

CE 3110

Mechanics of Materials

School of Engineering

Syllabus – Spring 2023

Course and Instructor Information

**Course Title: Mechanics** of Materials

**Credits:** #3

**Format:** (Flipped)

**Prerequisites:**  CE 2110, Enrollment in the school of engineering

**Classroom:** Science 1-Active Learning Classroom

**Professors:**

Sarira Motaref, Ph.D., P.E., Associate Professor in Residence

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**Telephone:** 860-486-2731

**Office location:** Engineering II, room 310

**Office Hours/Availability:** Monday and Friday 11:30AM-1:00 PM, or weekdays by previous appointment

Lexi Hain, Ph.D., P.E., Assistant Professor

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**Telephone:** (860) 486-5023

**Office location:** CAST 331

**Office Hours/Availability:** Tuesday and Thursday 4-5PM, Remote via Webex personal room (<https://uconn-cmr.webex.com/meet/ahh09002>), in person Wednesday 8:30AM-9:30AM

**Teacher Assistants:**

* Sachin Tripathi, [sachin.tripathi@uconn.edu](mailto:sachin.tripathi@uconn.edu)
* Giovanna Fusco, [giovanna.fusco@uconn.edu](mailto:giovanna.fusco@uconn.edu)
* Marcella Ripper Nogueira E Carvalho, [marcella.ripper@uconn.edu](mailto:marcella.ripper@uconn.edu)

Course Materials

Required Materials:

E-Book: Mechanics of Materials

By Ferdinand Beer and E. Russell Johnston, Jr. and John DeWolf and David Mazurek

ISBN10: 1260113272

ISBN13: 9781260113273

Copyright: 2020

A close up of a bridge

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<https://connect.mheducation.com/class/s-motaref-spring2023-001>

Texts are available through a local or online bookstore. The [UConn book](http://bookstore.uconn.edu/index.html) store carries many materials that can be shipped via its online [Textbooks To Go](http://bookstore.uconn.edu/text/ttg.html) service. For more information, see Textbooks and Materials on our [Enrolled Students](http://ecampus.uconn.edu/enrolled_students.html) page.

Course Organization:

The class is a flipped. It means that the lectures will be delivered online, and students will come to the class in-person for problem solving and to address their questions on assignments.

Class includes total of 14 weeks, 33 Lectures, [01/17/2023 to 04/28/2023]

**Class Outlines**

1. Watch a video (approximately 10 min.) lecturing concepts and background information.
2. Watch a video (approximately 10-20 min.) solving sample problems.
3. Try to solve “Test yourself” questions (available in HuskyCT) after each video. These problems are Not graded but designed to check your knowledge and show the implementation of your learnings in real life problems. Solutions to these questions are available at the bottom of the page for each week.
4. Study your E-book for assigned chapters by the assigned deadlines (Optional: See page 6).
5. Complete Assignments using your smart book Connect account (available in HuskyCT) before deadline.
6. Attend class to practice problem solving skills and submit teamwork assignments.
7. Take 3 midterm exams and an optional Final Exam.
8. Take online quizzes via HuskyCT by the assigned deadlines (Optional: See page 6).
9. Contribute to class materials based on your strength by completing Strength-Based Projects.

**In Class sessions**

An active learning method is utilized in this class. The class sessions involve problem solving (by students) individually and in teams. Instructors and TAs will guide you during problem solving. The solutions to the problems will be presented either in class or detailed solutions will be posted after the deadline in Connect.

To effectively use the class sessions, please follow the instructions below.

1. Please watch the pre-lecture video and sample solving video **before** attending the class. You can find the lecture number from class [Calendar](https://uconn-my.sharepoint.com/:w:/g/personal/sarira_motaref_uconn_edu/EVjPSJvRZ2NPpPzmjO6lMUoBdlZFeFlDKiFByyZU83iARw?e=wfthMi)
2. Having calculator/pencil/eraser in class session is mandatory.
3. Teamwork Problem Solving should be completed by teams and submitted during class.
4. Send your questions on the videos you watched to the instructors at least 2 hours before your class session. Instructors will have a recitation on that topic if it is necessary. Please send topics by email to both instructors.

Course Description

Simple and combined stress, torsion, flexure and deflection of beams, continuous and restrained beams, combined axial and bending loads, columns.

