TAM 251 - Introductory Solid Mechanics

Course description

Relationship between internal stresses and deformations produced by external forces acting on deformable bodies, and design principles based on mechanics of solids: normal stresses, shear stresses, and deformations produced by tensile, compressive, torsional, and bending loading of members; beam deflections; elastic energy and impact; multi-dimensional stress states; and buckling of columns.

Prerequisites

TAM 210 or TAM 211.

Instructor

Dr. Mariana Silva
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Office: MEB 154
Lecture: MWF, 9AM, 151 Everitt Lab
Office hours: M 10-11am and W 11am-12pm at MEB 248

Head teaching assistants

Joel Krehbiel, jkrehbi2@illinois.edu
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Teaching assistants

Timothy Garbaciak, garbaci1@illinois.edu
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Discussion sessions

ADA, R 8:00-8:50AM, 256 MEB, Timothy Garbaciak
ADB, R 4:00-4:50PM, 153 MEB, Joel Krehbiel + Xin Chen
ADC, T 12:00-12:50PM, 153 MEB, Ankit Saharan + Joel Krehbiel + Timothy Garbaciak
ADD, T 12:00-12:50PM, 139 Loomis, Ouli Jin
ADE, T 4:00-4:50PM, 135 MEB, Ankit Saharan + Timothy Garbaciak
ADF, F 1:00-1:50PM, 252 MEB, Joel Krehbiel + Xin Chen
ADG, R 5:00-5:50PM, 153 MEB, Xin Chen

Special accomodations

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact their lecturer and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES you may visit 1207 S. Oak St., Champaign, call 333-4603 (V/TDD), or e-mail a message to disability@uiuc.edu.

Compass 2g

Your grades, class notes and general announcements will be posted on Compass 2g (https://compass2g.illinois.edu).

i>clicker

Quizzes will be administered in lectures via the i>clicker system. The i>clicker remote may be purchased at any of the book stores and must be registered on Compass 2g, under the tab "Register i>clicker". **You need to register your i>clicker by September 6th, when the i>clicker roster will be synced for the last time.**

Supporting material

I will provide lecture notes and recording of my lectures.

The custom version (loose-leaf, three-hole punched, B&W) of "*Mechanics of Materials*" by Hibbeler R.C., Pearson can be used as SUPPLEMENTAL material and is available at UofI Bookstore for $124.00. This price includes the *MasteringEngineering* access code, which is required to complete your homework assignments (see section "Required online tool"). The custom textbook has the same material as the original *Mechanics of Materials*" by Hibbeler, 9th edition.

REQUIRED online tool - MasteringEngineering

Your online homework assignments will be available from the website www.masteringengineering.com. You should consider one of the following options to obtain access to MasteringEngineering:

1. Purchase custom textbook from the bookstore ($124.00): MasteringEngineering + **eText** + printed version of the textbook

2. Purchase MasteringEngineering + **eText** ($110.00)

3. Purchase MasteringEngineering only ($50) - in this case, you may choose to use your lecture notes for text reference, borrow a book from a friend or library, or buy an used textbook

Please follow the steps below to start using MasteringEngineering:

- Go to the website http://www.pearsoncustom.com/il/ui_engineering/

- Select one of the three options under the "Sign in" box on the top left of the page.

  - "Register Here" - if you purchased the printed version of the textbook from the bookstore (option 1 above)
  - "Purchase Access with eText" (option 2 above)
  - "Purchase Access without eText" (option 3 above)

- You will need to create a Login Name and Password.

- After you login for the first time, you will receive a Welcome Message. You will be asked to enter the Course ID: TAM251FA13

- You will also be asked to enter your UIUC NetID (which is the first part of your email address - NetID@illinois.edu). Make sure you type this information correctly, since it will be used to upload your grades into Compass 2g.

Study Hall

- A Study Hall in 429 Grainger Library is provided to answer questions you may have.

- Study Hall is intended to supplement the lectures and discussion sections.

- Do not ask the staff to work the homework problems before they are due. It is OK to ask them specific questions on the details of your attempted solutions or to work out problems that are similar to the homework problems.

