

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
Email: mfsilva@illinois.edu
Office: MEB 154
Lectures: MWF, 9AM (AL1) and 10AM (AL2), 100 MSEB
Office hour: Monday 12-1pm, MEB 154 (or by appointment)

Head teaching assistants

Ankit Saharan, saharan1@illinois.edu

Teaching assistants

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Discussion sessions

AD1, M 12:00-12:50PM, 260 MEB, Tim and Seunghwi
AD2, M 5:00-5:50PM, 135 MEB, Ouli and Robin
AD3, T 9:00-9:50AM, 252 MEB, Ouli and Jun
AD4, T 12:00-12:50PM, 260 MEB, Ankit and Robin
AD5, T 12:00-12:50PM, 252 MEB, Ouli and Jun
AD6, W 12:00-12:50PM, 260 MEB, Ankit and Robin
AD7, W 5:00-5:50PM, 260 MEB, Ankit and Xiaolu
AD8, R 9:00-9:50AM, 252 MEB, Xin and Xiaolu
AD9, R 11:00-11:50AM, 335 MEB, Xin and Xiaolu
ADA, R 12:00-12:50PM, 335 MEB, Tim and Seunghwi
ADB, R 5:00-5:50PM, 260 MEB, Xin and Jeff
ADC, M 5:00-5:50PM, 243 MEB, Tim and Jeff

Special accommodations

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 January 31st, 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) of “*Mechanics of Materials*” by Hibbeler R.C., Pearson can be used as SUPPLEMENTAL material and is available at Uofi Bookstore for \$146.00. This price includes the *MasteringEngineering* access code, which is required to complete your homework assignments (see section “Required online tool”) and eText.

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 (\$146.00): MasteringEngineering + **eText** + printed custom version of the textbook
2. Purchase MasteringEngineering + **eText** (\$110.00)
3. Purchase MasteringEngineering only (\$51.60) - in this case, you may choose to use your lecture notes for text reference, borrow a book from a friend or library, or buy any other 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: TAM251SP14
- 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.

Table 1: Office hours at 429 Grainger Library

Time	Monday	Thursday	Friday
1 - 2pm	Seunghwi	Jeff	
2 - 3pm	Tim	Ankit	Jun + Xiaolu
3 - 4pm	Tim + Xin	Ankit	Ouli + Robin + Jun
4 - 5pm	Tim + Xin	Ankit + Xiaolu	Ouli + Robin
5 - 6pm	Xin + Jun	Xiaolu	Ouli + Robin
6 - 7pm	Jun		

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, January 30th. It will be staffed by the TAs during the time slots indicated in Table 1.

Online Forum

This class uses Piazza <https://piazza.com/illinois/spring2014/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 - 4%
 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 mostly on **Mondays at 11:59 pm**. Late submissions will be penalized by 20% over each day late. Note that some assignments will be due on Wednesdays. Make sure to check the deadlines on MasteringEngineering.
3. Some of the problems will have a Hint. You can get bonus points 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 January 27th. This assignment is optional; its purpose is to help you getting familiar with “MasteringEngineering”. You can earn up to 0.18% of extra points to be added to your final grade.
13. The second online homework is due on January 31st. 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 February 3rd and covers the material of chapter 1.

Group worksheets (8%)

1. Discussion sessions will begin on Tuesday, January 21st. If you attend discussion session AD1, AD2 or ADC (i.e., Monday discussions), you should go to any other discussion session on the week of January 20th.
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”)

IN SUMMARY, WE WILL ONLY GRADE WRITTEN REPORTS UPLOADED AS A PDF FILE, SINGLE DOCUMENT, PORTRAIT FORMAT! NO EXCEPTIONS!!
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 February 7th.
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). No exceptions. PLEASE DO NOT SEND YOUR LATE HOMEWORK BY EMAIL.
13. Your lowest written homework score will be dropped. *This drop should be reserved for unexpected occurrences such as sickness or a family emergency.*

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. Quizzes (4%)
 - (a) Expect an i>clicker quiz in every lecture: 3% for attendance + 1% 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. Midterm 1: Thursday, March 6th, 7:00PM-9PM, Location: see table below
4. Midterm 2: Thursday, April 17th, 7:00PM-9PM, Location: see table below
5. 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
(263 seats) AD6 + AD7 + AD8 + ADB	MSEB 100	MSEB 100
(200 seats) AD1 + AD3	DCL 1320	DCL 1320
(200 seats) AD2 + AD4 + ADC	SIEBL 1404	SIEBL 1404
(274 seats) AD5 + AD9 + ADA	AH 314	AH 314

6. Conflict exams will be scheduled for students with legitimate (documented) scheduled conflicts. These are usually on the same day but earlier than the regular exam. You should contact Dr. Silva to schedule a conflict exam no later than one week prior to the exam date.

Final exam (30 %)

1. 3 hours exam, “closed book” and “closed notes”.
2. A formula sheet will be provided at the exam.
3. Make-up exams will only be allowed with a major documented excuse.
4. AL1: May 14th, 1:30-4:30PM, location TBA
5. AL2: May 12th, 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 (jkrehbi2@illinois.edu) 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

- Excuses from homework, quizzes and exams will be given only in one of the following circumstances:
 - illness;
 - 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
 - required attendance at an official UIUC activity (e.g. varsity athletics, band concert).
- 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.
- 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.
- 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.
- 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.
- 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).
- 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, talk to one of us in person during office hours or post messages on Piazza.

Academic integrity

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

List of topics

- Basic concepts of stress and strain
- Uniaxial loading and deformation: Statically determinate and indeterminate problems; design based on yield strength, ultimate strength
- Torsion of circular shafts and thin-walled sections: Geometry of deformation, stress, distribution, statically determinate and indeterminate systems, design of shafts for power transmission
- Stresses due to bending: Geometry of deformation, stress distribution, symmetric elastic beams, transverse shear, built-up beams, design of beams for structural applications
- Beam deflections: Differential equations, double integration, direct integration, method of superposition, design based on deflections, slopes, shear forces, and bending moments
- Multi-axial stress and strain states: Transformation of stress and strain, Mohr's 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
- 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]