CEE 216: Mechanics of Materials I/ BME 271: Intro to Biomechanics

Syllabus: Fall 2025

Lecture (all students): Mon, Tue, Wed, Fri 11:00–11:50 @ Fisk Hall 217 (Prof. Stein-Montalvo)
Thursday lecture (BME 271 only): Thu 11:00–11:50 @ Tech LG66 (Prof. Major)

Canvas: All course materials, homework, announcements, and grades will be posted on Canvas.

Please read all sections of this syllabus thoroughly. This document may be revised at any time; updates will be announced on Canvas.

Contents

1 Instructors

Lucia Stein-Montalvo, PhD
Email: lsmontal@northwestern.edu
Zoom: northwestern.zoom.us/my/lsmontal
Office: Tech A122
Office Hours: Mon 3-4:30pm, Wed 12:30-2pm, and by appointment

Matthew Major, PhD (BME 271)
Email: matthew-major@northwestern.edu

2 Graduate Teaching Assistants

TA office hours will be held in person in Tech AG40 unless otherwise noted.

Daiki Shoji
Email: daiki.shoji@northwestern.edu
Office Hours: Mon 12:30-2:30pm, Thu 9-11am

Tapiwanashe Bhibho
Email: tapiwanashe.bhibho@northwestern.edu
Office Hours: Thu 2-4pm, Fri 12:30-2:30pm

3 CEE Scholars (Undergraduate Tutors)

Check Office Hours Summary Table (Sect. 4) for CEE Scholars' office hours locations.

Name	Email (@u.northwestern.edu)	Mon	Tues	Wed	Thu	Fri
Jon Myers	jonmyers2026	9–10am	9–10am	9–10am		9–10am
Sophia Jedziniak	sophiajedziniak2026		12:30–2pm		11:30–2pm	
Mila Hrustic	milahrustic2027		2–4pm	2–4pm		

4 Office Hours Summary Table

Day	Time	Office Hours (Instructor / TA / CEE Scholar)	Location
Mon	9–10am	Jon Myers	AG40
	12:30–2:30pm	Daiki Shoji	AG40
	3–4:30pm	Prof. Stein-Montalvo	A122
Tue	9–10am	Jon Myers	A125
	12:30–2pm	Sophia Jedziniak	AG40
	2–4pm	Mila Hrustic	AG40
Wed	9–10am	Jon Myers	AG40
	12:30–2pm	Prof. Stein-Montalvo	A122
	2–4pm	Mila Hrustic	AG40
Thu	9–11am	Daiki Shoji	A125
	11:30–2pm	Sophia Jedziniak	AG40
	2–4pm	Tapiwanashe Bhibho	AG40
Fri	9–10am	Jon Myers	AG40
	12:30–2:30pm	Tapiwanashe Bhibho	AG40

5 Course Objectives

- Compute the stress distributions in linear elastic bar systems loaded in tension or compression, torsion, and bending.
- Determine displacements in linear elastic bar systems loaded in tension or compression and torsion.
- Distinguish between statically determinate and indeterminate problems.
- Use compatibility to solve statically indeterminate problems.
- Evaluate the effects of choosing different materials and geometries.
- Determine principal values and principal directions for plane stress states.
- Determine change of components of plane stress state due to rotation of a 2D coordinate system (Mohr's circle).
- Determine beam deflections for statically determinate and indeterminate systems.
- Determine beam deflections for different end constraints.
- Calculate centroids and moments of inertia for common beam cross-sections, e.g., T and I.
- Have a basic knowledge of approaches to design structural and machine components.
- Have hands-on design, fabrication (3D printing), testing, and analysis skills.
- Be ready for the Mechanics of Materials portion of the Fundamentals of Engineering (FE) exam.

6 Textbook and Calculator

Primary textbook: R. C. Hibbeler, *Mechanics of Materials*, 11th edition, Pearson.

Prior editions of the textbook as well as other similar textbooks are adequate for the reading content. It is your responsibility to check since chapter sections may be different.

Recommended reading: J.E. Gordon, *Structures: Or Why Things Don't Fall Down.*

Calculator Policy: NCEES approved calculators are required for exams. See the official list here: ncees.org/2017-calculator-list-approved-new-model-added. Approved calculators:

- Casio: All fx-115 and fx-991 models (must have "fx-115" or "fx-991" in its model name).
- Hewlett Packard: The HP 33s and HP 35s models, but no others.
- Texas Instruments: All TI-30X and TI-36X models (Any Texas Instruments calculator must have "TI-30X" or "TI-36X" in its model name.)

7 Course Assessment

Grading Breakdown:

- Homework Assignments — 10%
- Project — 15%
- Midterm 1 — 20%
- Midterm 2 — 20%
- Final Exam — 35%

Homework:

Homework is assigned weekly on Canvas (guidelines and problem statement) and is due on Canvas at 11:00 am on designated days (see Course Schedule, Sect. 14.) Please submit a single PDF named: `LastName_FirstName_CEE216_HW#.pdf`.