- The Study Hall will begin on Thursday, August 29th. It will be staffed by the TAs during the time slots indicated in Table 1.

Table 1: Office hours at 429 Grainger Library

Time	Monday	Thursday	Friday
11 - 12am			Xin
12 - 1pm			Xin
1 - 2pm		Ankit	
2 - 3pm	Xin	Ankit	Joel
3 - 4pm	Tim	Ankit	Ouli
4 - 5pm	Tim		
5 - 6pm	Tim		

Online Forum

This class uses Piazza https://piazza.com/illinois/fall2013/tam251/home for ALL online questions and feedback. You will receive an invitation to join this forum. Official class announcements will be sent via Piazza and Compass 2g, so you must register with an email address that you regularly check. You can also use the Search for Teammates feature on Piazza to help find a study group. TAs are scheduled to be checking Piazza everyday at the following times: 11am-12pm, 4pm-5pm and 9pm-10pm. The use of Piazza should not replace the Study Hall time, since some questions cannot be fully addressed via an online forum.

Grading distribution

Online Homework - 10%
Written Report - 8%
Discussion Group Worksheet - 8%
Lecture Quiz - 2%
Lecture Worksheet - 2%
Midterm 1 Exam - 20%
Midterm 2 Exam - 20%
Final Exam - 30%

Online homework (10%)

1. You will find your online homework assignments on MasteringEngineering.

2. Online homework assignments will be due on **Mondays at 11:59 pm**. Late submissions will be penalized by 20% over each day late.

3. Some of the problems will have a Hint. You can get 1% bonus if you choose not to open the Hint.

4. You can rework completed items after the due date. This work will not be saved and will not affect your grades.

5. You will receive a grade for ALL assigned online homework problems. Your HW score will also appear on the Compass 2g grade book.

6. To encourage you to work through the problems and to obtain the correct solution you may revise and resubmit your solutions numerous times until the due date.

7. The online homework problems give explicit values and units to the relevant lengths, material properties, forces, et cetera, and therefore you should give your final answer with an explicit numerical value. Nevertheless, when solving a homework problem you should (to the utmost extent possible) assign symbols to all the relevant lengths, forces, material properties, et cetera, and then solve the problem symbolically. As a last step, you should substitute the value and units of each of the symbols in the symbolic formula. You are encouraged to solve all problems symbolically.

8. This symbolic form of working out the problems will be used by me in the lectures and by yourselves in the written reports, worksheets and exams.

9. You are encouraged to print out each homework problem and derive your symbolic solution on this print out. Store these solutions for your future reference.

10. You should come to office hours with the symbolic solution for your online assignment. We will be able to check your work better if you have that in hand.

11. Solutions will not be posted.

12. The first online homework is due on September 2nd. This assignment is optional; its purpose is to help you getting familiar with "MasteringEngineering". You can earn up to 0.2% of extra points to be added to your final grade.

13. The second online homework is due on September 6th. This assignment is also optional and consists of multiple choice questions regarding this syllabus. You can earn up to 0.28% of extra points to be added to your final grade. FOR THIS ASSIGNMENT, YOU WILL HAVE ONLY ONE ATTEMPT FOR EACH MULTIPLE CHOICE ITEM.

14. The first required assignment is due on September 9th and covers the material of chapter 1.

Group worksheets (8%)

1. Discussion sessions will begin on Tuesday, August 27th.

2. Most discussions will consist of a group worksheet exercise, which is a high-energy and efficient 50 minute learning experience. Students are randomly assigned each session to a group of three to five students.

3. Each student should work on his/her own worksheet, but only one randomly chosen worksheet will be scored from each group, and every student in that group will be given that score. Among other things, the TA will be evaluating team work, problem-solution skills and the correct interpretation of the problem.

4. You MUST attend the discussion session in which you are registered. You won't get any grade for the worksheet if you attend the wrong discussion.

Written report (8%)

1. To teach you how to prepare your analyzes in a logical manner, you will be asked to submit a written report based on the worksheet that you started solving in your discussion session the week before. The report could consist of the exact same problem of the one given in the worksheet or a small variation of it.

