Plasticity, and Creep.
- Linear Elasticity, Hooke's Law, and Poisson's Ratio.
- Shear Stress and Strain.
- Allowable Stresses and Allowable Loads.
- Design for Axial Loads and Direct Shear.

**Chapter 2**
- Introduction
- Changes in lengths of Axially Loaded Members.
- Changes in Lengths under Nonuniform Conditions.
- Statically Indeterminate Structures.
- Thermal Effects, Misfits, and Prestrains.
- Stresses on Inclined Sections.
- Strain Energy.
- Impact Loading.
- Repeated Loading and Fatigue.
- Stress Concentrations.

**Chapter 3**
- Introduction.
- Torsional Deformations of a Circular Bar.
- Circular Bars of Linearly Elastic Materials.
- Nonuniform Torsion.
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<tr>
<th>Date</th>
<th>Lecture</th>
<th>Topics</th>
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| Thursday, October 1, 2020   | Lecture 11 | • Stresses and Strains in Pure Shear.  
• Relationship Between Moduli of Elasticity E and G.  
• Transmission of Power by Circular Shafts.  
• Statically Indeterminate Torsional Members.  
• Strain Energy in Torsion and Pure Shear.  
• Stress Concentration in Torsion  |
| Friday, October 2, 2020     |         | Chapter 4  
• Types of Beams, Loads, and Reactions.  
• Shear Forces and Bending Moments.  
• Relationship Between Loads, Shear Forces and Bending Moments.  |
| Tuesday, October 6, 2020    | Lecture 12 | • Shear-Force and Bending-Moment Diagrams.  |
| Thursday, October 8, 2020   | Lecture 13 | Chapter 5  
• Pure Bending and Nonuniform Bending.  
• Curvature of Beam.  
• **Review of Problems for Mid-Term 1**  
  • Longitudinal Strains in Beams.  
  • Normal Stress in Beams (Linearly Elastic Materials).  
  • Design of Beams for Bending Stresses.  |
| Tuesday, October 13, 2020   | Exam 1   |  |
| Thursday, October 15, 2020  | Lecture 14 |  |
| Tuesday, October 20, 2020   | Lecture 15 | • Nonprismatic Beams.  
• Shear Stresses in Beams of Rectangular Cross Section.  
• Shear Stresses in Beams of Circular Cross Section.  |
| Thursday, October 22, 2020  | Lecture 16 |  |
| Tuesday, October 27, 2020   | Lecture 17 |  |
| Thursday, October 29, 2020  | Lecture 18 |  |
| Tuesday, November 3, 2020   | Lecture 19 |  |
| Thursday, November 5, 2020  | Lecture 20 | Chapter 8  
• Plane Stress.  
• Principal Stresses and Maximum Shear Stresses.  
• Mohr's Circle for Plane Stress.  
• Hooke's Law for Plane Stress.  
• Triaxial Stress.  
• Plane Strain.  
• Strain Rosette  |
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<tr>
<th>Date</th>
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<th>Notes</th>
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<tr>
<td>Tuesday, November 10, 2020</td>
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<tr>
<td>Thursday, November 12, 2020</td>
<td>Lecture 22</td>
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<tr>
<td>Tuesday, November 17, 2020</td>
<td>Lecture 23</td>
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<tr>
<td>Thursday, November 19, 2020</td>
<td>Lecture 24</td>
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<tr>
<td><strong>Tuesday, November 24, 2020</strong></td>
<td><strong>Exam 2</strong></td>
<td><strong>Chapter 9</strong></td>
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<tr>
<td>Thursday, November 26, 2020</td>
<td>No Class</td>
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<tr>
<td>Tuesday, December 1, 2020</td>
<td>Lecture 25</td>
<td><strong>Chapter 11</strong></td>
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<tr>
<td>Thursday, December 3, 2020</td>
<td>Lecture 26</td>
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<tr>
<td>Tuesday, December 8, 2020</td>
<td>Lecture 27</td>
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</table>

- Spherical Pressure Vessels.
- Cylindrical Pressure Vessels.
- Maximum Stresses in Beams.
- Combined Loadings.