Important Notes:

- Late homework will not be graded. The lowest homework score will be dropped at the end of the quarter.
- If a problem is unclear, post on Canvas Discussions and/or attend office hours.
- Collaboration is allowed, but you must submit your own work.*
- Ensure the PDF includes all problems and is uploaded correctly.
- Detailed solutions will be posted each week.

Formatting Guidelines:

1. Print your first and last name, assignment number, and page number.
2. Write neatly and clearly (engineering paper preferred; see template on Canvas).
3. Start each problem on a new page.
4. Include a brief statement of the problem (Given = ..., Find = ...).
5. Use a straightedge (e.g. ruler) to draw straight lines.
6. Box your final answer and include units.
7. Submit a single PDF named: `LastName_FirstName_CEE216_HW#.pdf`.

**Academic Integrity Reminder:* It is cheating to copy the solution from the solution manual or other online sources. From the NU Academic Integrity Guide: "Do your own work. The purpose of assignments is to develop your skills and measure your progress. Letting someone else do your work defeats the purpose of your education, and may lead to serious charges against you."

Project:

You will complete a quarter-long group project for this course, in which you will research, design, build (i.e. 3D print), and test a model bridge (CEE 216) or model prosthetic foot (BME 271). Complete instructions will be communicated in a separate document. Groups will be randomly assigned, and each group will submit a report at the end of the quarter. Class days will occasionally be dedicated to project feedback following key checkpoints (see Course Schedule, Sect. 14), but the majority of project work will be completed outside of class.

Exams:

There will be two midterm exams and one comprehensive final exam. Exams will occur on the dates shown in the syllabus (see Course Schedule, Sect. 14) during regular class time. Exams are closed-book and closed-notes unless otherwise noted. Only approved calculators are allowed. **No make-up exams will be given.**

8 Northwestern University Syllabus Standards

This course follows the NU Syllabus Standards (registrar.northwestern.edu/registration-graduation/northwestern-university-syllabus-standards.html). Students are responsible for familiarizing themselves with this information.

9 Special Accommodations

Northwestern University is committed to providing the most accessible learning environment possible for students with disabilities. Should you anticipate or experience disability-related barriers in the academic setting, please contact AccessibleNU to move forward with the university's established accommodation process (accessiblenu@northwestern.edu; +1 (847) 467-5530). If you already have established accommodations with AccessibleNU, please let me know as soon as possible, preferably within the first two weeks of the term, so we can work together to implement your disability accommodations. Disability information, including academic accommodations, is confidential under the Family Educational Rights and Privacy Act.

10 Academic Integrity

Students in this course are required to comply with the policies found in the booklet, "Academic Integrity at Northwestern University: A Basic Guide" (northwestern.edu/provost/policies-procedures/academic-integrity.) All assignments submitted for credit in this course must be submitted electronically unless otherwise instructed by the professor. Your written work may be tested for plagiarized content. Unauthorized student recording of classroom or other academic activities (including advising sessions or office hours) is prohibited. Students requesting the use of assistive technology as an accommodation should contact AccessibleNU. Unauthorized use of classroom recordings – including distributing or posting them – is also prohibited.

Under the University's Copyright Policy, faculty own the copyright to instructional materials – including those resources created specifically for the purposes of instruction, such as syllabi, lectures and lecture notes, and presentations. Students cannot copy, reproduce, display, or distribute these materials.

A full explanation of Northwestern's and McCormick's policies on academic integrity is available at mccormick.northwestern.edu/students/academic-integrity.htmls

11 Generative Artificial Intelligence (GenAI)

Generative AI (GenAI) tools (e.g., ChatGPT, Copilot) can be valuable for e.g. clarifying concepts and practicing problem-solving. You are welcome to use it for certain purposes during this course. However, your learning depends on developing your own ability to set up and solve problems. Please keep in mind that you will not have access to GenAI during exams.

Permitted uses: You are welcome to use AI tools to check definitions, review concepts, generate practice problems for yourself, check work, or improve writing you have already completed. *When in doubt, feel free to ask.*

Prohibited uses: Submitting AI-generated solutions for assignments is not allowed and will be treated as an academic integrity violation. You remain fully responsible for all work you submit.

Cite it: Any use of GenAI should be accompanied by a disclosure explaining (1) what you used GenAI for; (2) the specific tool(s) you used; and (3) what prompts you used to get the results.

GenAI technology is continuously evolving, so this policy is subject to revision at any point. Students will be alerted to any changes on Canvas.

