MAE 2312-001: Solid Mechanics

Spring 2014

Instructor(s): Ashfaq Adnan
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Office Hours: 2:30 pm – 3:30 pm; Tu Th (or, by appointment)
Time and Place of Class Meetings: WH 210, Woolf Hall (WH)
                                        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
Textbooks: J.M. Gere and B. J. Goodno,, <u>Mechanics of Materials</u>, 8th Edition, Cengage Learning.
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, one special assignment, two midterm exams and one final exam.

Course Grading Policy:

1st Midterm	100
2nd Midterm	100
Homework	60
Final Exam	140
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Semester Total points	400

Tentative Grading Scale	**Letter Grade**
340 or above	A
300 – 339	B
260 – 299	C
220 – 259	D
000 – 220	F

Important Dates:
> **1st Midterm: Tuesday**, **February 13**, **2014**, **12:30 pm – 1:45 pm.**
> <u>Syllabus:</u> All class materials, solved problems, homework and reading assignments that are covered to date.
>
> **2nd Midterm: Tuesday**, **March 25, 2014**, **12:30 pm – 1:45 pm.**
> <u>Syllabus:</u> All class materials, solved problems, homework and reading assignments that are covered between 1st midterm and to date.
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> **Homework:** Assigned weekly during the **Thursday** class and due before the next **Thursday** class unless otherwise stated.
>
> **Final Exam:** On the date scheduled by the University during the Final Exam Period. Covers all class materials including homework, solved problems, reading assignments and midterm exams.
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> **Note:**
> - All students MUST check blackboard and UTA email periodically. All HWs, announcements and course related information will be made available to Blackboard only.
> - All homework assignments should be prepared on <u>instructor-approved papers</u> and turned in with a <u>coversheet</u>. The template for the coversheet will be uploaded to Blackboard before the 1st HW assignment is due.
> - 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.

First Class: January 14, 2014
Martin Luther King Jr. Day: January 20, 2014
Census Date: January 29, 2014
Spring Breaks: March 10 – 14, 2014.
Last day to drop class: March 28, 2014.
Last day of class: May 2, 2014.

Attendance Policy: Students are strongly recommended to attend each class.

Drop Policy: Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. **Students will not be automatically dropped for non-attendance**. Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (http://wweb.uta.edu/aao/fao/).

Americans with Disabilities Act: The University of Texas at Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including the *Americans with Disabilities Act (ADA).* All instructors at UT Arlington are required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of that disability. Any student requiring an accommodation for this course must provide the instructor with official documentation in the form of a letter certified by the staff in the Office for Students with Disabilities, University Hall 102. Only those students who have officially documented a need for an accommodation will have their request honored. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability or by calling the Office for Students with Disabilities at (817) 272-3364.

Academic Integrity: Students enrolled in this course are expected to adhere to the UT Arlington Honor Code:

> *I pledge, on my honor, to uphold UT Arlington's tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.*
>
> *I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.*

UT Arlington faculty members may employ the Honor Code as they see fit in their courses, including (but not limited to) having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System *Regents' Rule* 50101, §2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student's suspension or expulsion from the University.

Student Support Services: 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, major-based learning centers, developmental education, advising and mentoring, personal counseling, and federally funded programs. For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, send a message to resources@uta.edu, or view the information at www.uta.edu/resources.

Electronic Communication: UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at http://www.uta.edu/oit/cs/email/mavmail.php.

Student Feedback Survey: At the end of each term, students enrolled in classes categorized as "lecture," "seminar," or "laboratory" shall be directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student's feedback enters the SFS database anonymously and is aggregated with that of other students enrolled in the course. UT Arlington's effort to solicit, gather, tabulate, and publish student feedback is required by state law; students are strongly urged to participate. For more information, visit http://www.uta.edu/sfs.

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 syllabus. 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. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

Emergency Exit Procedures: Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist handicapped individuals.

Woolf Hall 406 Computer Teaching Lab Policies:
1. WH 406 must be officially reserved for all events including classroom instructions due to the limited classroom space equipped with computers and scheduling logistics. Please see Lanie or Janet for reservation.
2. WH 406 is a computer teaching lab. Faculty and Instructors must be present while students occupy this room. When an instructor leaves the room, students are to leave WH 406 as well. Instructors should encourage students to use WH 320 if needed after class is over. The computer lab in WH 320 is available for MAE student access 24/7.
3. WH 406 doors are not to be propped open. Propped doors are considered a security breach by the UTA Police Department and a hazard violation by the Fire Inspector.
4. Food, drink, and tobacco products are prohibited in WH 406.

