

Schedule: TR 11:00am–12:20pm in 103 Talbot; discussion F in 305 MSEB, see below for times; exams in the Computer-Based Testing Facility (CBTF).

Course websites:

- Schedule, lecture slides, gradebook, and written report deposit: [MSE406 website](#) (Compass2g)
- Online homework: [PRAIRIELEARN](#), a link will be provided via Compass2g
- Announcements and online discussion forums: piazza.com/illinois/fall2017/mse406/home

Scope: Fundamentals of elastic, viscoelastic and plastic deformation of materials; composite behavior; elementary theory of dislocations; strengthening mechanisms; creep, fracture, and toughening; and fundamentals of thermal behavior (heat capacity, thermal expansion, conductivity, and the effects of thermal stresses). Connecting underlying microscopic mechanisms to macroscopic material behavior, with the goal of controlling or coping with that behavior.

Objectives: Students will be able to explain how fundamental microscopic physical mechanisms produce macroscopic mechanical and thermal behavior of materials. Students will calculate mechanical and thermal behavior for a variety of realistic problems. Moreover, students will be able to apply empirical and theoretical models to novel engineering questions.

Prerequisites: Math 225 (Linear Algebra), TAM 206 (Statics and Mechanics of Materials), MSE 201 (Phases and Phase Relations); as well as their prerequisites, e.g., Math 241 (Calculus III), Physics 211 (Mechanics). *If you have not passed a prerequisite course, please see the instructor before continuing.*

Instructor: Robert Maass ([rmaass](#); 408B MSEB near the west stairwell)

Teaching Assistants:

Discussion Sections: *You may only attend your registered section:*

AD1, F 11:00–11:50am, 305 MSEB

AD2, F 12:00–12:50pm, 305 MSEB

AD3, F 1:00–1:50pm, 305 MSEB

Text: *Mechanical Behavior of Materials*, Thomas L. Courtney, Second edition (Waveland, 2005).

Alternative Text: *Mechanical Behavior of Materials*, Mark Meyers & Krishan Chawla, 2nd ed. (Cambridge, 2009).

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, disability.illinois.edu) as soon as possible, and no later than Aug. 31.

i>clickers: Quizzes will be administered in lectures using the i>clickers. The i>clicker remote may be purchased at any of the book stores and must be registered on the [MSE406 website](#) on Compass2g, under the tab on the left menu “Register your i>clicker” **You need to register your i>clicker by Sept. 4, when the i>clicker roster will be synced for the last time.**

Course evaluation:

$$10\% \times (\text{Online Homework}) + 4\% \times (\text{In-lecture i>clicker}) + 8\% \times (\text{Discussion Worksheets}) + 8\% \times (\text{Written Reports}) + 10\% \times (\text{Prerequisite exam}) + 20\% \times (\text{Exam 1}) + 20\% \times (\text{Exam 2}) + 20\% \times (\text{Exam 3}) = \text{Total}$$

Numerical total score corresponds to the following final grades:

A+ (98–100)	B+ (88–90)	C+ (78–80)	D+ (68–70)	
A (94–97)	B (84–87)	C (74–77)	D (64–67)	F (0–60)
A– (91–93)	B– (81–83)	C– (71–73)	D– (61–63)	

Online Homework (10%): Assignments on [PRAIRIELEARN](#).

- Online homework assignments are due on **Tuesdays at 11:59 pm**. Late submissions will not be accepted.
- You can rework completed items after the due date. This work will not be saved and will not affect your grades.
- You will receive a grade for ALL assigned online homework problems. Your HW score will also appear in the grade book.
- The online homework problems give explicit values and units to the relevant lengths, material properties, forces, etc., 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, etc., 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.
- 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.
- The “zeroth” online homework is optional, and due on *Tuesday Sept. 5*. It contains multiple choice questions regarding the syllabus. *You will only have one attempt for each multiple choice item*. You can earn up to 0.5 of extra points to be added to your final grade.
- The first online homework is due on Tuesday Sept. 12 and covers the material of the first three lectures.

Lectures (4%): Prompt and regular attendance at lectures is required to obtain credit for i>clicker quizzes: 75% participation, 25% correctness.

Discussion Sections (8%): Prompt and regular attendance at your discussion section is required. You must attend only the discussion section in which you are enrolled.

Most discussion sessions will consist of a group worksheet exercise, which is a high-energy and efficient 50-minute learning experience. For each session, students will work with their group of three to four people. Each student must submit a completed worksheet, but only one randomly-chosen worksheet will be scored from each group, and every student in that group will be given that score. If you are more than 5 minutes late to a discussion session, then you will not be permitted to complete the worksheet. There are two main goals for the discussion worksheets:

- **Gain experience in team-work.** This skill is critical in all engineering disciplines, from large-scale industrial projects to academic research. To work productively in teams is a skill that must be learned just like math or physics, and regular practice is essential. Often you will have to work with people who you do not especially like, or who you find it difficult to work with. It is important to learn how to manage these situations so that the important work is still accomplished.
- **Apply engineering concepts to real-world problems.** Each worksheet focuses on a real-world problem that you will have to use your engineering skills to solve, including the material from class and also knowledge from previous engineering, math, and science classes. You will also have to think like an engineer and understand when to make approximations, how to judge the appropriateness of different models, and which mathematics and physics is most useful for a given engineering problem.