2. Scan your written report and save it in pdf format. Files in any other format will not be graded.

3. While scanning make sure you scan all the pages of your written report in ONE pdf file. We will only grade a single pdf file.

4. Your scanned work must be in portrait format. I have included examples of BAD and GOOD scanned documents on Compass 2g ("Course Content ¿ Written Report)

5. You will upload your written reports on compass 2g. These reports are due on Fridays at 11:59pm, on the week after the worksheet was given.

6. You will have two attempts to upload your report and we will grade only your last attempt.

7. You can find more information on how to upload these reports on compass 2g.

8. The first written report is due on September 13th.

9. Your name and discussion session number must be printed legibly on the top of the first page.

10. When preparing your written report, you MUST assign symbols (to the utmost extent possible) to all the relevant lengths, forces, material properties, et cetera, and then solve the problem symbolically. If given, you should assign numerical values to your final result. Depending on the difficulty of the problem, you may assign numbers at intermediate steps.

11. Written reports are designed to practice the communication of engineering concepts in writing. They will be graded based on presentation, neatness, correct use of symbols, quality of drawings and diagrams, clarity of explanation and correctness of the answer. Here is the point breakdown for the written report:

    - Correct interpretation of the problem: 1
    - Correct final answer: 1
    - Presentation quality*: 2
    - Clarity of explanation: 1
    - Clear drawings and diagrams: 2
    - Use of symbolic work: 2
    - Use of units on numerical answers: 1

    *Your report should be neat and organized, hand-written using pen or typed.

12. Late homework will not be accepted (you will not be able to upload it on compass 2g).

Lectures (4%)

1. Prompt and regular attendance at lectures is required.

2. The lectures will be delivered on a Tablet-PC. Lectures are recorded and uploaded on MasteringEngineering for your future reference. Click on the "Manage/Record Lecture Video" button under the "Course Materials" box (top right of your screen).

3. Lecture notes are uploaded on Compass 2g.

4. Worksheets (2%)

   (a) In some classes, you will receive a worksheet similar to the one you solve in discussion sessions, but with shorter questions. You can work individually or with students sitting around you. You will have one multiple choice question to answer using the i>clicker: 1.5% for attendance + 0.5% for correct answer.

5. Quizzes (2%)

   (a) Expect an i>clicker quiz in every lecture: 1.5% for attendance + 0.5% for correct answer

   (b) Your three lowest scores will be dropped. *These drops should be reserved for unexpected occurrences such as sickness or a family emergency.*

Midterms (40%)

1. 2 hours exam, "closed book" and "closed notes".

2. A formula sheet will be provided at the exam.

3. Your name and discussion section number must appear on the top of EACH page of the exam.

4. Midterm 1: Tuesday, October 1st, 7:00PM-9PM, Location: see table below

5. Midterm 2: Thursday, November 14th, 7:00PM-9PM, Location: see table below

6. Report to the room indicated in the table below corresponding to the discussion session you are REGISTERED in!. You are not going to be allowed to take the exam in the wrong classroom. Bring your ID to the exam and show up early so you have time to sign in.

Discussion sessions	Midterm 1	Midterm 2
ADB + ADC + ADD	MSEB 100	MSEB 100
ADA + ADE + ADF + ADG	AH 314	AH 314

7. Conflict exams will be scheduled for students with legitimate (documented) scheduled conflicts. These are usually on the same evening but earlier than the regular exam. Actual times will be announced in lecture.

Final exam (30 %)

1. 3 hours exam, "closed book" and "closed notes".

2. A formula sheet will be provided at the exam.

3. Your name and discussion section label must appear on the top of EACH page of the exam.

4. Make-up exams will only be allowed with a major documented excuse.

5. Conflict exam will be offered for students with legitimate (documented) scheduled conflicts

6. Regular exam time: Dec 18th, 8AM-11AM, location TBA

7. Conflict exam time : Dec 16th, 8AM-11AM, location TBA

Final grades

You total score corresponds to final letter grades as described in Table 2

Table 2: Final letter grade

97 - 100	A+	92 - 97	A	89 - 92	A-
86 - 89	B+	82 - 86	B	79 - 82	B-
76 - 79	C+	72 - 76	C	69 - 72	C-
66 - 69	D+	59 - 66	D	55 - 59	D-
		0 - 55	F		

Grading generalities

1. Questions about your grades must be made within the week after the quiz, exam or HW is returned. Discuss the issue with the TA who graded the problem in question.