**Mechanics of Materials**, also called strength of materials, is a subject which deals with the behavior of solid objects subject to [stresses](http://en.wikipedia.org/wiki/Stress_%28physics%29) and [strains](http://en.wikipedia.org/wiki/Strain_%28physics%29). The study of Mechanics of materials often refers to various methods of calculating the stresses and strains in structural members, such as beams, columns, and shafts. The methods employed to predict the response of a structure under loading and its susceptibility to various failure modes takes into account the properties of the materials such as its [yield strength](http://en.wikipedia.org/wiki/Yield_strength), [ultimate strength](http://en.wikipedia.org/wiki/Ultimate_strength), [Young's Modulus](http://en.wikipedia.org/wiki/Young%27s_Modulus), and [Poisson's ratio](http://en.wikipedia.org/wiki/Poisson%27s_ratio); in addition the mechanical element's macroscopic properties (geometric properties), such as it length, width, thickness, boundary constraints and abrupt changes in geometry such as holes are considered.

Course Objectives

By the end of the semester, students should be able to:

1. Explain basic concepts of stress, strain and their relations based on linear elasticity
2. Calculate stresses and deformation of a bar due to an axial loading under uniform and non-uniform conditions
3. Calculate stresses and deformation of a torsional bar
4. Sketch shear-moment diagrams of a beam and find the maximum moment/shear and their locations
5. Calculate normal and shearing stresses on any cross-section of a beam
6. Apply Mohr’s circle to calculate principal stresses and angles in plane stress cases.
7. Calculate stresses on a structure under combined loadings
8. Calculate deflections of a beam under combined loads by using methods of moment-area and superposition
9. Recognize stability and buckling phenomena for a slender member under an axial compressive force.

Course Outline (and Calendar if Applicable)

|  |
| --- |
| **Course Modules** |
| **See each Module’s Objectives and Activities page for complete information and the calendar for all due dates.** |
| **Lecture 1:** Introduction to Normal and Shear Stress (CH-1) |
| **Lecture 2:** Normal and Shear Stress Components (CH-1) |
| **Lecture 3:** Stress-Strain Diagram (CH-2) |
| **Lecture 4:** Hook’s law and deformation of member under axial loading (CH-2) |
| **Lecture 5:** Stress Calculation in Statically Indeterminate Elements (CH-2) |
| **Lecture 6:** Elements under temperature, Poisson’s Ratio, and Shearing strain (CH-2) |
| **Lecture 7:** Stress Concentration; Plastic Deformation (CH-2) |
| **Lecture 8:** Torsion (CH3) |
| **Lecture 9:** Angle of Twist, Indeterminate Shafts (CH-3) |
| **Lecture 10:** Design of Transmission shaft (CH-3) |
| **Midterm Exam 1-Refer to you course Calendar for date (Chapters 1 to 3)** |
| **Lecture 11:** Stresses and Deformations under pure bending (CH-4) |
| **Lecture 12:** Neutral axis location and second moment of inertia (CH-4) |
| **Lecture 13:** Composite Materials under bending, curvature (ρ) (CH-4) |
| **Lecture 14:** Eccentric Axial Loading (CH-4) |
| **Lecture 15:** Shear and Bending-Moment Diagrams (CH-5) |
| **Lecture 16:** Beam analysis method of cut, method of integration (CH-5) |
| **Lecture 17:** Relations Among *w, V,* and *M* (CH-5) |
| **Lecture 18:** Design of Prismatic Beams in Bending (CH-5) |
| **Lecture 19:** Shearing Stresses in a Beam (CH-6) |
| **Lecture 20:** Sharing Flow, Thin-Walled Members(CH-6) |
| **Lecture 21:** Shear Center (CH-6) |
| **Midterm Exam 2-Refer to you course Calendar for date (Chapters 4, 5, 6)** |
| **Lecture 22:** Transformation of Plane Stress, Principal plane, (CH-7) |
| **Lecture 23:** Mohr’s Circle for Plane Stress (CH-7) |
| **Lecture 24:** Three-Dimensional Stress Analysis; Fracture Criteria (CH-7) |
| **Lecture 25:** Stresses in Thin-Walled Pressure Vessels (CH-7) |
| **Lecture 26:** Deflection of Beams, Equation of the elastic curve (CH-9) |
| **Lecture 27:** Application of Equation of Elastic Curve in Beams (CH-9) |
| **Lecture 28:** Application of equation of elastic curve in indeterminate beams (CH-9) |
| **Lecture 29:** Method of Superposition (CH-9) |
| **Lecture 30:** Columns: Euler’s Formula (CH-10) |
| **Lecture 31:** Stability of structures (CH-10) |
| **Lecture 32:** Columns with other end conditions, Design of Columns (CH-10) |
| **Lecture 33:** Design of Columns Under an Eccentric Load (CH-10) |
| **Midterm Exam 3-Refer to you course Calendar for date (Chapters 7,9, 10)** |

Course Requirements and Grading

Summary of Course Grading:

| Course Components | Weight |
| --- | --- |
| Homeworks (12 sets) | 20% |
| Strength-Based Project 1 or 2 | 10% |
| Teamwork problem solving  (9-12 sets) | 10% |
| Midterm exams (3 sets) | 60% |
| \*\*Comprehension of Concepts Assignments (Smart Book) (Optional) | 1.5 points toward final grade |
| Quizzes (Optional) | 1.5 points towards final grade |
| INCLUDE surveys participation-If approved by IRB | 2 points towards final grade |
|  |  |

\*\*Please see descriptions below about Reading assignments, Final Exam and Strength based Projects.