Discussion sections start Friday Sept. 1. Teams will be constructed at the beginning of the semester and can not be changed. You are encouraged to also work together as a team on computational

reports (see below). For Sept. 1, you will work in random teams in recitation, but starting Sept. 8, you will work in your assigned team for the rest of the semester.

Written Reports (8%): Each week a report must be submitted, consisting of a full write-up of a problem related to the group worksheet that was assigned in that week's discussion section. The report assignments will be available after each discussion session at 2 pm on the [MSE406 website](#) on Compass2g, where it also must be submitted the following **Friday at 11:59pm**. The only format that will be accepted for report submission is a single, properly-ordered PDF, in portrait format that includes the scanned version of your handwritten calculations. Your name and discussion section must be printed legibly on the top of the first page. The TAs will grade the report. You may submit each report a maximum of three times; only the latest submission will be graded.

Computational reports. Computational material science and engineering is a field with increasing importance in research and industry; to give you experience in applying the tools of computational modeling to materials science and engineering, there will be three computational report assignments. Fridays during your exam weeks, you will be able to take advantage of additional optional support from the TAs on these assignments. Computational office hours will be held in the computational lab in the Ceramics building in room 322 as follows: Tuesdays and Wednesdays 5pm. *As all other reports, computational reports are to be submitted individually.*

Written reports are assigned 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, and clarity of explanation (80%). Reports should be neat and organized, handwritten or typed. Tables and graphical representations of results should be generated using some software program such as Excel, TecPlot, MatLab, etc., rather than being hand-drawn. Correct interpretation of the problem and correct final answers are important but not the focus (20%). Late written reports will not be accepted. The first reports will be assigned Friday Sep. 08 following your discussion section, and is due Friday Sept. 15. An example of a good report can be found on the class website. Point breakdown for the written report:

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

Prerequisite Exam (10%), Midterm Exams (20% + 20% + 20%) and an optional Comprehensive Final Exam: Exams will take place in the [CBTF](#) located in the basement of the Grainger Engineering Library in room 57. There are four exams: Sept. 14-17 (prerequisite exam), Sept. 28-Oct. 1 (exam 1), Nov. 2-5 (exam 2), and Dec. 7-10 (exam 3). The optional comprehensive final exam will be in the week of Dec. 15. If you are unable to attend an exam then you must inform your professor by email at the earliest possible opportunity. For non-emergency absences this notification must be at least *one week in advance*. Conflict-exam arrangements will be announced in the week before the final exam, and will be scheduled for students with a legitimate scheduled conflict according to the final exam policies. Please read the Student Expectations and Procedures for the [CBTF](#). **Bring your student ID to the exam, and arrive with sufficient time to sign in. Details on CBTF exam hours will be provided later.**

Each exam will cover a subset of topics from the class. The prerequisite exam covers a review of topics from the prerequisites for the class, while exams 1, 2, and 3 each cover a broad topic

(elasticity, plasticity, and creep and failure) corresponding to eight lectures each. Lastly, the class will conclude with an *optional* comprehensive final exam. If you choose to take the final exam, your grade on the final exam will replace your *lowest* single exam grade, provided that your final exam grade is not lower. This exam is an opportunity for you to demonstrate your understanding of the topics from class.

Canceled classes: There will not be any Friday discussion sections immediately after Exams 1, 2, and 3 (Sept. 29, Nov. 3, Dec. 8). There will, however, be a Friday discussion section immediately after the prerequisite exam. Be aware that despite the canceled discussions, **written reports are still due on those Fridays.**

Grade Reporting: All assessment scores are stored on the [MSE406 website](#). Any errors in grade reporting appearing in the gradebook must be reported within 2 weeks of the due date of the assessment item or by the last day of class, whichever is earlier. If you have a missing grade for discussion section, a homework, or a written report, contact the *TAs in your section*. If you have a missing grade from an exam, or i>clicker, contact the instructor.

Expectations: To succeed in this class, you will need to

- read the chapter *before* coming to class, and formulate questions;
- participate in the class;
- make sure you understand the homework problems and solutions;
- seek out help when you have trouble.

Obtaining help: The main two ways to obtain help are online at Piazza or in person at office hours. You can also speak with your professor briefly after lecture. Please do not send email directly to TAs or professors for routine help or absences. In cases of emergencies related to exams (e.g., illness) you should email your professor at the earliest possible opportunity.