Course Schedule

Date	Day	Lecture	Topic	Note
14-Jan-14	Tuesday	Lecture 1	**Chapter 1** • Introduction to Mechanics of Material. • Statics Review.	
16-Jan-14	Thursday	Lecture 2	• Normal Stress and Strain. • Mechanical Properties of Materials. • Elasticity, Plasticity, and Creep.	HW 1 Assigned
21-Jan-14	Tuesday	Lecture 3	• 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.	
23-Jan-14	Thursday	Lecture 4	**Chapter 2** • Introduction • Changes in lengths of Axially Loaded Members. • Changes in Lengths under Nonuniform Conditions.	HW 1 Due HW 2 Assigned
28-Jan-14	Tuesday	Lecture 5	• Statically Indeterminate Structures. • Thermal Effects, Misfits, and Prestrains. • Stresses on Inclined Sections.	
30-Jan-14	Thursday	Lecture 6	• Strain Energy. • Impact Loading. • Repeated Loading and Fatigue. • Stress Concentrations.	HW 2 Due HW 3 Assigned
4-Feb-14	Tuesday	Lecture 7	**Chapter 3** • Introduction. • Torsional Deformations of a Circular Bar. • Circular Bars of Linearly Elastic Materials.	
6-Feb-14	Thursday	Lecture 8	• Nonuniform Torsion. • Stresses and Strains in Pure Shear.	HW 3 Due **SELF READ: Chapter 12** Special HW Assigned
11-Feb-14	Tuesday	Lecture 9	• Relationship Between Moduli of Elasticity E and G. • Transmission of Power by Circular Shafts. • Review of Problems for Mid-Term 1	
13-Feb-14	Thursday	**Mid-Term Exam 1**	*** EXAM ***	
18-Feb-14	Tuesday	Lecture 10	• Statically Indeterminate Torsional Members. • Strain Energy in Torsion and Pure Shear. • Stress Concentration in Torsion	Special HW Due
20-Feb-14	Thursday	Lecture 11	**Chapter 4** • Types of Beams, Loads, and Reactions. • Shear Forces and Bending Moments. • Relationship Between Loads, Shear Forces and Bending Moments.	HW 4 Assigned

25-Feb-14	Tuesday	Lecture 12	• Shear-Force and Bending-Moment Diagrams.	
27-Feb-14	Thursday	Lecture 13	**Chapter 5** • Pure Bending and Nonuniform Bending. • Curvature of Beam. • Longitudinal Strains in Beams. • Normal Stress in Beams (Linearly Elastic Materials).	HW 4 Due HW 5 Assigned
4-Mar-14	Tuesday	Lecture 14	• Design of Beams for Bending Stresses. • Nonprismatic Beams.	
6-Mar-14	Thursday	Lecture 15	• Shear Stresses in Beams of Rectangular Cross Section. • Shear Stresses in Beams of Circular Cross Section.	HW 5 Due HW 6 Assigned
11-Mar-14	Tuesday	No Lecture	**Spring Break**	
13-Mar-14	Thursday	No Lecture		
18-Mar-14	Tuesday	Lecture 16	• Shear Stresses in the Webs of Beams with Flanges. • Stress Concentrations in Bending.	
20-Mar-14	Thursday	Lecture 17	**Chapter 7** • Plane Stress. • Principal Stresses and Maximum Shear Stresses. • Review of Problems for Mid-Term 2	HW 6 Due HW 7 Assigned
25-Mar-14	Tuesday	**Mid-Term Exam 2**	***** EXAM *****	
27-Mar-14	Thursday	Lecture 18	• Mohr's Circle for Plane Stress.	HW 7 Due HW 8 Assigned
1-Apr-14	Tuesday	Lecture 19	• Hooke's Law for Plane Stress. • Triaxial Stress.	
3-Apr-14	Thursday	Lecture 20	• Plane Strain. • Strain Rosette	HW 8 Due HW 9 Assigned
8-Apr-14	Tuesday	Lecture 21	**Chapter 8** • Spherical Pressure Vessels. • Cylindrical Pressure Vessels. • Maximum Stresses in Beams.	
10-Apr-14	Thursday	Lecture 22	• Combined Loadings.	HW 9 Due HW 10 Assigned
15-Apr-14	Tuesday	Lecture 23	**Chapter 9** • Introduction. • Differential Equations of the Deflection Curve.	
17-Apr-14	Thursday	Lecture 24	• Deflections by Integration of the Bending-Moment Equation.	HW 10 Due HW 11 Assigned
22-Apr-14	Tuesday	Lecture 25	• Deflections by Integration of the Shear-Force and Load Equations. • Method of Superposition	
24-Apr-14	Thursday	Lecture 26	**Chapter 11** • Introduction. • Buckling and Stability.	HW 11 Due HW 12 Assigned
29-Apr-14	Tuesday	Lecture 27	• Columns with Pinned Ends. • Columns with Other Support Conditions.	

1-May-14	Thursday	Lecture 28	• Columns with Eccentric Axial Loads. • The Secant Formula for Columns. • Column Design	HW 12 Due

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