**Chapter 9**
- Introduction.
- Differential Equations of the Deflection Curve.
- Deflections by Integration of the Bending-Moment Equation.
- Deflections by Integration of the Shear-Force and Load Equations.
- Method of Superposition
- **Review of Problems for Mid-Term 2**

**Chapter 11**
- Introduction.
- Buckling and Stability.
- Columns with Pinned Ends.
- Columns with Other Support Conditions.
- Columns with Eccentric Axial Loads.
- The Secant Formula for Columns.
- Column Design

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**As the instructor for this course, I reserve the right to adjust this schedule in any way that serves the educational needs of the students enrolled in this course. —Ashfaq Adnan**

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**Institution Information**

UTA students are encouraged to review the below institutional policies and informational sections and reach out to the specific office with any questions. To view this institutional information, please visit
the Institutional Information page (http://www.uta.edu/provost/administrative- forms/course-syllabus/syllabus-institutional-policies.php) which includes the following policies among others:

- Drop Policy
- Disability Accommodations
- Title IX Policy
- Academic Integrity
- Student Feedback Survey
- Final Exam Schedule

### Additional Information

**Mandatory Face Covering Policy:**  
All students and instructional staff are required to wear facial coverings while they are on campus, inside buildings and classrooms. Students who fail to comply with the facial covering requirement will be asked to leave the class session. If students need masks, they may obtain them at the Central Library, the E.H. Hereford University Center’s front desk, or in their department. Students who refuse to wear a facial covering will be asked to leave the session by the instructor, and, if the student refuses to leave, they may be reported to UTA’s Office of Student Conduct.

**Attendance:**  
At The University of Texas at Arlington, taking attendance is not required but attendance is a critical indicator of student success. Each faculty member is free to develop his or her own methods of evaluating students’ academic performance, which includes establishing course-specific policies on attendance. As the instructor of this section. However, while UT Arlington does not require instructors to take attendance in their courses, the U.S. Department of Education requires that the University have a mechanism in place to mark when Federal Student Aid recipients “begin attendance in a course.” UT Arlington instructors will report when students begin attendance in a course as part of the final grading process. Specifically, when assigning a student a grade of F, faculty report must the last date a student attended their class based on evidence such as a test, participation in a class project or presentation, or an engagement online via Canvas. This date is reported to the Department of Education for federal financial aid recipients.

**Final Review Week:**  
A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week unless specified in the class syllabi. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week.  
For Fall Semester 2019: We designate November 27 to December 4 as review week. This gives students a full week before finals for review. While the 28th is Thanksgiving, November 27 and 29 are review days as are December 2, 3 and 4.

**Emergency Exit Procedures:**  
Should we experience an emergency event that requires evacuation of the building, students should exit the room and move toward the nearest exit. When exiting the building during an emergency, do not take an elevator but use the stairwells instead. Faculty members and instructional staff will assist
students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities.

**Student Success Programs:**
UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include tutoring by appointment, drop-in tutoring, etutoring, supplemental instruction, mentoring (time management, study skills, etc.), success coaching, TRIO Student Support Services, and student success workshops. For additional information, please email resources@uta.edu, or view the Maverick Resources website.

**Emergency Phone Numbers**

In case of an on-campus emergency, call the UT Arlington Police Department at **817-272-3003** (non-campus phone), **2-3003** (campus phone). You may also dial 911. Non-emergency number **817-272-3381**

**Library Information**

**Research or General Library Help**
Ask for Help
- Academic Plaza Consultation Services (library.uta.edu/academic-plaza)
- Ask Us (ask.uta.edu/)
- Research Coaches (http://libguides.uta.edu/researchcoach)

**Resources**
- Library Tutorials (library.uta.edu/how-to)
- Subject and Course Research Guides (libguides.uta.edu)
- Librarians by Subject (library.uta.edu/subject-librarians)
- A to Z List of Library Databases (libguides.uta.edu/az.php)
- Course Reserves (https://uta.summon.serialssolutions.com/#/course_reserves)
- Study Room Reservations (openroom.uta.edu/)