2. Questions about missing quiz/exam/HW grades must be addressed to Joel Krehbiel within the week after the quiz/exam/HW was returned to your class-mates. Make sure to routinely check your grades on compass.

Absences and excused grades

1. Excuses from homework, quizzes and exams will be given only in one of the following circumstances:
(a) illness;
(b) personal crisis (e.g. automobile accident, required court appearance, death of a close relative, weather conditions which make it impossible to get to the university); and
(c) required attendance at an official UIUC activity (e.g. varsity athletics, band concert).

2. In all cases you must complete the "TAM Excused Absence Request Form" (https://illinois.edu/fb/sec/411728) and upload a scan of the official written documentation explaining your absence.

3. In cases (a) or (b) an official excuse letter from the Dean on Duty (http://www.odos.uiuc.edu/deanonduty/)must be submitted via the online form within 2 weeks of the due date of the missed assessment, but no later than reading day. In cases of extended or unusual illness, late submission of excuse documentation will be considered.

4. In case (c) an official letter from the designated university official must be submitted via the online form at least one week prior to the due date of the missed assessment.

5. The dropped homework and quiz grades are intended for excused absences. If additional homework and quizzes are excused, then each such approved excuse will increase the number of grades that will be dropped.

6. An excused absence from a midterm exam will receive the score EX. At the end of the semester, midterm-exam EX scores will be replaced by a weighted average of your non-EX exam scores (midterm-exams and the final exam).

7. When possible, you will be required to attend another discussion section rather than miss your scheduled discussion section for one of the aforementioned circumstances. In this situation please contact Joel ASAP, so you don't get penalized on your HW assignment.

Effective use of email

Email is most useful when you need to report a problem or request an appointment. But it is hard to discuss concepts, equations, plots or diagrams by email. If you have difficulties solving your homework or understanding a theoretical point, then bring a copy of your equations, diagrams, et cetera, and talk to one of us in person during office hours. You can also post messages on Piazza.

I usually reply to emails within one day, but I won't reply to emails requesting information that is readily available in this document or the course website (for example, "When is the first partial exam?"). Requests such as "I need to have my grade fixed on compass" should be addressed to Joel Krehbiel. Please do not send emails asking "What kind of problems will you give us in the exam?", "Can you give me an idea as to how many problems we should expect in the exam?", or other questions similar to these; instead, check the sample exams that have been posted on the course web page (or come to lectures, I will usually give some hints on that). Certain questions I cannot possibly answer individually without favoring one student over the rest of the class. For example, "Will the final exam include any problems on torsion?" Had I been willing to provide an answer to this question, I would have made an announcement to the entire class, not just to you by email.

Most of you have impeccable email etiquette, and I am sure all of you want to achieve this lofty status. Therefore, I do not answer emails that do not exhibit proper etiquette. There are numerous websites that address this subject. But in particular at least be sure to:

1. Mind Your Manners: Think of the basic rules you learned growing up, like saying please and thank you. Address people you don't know as Mr., Mrs., or Dr. Only address someone by first name if they imply it's okay to do so.

2. Watch Your Tone: Merriam-Webster defines tone as an "accent or inflection expressive of a mood or emotion." It is very difficult to express tone in writing. You want to come across as respectful, friendly, and approachable. You don't want to sound curt or demanding.

3. Sign your name: End you message with an appropriate closing and include your name.

Academic integrity

Infractions will not be tolerated. See the University's Student Code, Article 1, Part 4.

