

Fall 2025 MSE 406 Thermal & Mechanical Behavior of Materials

Course quick links:

[https://campuswire.com/p/G83094EE6Links to an external site.](https://campuswire.com/p/G83094EE6Links%20to%20an%20external%20site.); access code **7998**

[Mediaspace](#) for recorded lectures

Overview

1) When/where to show up?

- **Lectures: TR 11:00–12:20pm in Everitt 2310** | You are *strongly encouraged* to come.

Bring your **iClicker**, participation counts for 4% of your final grade (see details below)

- **Discussion sections:** F 11:00-11:50 (AD1), 12:00-12:50 (AD2), 13:00-13:50 (AD3),
1047 Sidney Lu Mech Engr Bldg. These are *mandatory* and graded each week.

2) Resources

- Primary reference: **Canvas space** (lecture slides, due dates for all assignments, logistics, syllabus)

<https://canvas.illinois.edu/courses/59483>

- **Recorded lectures:**

Link requested

- Textbook: ***Mechanical Behavior of Materials*, Thomas H. Courtney, 2nd ed.**
(Waveland, 2005), preferred. Alt.: *Mechanical Behavior of Materials*, Mark Meyers & Krishan Chawla, 3rd ed. (Cambridge, 2024).

3) Assignments

7 exams throughout the semester, to be taken at the CBTF

1 optional final at CBTF

7 online homeworks, to be found on prairielearn.org [Links to an external site.](#) (students typically find it on their own...mystery to me, let me know if you don't see it!), due on Mondays every other week at 23:59:59.

10 written or computational reports uploads: submit here on Canvas Wednesdays at 23:59:59.

Scope

- Isotropic and anisotropic elasticity
- Thermal stress and strain
- Polymer behavior and visco-elasticity
- Composite behavior
- Elementary theory of plasticity
- Strengthening of metallic alloys
- Creep
- Fracture mechanics
- Toughening
- Fatigue

Connecting underlying microscopic mechanisms to macroscopic material behavior, with the goal of controlling or designing novel materials.

Objectives

We will be able to:

- (a) explain how fundamental microscopic physical mechanisms produce macroscopic mechanical and thermal behavior of materials;
- (b) calculate mechanical and thermal behavior for a variety of realistic problems;
- (c) apply empirical and theoretical models to novel engineering questions.
- (d) work together with their colleagues in a professional, scientific manner.

Prerequisites

- * Math 225 (Linear Algebra)
- * TA/MSE 206 (Statics and Mechanics of Materials -though we will not bother you with

Mohr's circle anymore)

* 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 email the instructor before continuing.

Instructors

Prof

- Marie A. Charpagne (email: mcharp@illinois.edu ; office located in 408A MSEB, west stairwell).
 - Assistant Professor in Materials Science and Engineering (joined Univ. Illinois in 2021)
 - Research area: alloy design and synthesis (solidification, 3D printing, thermal-mechanical processing, sputtering) and materials behavior in extreme environments (mechanical performance, corrosion, irradiation)

Teaching assistants

- **Christopher Bean** (email: cmbean2@illinois.edu)

Chris is a **Racheff scholar awardee 2023-2024** and **2024-2025**, which means that he's strongly dedicated to teaching. He has received almost all possible awards for his teaching service and skills (ranked as excellent TA in Fall 2022, Fall 2023, Fall 2024). This is his 4th year teaching MSE 406. He works in the Stinville group.

- **Davin Yoo** (email: davinjy2@illinois.edu)

Davin is teaching MSE 406 for the first time. He works in Marie's group.

Course evaluation

10% x (Online Homework) + 4% x (Participation) + 8% x (Discussion Worksheets) + 8% x (Written Reports) + 70% x (Exams)

Numerical total score corresponds to the following final grades:

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

1) Homework submissions (10%)

Please refer to the course schedule onto the Canvas' page or PrairieLearn for due dates and times. Late submissions will not be accepted and will lead to whichever grade you left at.

You can rework completed items after the due date to prepare for exams and exams, however this work will not be saved and will not affect your grade.

You will receive a single grade for ALL assigned online homework problems. Your average 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 a numerical value. Nevertheless, when solving a homework problem you should assign symbols to all the relevant lengths, forces, material properties, etc., and then solve the problem symbolically to ensure you follow the math. Finally, substitute the value and units of each of the symbols in the symbolic formula.

2) Participation (4%)

During lectures, we will use iClickers to help check your understanding of the material, and give you practice working some problems. The iClicker grade is calculated *based on participation, and not correctness of your answers*, but the idea is for you to try and answer correctly !

3) Discussion worksheets (8%)

Prompt and regular attendance at your discussion section is required. You must attend only the discussion section in which you are enrolled, e.g. at 11AM, 12PM, or 1PM. 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 in groups. Each student must work on completing their worksheet, as 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 and your grade for that session will be 0%. **Please send an email to the TAs & prof in advance (as much as possible) regarding missed sessions or late arrivals.** Missing a session requires an excused absence letter.