12 Support for Wellness and Mental Health

Northwestern University is committed to supporting the wellness of our students. Student Affairs has multiple resources to support student wellness and mental health. If you are feeling distressed or overwhelmed, please reach out for help. Students can access confidential resources through the Counseling and Psychological Services (CAPS; northwestern.edu/counseling), Religious and Spiritual Life (RSL; northwestern.edu/religious-life), and the Center for Awareness, Response and Education (CARE; northwestern.edu/care.) Northwestern also participates in TimelyCare (northwestern.edu/studentaffairs/timelycare.html), a virtual mental health platform that provides counseling, health coaching and 24/7 on-demand services at no cost.

13 Helpful Suggestions

- **Effort commitment.** You should expect to spend approximately two hours working on the course out of class for each hour of class time. This is a total of 12 hours per week on average. All students are expected to participate in class by regularly attending lectures, by preparing adequately for class (through assigned readings and deliberate practice work), and by actively participating in class discussions and activities.
- **Check Canvas regularly.** Under Modules I post course notes and homework, homework hints, relevant course information, and supplemental materials (sometimes fun ones!)
- **Course communication policy.** Due to the volume of email I receive daily, please use Discussions in Canvas for all class-related communications. We monitor this frequently and will answer your questions. Before posting, check whether your question has already been answered. For personal matters, you may email me, but please include *CEE 216* or *BME 271* in the subject line.
- **Solve lots of problems.** More importantly, make sure you understand them. At a minimum, you should understand the examples presented in class, homework problems, and the textbook examples.
- **Take advantage of office hours.** This is time set aside to meet with students. Our section has two TAs and several undergraduate CEE Scholars who can help. If any changes occur, they will be announced on Canvas.

14 Course Schedule (Tentative)

Schedule is subject to change at any point. You will be notified of any changes via Canvas.

Week	Day	Date	Topic	HW & Reading
1	Tues	Sept 16	Intro/organization/review	
	Wed	Sept 17	Stress & strain	**HW 0 due** & 1.1-1.5, 2.1-2.2
	Fri	Sept 19	Mechanical properties & Poisson's ratio	3.1-3.3, 3.5-3.6
2	Mon	Sept 22	Axial loading	4.1-4.3
	Tues	Sept 23	Statically indet. axially loaded members	**HW 1 due** & 4.4-4.5
	Wed	Sept 24	Statically indet. axially loaded members	
	~~Fri~~	~~Sept 26~~	~~No class~~	
3	Mon	Sept 29	Thermal effects	4.6
	Tues	Sept 30	Torsion of circular shafts	**HW 2 due** & 5.1-5.2
	Wed	Oct 1	Angle of twist	5.4
	Fri	Oct 3	Statically indet. torque-loaded members	5.5
4	Mon	Oct 6	Statically indet. torque-loaded members	
	Tues	Oct 7	Pure bending	**HW 3 due** & 6.3-6.4
	Wed	Oct 8	Centroids & moment of inertia	A.1, A.2
	Fri	Oct 10	Review for midterm (through torsion)	
5	Mon	Oct 13	**Midterm 1**	
	Tues	Oct 14	Shear & bending moment diagrams	**HW 4 due** & 6.1-6.2
	Wed	Oct 15	Shear & bending moment diagrams	
	Fri	Oct 17	Design of beams for bending	11.1-11.2
6	Mon	Oct 20	Design of beams for bending	
	Tues	Oct 21	Transverse shear	**HW 5 due** & 7.1-7.2
	Wed	Oct 22	Shear stress in beams	
	Fri	Oct 24	Shear stress in beams	
7	Mon	Oct 27	*Project: Research & conceptual design review*	
	Tues	Oct 28	Review for midterm 2	**HW 6 due**
	Wed	Oct 29	**Midterm 2**	
	Fri	Oct 31	Deflection of beams: elastic curve	12.1
8	Mon	Nov 3	Deflection of beams: slope & disp. by integ.	12.2
	Tues	Nov 4	Method of superposition: statically det. beams	12.5
	Wed	Nov 5	Deflection of beams: statically indet.	12.6-12.7, 12.9
	Fri	Nov 7	*Project: Structural design, materials review*	
9	Mon	Nov 10	Transformation of plane stress	**HW 7 due** & 9.1
	Tues	Nov 11	Mohr's circle for plane stress	9.2-9.4

Week	Day	Date	Topic	HW & Reading
	Wed	Nov 12	Mohr's circle	
	Fri	Nov 14	Mohr's circle	
10	Mon	Nov 17	Buckling	**HW 8 due** & 13.1-13.3
	Tues	Nov 18	Buckling	
	Wed	Nov 19	Review for final exam	**HW 9 due**
	Fri	Nov 20	Review for final exam	
11	Mon	Nov 24	**Final Exam**	
	~~Tues~~	~~Nov 25~~	~~No class~~	
12	Mon	Dec 1	Research	
	Tues	2-Dec	*Project: Testing (construction must be done)*	**HW 10 (CTEC) due**
	Wed	3-Dec	*Project: Wrapping up*	
	~~Fri~~	~~5-Dec~~	~~No class~~ (**Project due Mon Dec 8**)	