List of topics

1. Basic concepts of stress and strain

2. Uniaxial loading and deformation: Statically determinate and indeterminate problems; design based on yield strength, ultimate strength

3. Torsion of circular shafts and thin-walled sections: Geometry of deformation, stress, distribution, statically determinate and indeterminate systems, design of shafts for power transmission

4. Stresses due to bending: Geometry of deformation, stress distribution, symmetric elastic beams, transverse shear, built-up beams, design of beams for structural applications

5. Beam deflections: Differential equations, double integration, direct integration, method of superposition, design based on deflections, slopes, shear forces, and bending moments

6. Multi-axial stress and strain states: Transformation of stress and strain, Mohrs circle representations, principal stresses and strains, states of plane stress and plane strain, two-dimensional elastic stress-strain relations, yield criteria, design problems for combined states of stress

7. Buckling of columns: Euler theory, design of columns

Course outcomes (Brackets refer to program outcomes)

1. Be able to calculate normal stresses in straight bars subjected to combinations of bending and either tension or compression. [a,c,e]

2. Be able to apply principles of failure analysis and factors of safety based on stress. [a,c,e,i,k]

3. Be able to calculate shear stresses in transversely loaded beams and in torsionally loaded members of circular cross section. [a,c,e]

4. Be able to calculate maximum principal stresses and principal stress orientations in combined loading cases of generalized plane stress. [a,c,e,i,k]

5. Be able to calculate deflections of elastic beams subjected to simple types of transverse loading. [a,c,e]

6. Be able to determine the buckling loads of slender columns with simple types of end condition. [a,c,e]

Outline of the course

Date	Topic	Reading
M 08/26	Introduction to mechanics of materials	-
W 08/28	Equilibrium and stress	1.1 - 1.3
F 08/30	Normal and Shear Stresses	1.4 - 1.5
M 09/02	*Labor Day*	-
W 09/04	Allowable stress design	1.6
F 09/06	Strain	2.1 - 2.2
M 09/09	Stress-Strain diagram	3.1 - 3.4; 3.6
W 09/11	Stress-Strain diagram	3.1 - 3.4; 3.6
F 09/13	Deformations under axial loading	4.1 - 4.3
M 09/16	Statically indeterminate structures	4.4
W 09/18	Temperature effects	4.6
F 09/20	Torsion of circular shafts	5.1 - 5.3
M 09/23	Torsion of circular shafts	5.4
W 09/25	Indeterminate shafts and Thin-walled shafts	5.5 - 5.7
F 09/27	Review	-
M 09/30	Review	-
T 10/01	**Hour exam 1 - 7PM - 9PM**	Chapters 1-5
W 10/02	SF and BM diagrams	6.1
F 10/04	SF and BM diagrams	6.2
M 10/07	Beams in bending	6.3 - 6.4
W 10/09	Beams in bending	6.3 - 6.4
F 10/11	Non-symmetric bending; Composite beams	6.5 - 6.6
M 10/14	Transverse shear	7.1 - 7.2
W 10/16	Shear flow in built-up members	7.3
F 10/18	Shear stress in thin-walled members	7.4
M 10/21	Pressure vessels	8.1
W 10/23	Combined loading	8.2
F 10/25	Combined loading	8.2
M 10/28	Plane stress transformation	9.1 - 9.3
W 10/30	Mohr's Circle	9.4
F 11/01	Mohr's circle	9.5
M 11/04	Plane strain; strain gages	10.1, 10.5
W 11/06	Generalized Hooke's law	10.6
F 11/08	Theories of failure	10.7
M 11/11	Review	-
W 11/13	Review	-
R 11/14	**Hour exam 2 - 7PM - 9PM**	Chapters 6-10
F 11/15	Deflection in beams - integration methods	12.1 - 12.2
M 11/18	Deflection in beams - integration methods	12.1 - 12.2
W 11/20	Superposition methods	12.5
F 11/22	Statically indeterminate + integration methods	12.6 - 12.7
M 12/02	Statically indeterminate + superposition methods	12.9
W 12/04	Buckling	13.1 - 13.3
F 12/06	Buckling	13.6 - 13.7
M 12/09	Final Review	-
W 12/11	Final Review	-
M 12/16	**CONFLICT FINAL EXAM - Time TBA**	-
W 12/18	**FINAL EXAM - 8-11am**	-