Online Forum (Piazza): This class uses Piazza for all communication between the instructor, TAs, and students. Please visit piazza.com/illinois/fall2017/mse406/home to register. The class link will take you to the current class page at any time. Official class announcements will be sent via Piazza, so you must register with an email address that you regularly check. If you desire, you can post anonymously on Piazza or make a private post just to the instructors (this should be done rather than emailing the professor directly). TAs are scheduled to be checking Piazza during the week 10am–11am, 5–6pm, and 9–10pm. *Note that Piazza should be used to communicate with your instructors, rather than email.*

Office Hours: TA office hours will be held as follows: MSEB 322, Mondays 4–6pm and Wednesday noon–2pm. Please collect the key in the business office. The first hour (4–5pm and noon–1pm) will be a time to meet up with fellow MSE406 students to work on homework and written reports together, and the second hour (5–6pm and 1–2pm) will be staffed by a TA. Office hours will start Aug. 30). Do not ask TAs to work the homework problems before they are due; it is fine to ask specific questions on the details of your attempted solutions, or to work out problems that are similar to homework problems.

Absences: Excused Absence Request Form: illinois.edu/fb/sec/1070536

1. Excuses from assessments will only be given in the following circumstances:
 - (a) Illness.
 - (b) Personal crisis (e.g., car accident, required court appearance, death of a close relative).
 - (c) Required attendance at an official UIUC activity (e.g., varsity athletics, band concert).
2. In all cases you must complete the online Excused Absence Request Form 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 must be submitted via the online form within 2 weeks of the due date of the missed assessment, but no later than reading day (Dec. 14). In cases of extended or unusual illness, late submission of excuse documentation will be considered. See [Student Assistance Center](#).
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. If you will not be able to take an exam due to illness or any other reason, you must send email to your professor at the earliest possible opportunity. Excused exams will be replaced by a weighted average of the other exam scores at the end of semester.
6. Notwithstanding the above, at the professor's discretion you may be required to make up any excused work or attend substitute instruction or assessment.

Academic Integrity, Harassment, and Discrimination: You are bound by the [University Honor Code](#) in this course. Any violation of the Honor Code will result in disciplinary action. In addition, harassment or discrimination of any kind will not be tolerated. Please report any concerns immediately to your professor.

Changes to syllabus: may occur as deemed necessary by the professor; they will be announced.

Calendar and Topics: Changes to schedule will be announced; see [MSE406 website](#) calendar for specific reading assignment and to remain up to date.

		Assignments		
	available	due	Chapter	Description
T Aug 29	HW0		1	Review of mechanical response
R Aug 31			2	Elastic behavior
F Sep 01	WS0			
T Sep 05	HW1	HW0	2	Anisotropic elastic behavior
R Sep 07			2, 8	Rubber, viscous flow
F Sep 08	WS1, RP1			
T Sep 12	HW2	HW1	2, 8	Polymer deformation, damping
R Sep 14	Begin EXAM0		prerequisites	schedule your time at CBTF
F Sep 15	WS2, RP2	RP1		
T Sep 19	HW3	HW2	6	Reinforcement type
R Sep 21			6	Fiber effects
F Sep 22	WS3, RP3	RP2		
T Sep 26		HW3	6	Statistical failure
R Sep 28	Begin EXAM1		1, 2, 6, 8	schedule your time at CBTF
F Sep 29	—		—	<i>no discussion</i>
T Oct 03	HW4		3	Dislocation types
R Oct 05			3	Dislocation properties
F Oct 06	WS4, RP4	RP3		
T Oct 10	HW5	HW4	3	Crystal structures, dislocation intersections
R Oct 12			3, 4	Plastic flow
F Oct 13	WS5, RP5	RP4		
T Oct 17	HW6	HW5	5	General strengthening, work-hardening
R Oct 19			4, 5	Boundary strengthening, polycrystals
F Oct 20	WS6, RP6	RP5		
T Oct 24	HW7	HW6	5	Solid solution, particle hardening
R Oct 26			5	Particle hardening
F Oct 27	WS7, RP7	RP6		
T Oct 31		HW7	7	Creep phenomenology and mechanisms
R Nov 02	Begin EXAM2		3, 4, 5	schedule your time at CBTF
F Nov 03	—		—	<i>no discussion</i>
T Nov 07	HW8		7	Creep: DMM, LM parameter
R Nov 09			9	Crack initiated fracture
F Nov 10	WS8, RP8	RP7		
T Nov 14	HW9	HW8	9	Fracture mechanics, toughness, statistics
R Nov 16			10	Toughening of metals, ceramics
F Nov 17	WS9, RP9	RP8		
— Thanksgiving break —				
T Nov 28	HW10	HW9	10	Toughening of polymers, composites
R Nov 30			10	Fatigue
F Dec 01	WS10, RP10	RP9		
T Dec 05		HW10	12	Fatigue
R Dec 07	Begin EXAM3		7, 9, 10, 12	schedule your time at CBTF
F Dec 08	—		—	<i>no discussion</i>
T Dec 12			Online	Ashby plots and mechanical design
R Dec 14		RP10		<i>Reading day</i>
F Dec 15	Begin FINAL		1–10, 12	comprehensive final exam at CBTF