There are two main goals for the discussion worksheets:

1- Gain experience in teamwork. 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.

2- 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.

We also hope that these discussion worksheets will help you to meet your classmates, and we encourage you to get together outside of lectures and discussions to work collaboratively on homeworks and exam study. You should work with your team to study outside of the class, and you will work together on computational reports (see below).

4) Written Reports (8%)

Written reports consist of a full write-up of a problem related to the group worksheet that was assigned in that week's discussion section. The report will be posted after the discussions on Friday and must be **submitted individually on Canvas**. The TAs will grade the report. 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, hand-written or typed. Tables and graphical representations of results should be generated using some software program such as Excel, Python, MatLab, etc., rather than being hand-drawn. Correct interpretation of the problem and correct final answers is important but not the focus (20%). Late written reports will not be accepted.

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

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 computational reports that are assigned throughout the semester. Additional information will accompany these assignments, and you will be able to take advantage of additional support from a teaching

assistant on these assignments. In addition, you can work as a group on the computational reports, and turn in a single report for the computational modeling. All other reports are to be done individually.

5) Exams/Exams (70%)

Dates and policies: There are regular 50 minutes Exams throughout the semester. Please refer to the course's Canvas page for dates and details. The final exam will take place during exam week. This course uses the College of Engineering Computer-Based Testing Facility (CBTF) for its exams and exams: <https://cbtf.engr.illinois.edu>

The policies of the CBTF are the policies of this course, and academic integrity infractions related to the CBTF are infractions in this course. If you have accommodations identified by the Division of Rehabilitation-Education Services (DRES) for exams, please take your Letter of Accommodation (LOA) to the CBTF proctors in person before you make your first exam reservation. The proctors will advise you as to whether the CBTF provides your accommodations or whether you will need to make other arrangements with your instructor. Any problem with testing in the CBTF must be reported to CBTF staff at the time the problem occurs. If you do not inform a proctor of a problem during the test then you forfeit all rights to redress.

Exam Content

The exams last fifty minutes, and will give you an immediate assessment and feedback on your understanding of the material since the previous exam. The first exam is a prerequisite exam, which covers a review of topics from prerequisites for the class, while the other exams are roughly paired around the topics of elasticity, plasticity, and failure. The final exam is optional. It is cumulative over the entire course, and lasts three hours.

Total score

Your total score of 70% is calculated from your seven exams using a weighted sum. First, we sort your exam scores from highest (score S1) to lowest (score S7). We sum them up as $14S1 + 12S2 + 10S3 + 8S4 + 6S5 + 4S6 + 2S7$, where S is your combined exam score. If you take the final exam and your score exceeds your lowest exam score, the exam score will replace the lowest exam in the total calculation; if your score exceeds your lowest two exam scores, the exam score will replace your two lowest exams in the total calculation.

Expectations

To succeed in this class, you will need to

- * do your reading and homework on-time
- * participate in the class, be a strong contributor and leader in discussion sections

- * 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 CampusWire or in person at office hours. Please do not send email directly to TAs or professors for routine help, because our email inboxes are flooded; CampusWire is much better for this. In cases of emergencies related to exams (e.g., illness) you should email message Prof. Charpagne at the earliest possible opportunity; note that due to the ability to (re)schedule via the CBTF, you will be able to take care of this yourself in most cases.

Online forum (CampusWire)

<https://campuswire.com/p/G83094EE6>Links to an external site. ; access code **7998**

This class uses CampusWire for all communication between the instructor, TAs, and students. You will receive an email to register with CampusWire soon. Official class announcements will be sent via CampusWire, so you must register with an email address that you regularly check, or check CampusWire regularly. If you desire, you can post anonymously on CampusWire to the entire class, or post a private question just to the instructors (this should be done rather than emailing the professor directly). TAs are checking CampusWire on a daily basis during the week. Note that CampusWire should be used to communicate with your instructors, rather than email.

Office hours

Mondays and Thursdays 2-4PM in MSEB 408F. TAs will be there from 3-4PM.

Absences

Excuses from assessments will only be given in the following circumstances:

- Illness.
- Personal crisis (e.g., car accident, required court appearance, death of a close relative).
- Required attendance at an official UIUC activity (e.g., varsity athletics, band concert).

The first two cases follow the student code regarding absences. This includes absence due to exposure to COVID-19, and a letter is requested from ODOS.

In case of the latter 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.

Need an accommodation for Exams? Walk over to CBTF. Need a temporary date extension for a Exam? Email mcharp@illinois.edu . Already missed your Exam? Same as above.

Formal and Informal Accommodations

I am committed to assisting students requiring special accommodations for circumstances that are registered with the DRES Student Services Department. These formal accommodations should be discussed with me as early as possible in the semester or as soon after DRES approval as possible.

If you are not formally registered with DRES and have anxiety, depression, learning disabilities, or other issues that affect your ability to fully participate and learn in this class, you are encouraged to check-in with the instructor so we can determine together the kind of support you need to thrive in this class. If this is the case, please set up a meeting with me via email.