Homework

* There are 12 sets of Homework during the semester. Each set includes 4 to 7 homework problems.
* Homeworks are available under **Connect** access. You can receive hints, check your work before each submission. Detailed feedback will be available to you after due date.
* The due date is on **Tuesdays or Sundays (until 11:59PM**). The due dates are available on calendar.
* Please start your HW early. Reach out to the instructors or TAs for additional help before the deadline. You may reach out to the instructors up to 2 times during the semester to get an extension **BEFORE** the deadline. No explanation is needed when you need extension.

Strength based projects (I-Course (INCLUSIVITY):

Contribute to the class materials by completing a project relevant to Mechanics of Materials topic and from areas of your strength/interest/talent. You can choose a mechanics concept and find a real-life application that you are interested in and build a project from

You can choose to participate in Strength Based Project 1 (chapters 1, 2, 3) or strength Based Project 2 (chapters 4, 5, 6).

Please refer to the class **HuskyCT/ Strength Based Projects (on the left menu)** to learn more about

1. Previous Projects
2. Rubric
3. Deliverables for each project

Feel free to contact the instructor if you need more information.

10 points of the Strength based project will be as follow

1. Submitted draft of your project (mandatory to receive feedback from the instructors). Please check the requirements.
2. Submitted project (7 points). Please check the rubric to find the requirements.
3. Assessments (3 points)

Teamwork problem solving

* You will be assigned to a team of 3 (your team location and team number will be posted in the beginning of the class). A problem from the past exams related to the topic of that day (refer to the calendar) should be completed by the team in 15-20 minutes. Instructor and TAs provide guidance during this activity.
* Each team will submit 1 paper and the grade is assigned to all team members.
* You should come to the instructors/TAs’ office hours **immediately** if you miss a teamwork assignment. You can complete makeup questions up to 2 times in the semester.

Midterm exams

* Midterm exams (3 Midterm exams, optional retakes for all exams):

Midterm exam 1: Monday, February 13th, 2023 (60 minutes) [Chapters 1, 2, 3] - in-person Optional Retake: Friday, February 24th – in person

Midterm exam 2 Monday, March 27th, 2023 (60 minutes) [Chapters 4, 5, 6] - in-person

Optional Retake: Friday April 7th – in person

Midterm exam 3: Monday, April 24 th, 2023 (60 minutes) [Chapters 7,9, 10] - in-person

Optional Retake: Friday, May 6th - in person

* Midterm exams contain 4 questions. You have 60 minutes to answer questions.
* Exams are NOT open book/open notes. Equation Sheets will be provided. You can only have your calculator, pencil and eraser. There is no restriction on the calculator model for the exam
* Solution to midterm exams will be available in HuskyCT under Course Resources/Exam Solutions.
* The better grade between original and Re-take exams will be used in your final grade calculation.

**NOTE: Rescheduling Policy**

1. Students approved by CSD can schedule makeup exam in a private room with extended time if they have conflicts with the original exam.
2. Athletic team members also can reschedule exams with a letter from their coach (in case of conflict between exams and their tournaments).

**Absent due to Medical emergency or Family emergency in one of the midterm exams:**

with an official letter from hospital or doctors. Makeup Date: **Friday April 28th** during class time, Materials:varaibale

INCLUDE surveys participation [optional]

You are invited to participate in a research study **by completing 2 surveys** upon UConn IRB approval. We would like to investigate the value of using Strength Based Projects (SBP) in engineering education. We are conducting this study to understand: (1) How student characteristics relate to performance on strength-based projects; (2) To determine if strength-based projects enhance student learning; (3) To understand how student characteristics are influenced by completing this course. To compensate you for your time, you will receive 1 extra credit point for completing the first set of surveys or a total of 2 points extra credit for completing the first and the second set of surveys.

Assessment on comprehension of Engineering concepts (Smart Book) [Optional]

There are assignments from the engineering concepts available in (SmartBook McGrawhill) Connect via HuskyC. You will read and comprehend the engineering concepts and then complete the practice questions. You can **earn up to 1.5 bonus points towards your final grade. There are deadlines for this activity (please check the calendar).**

Quizzes [Optional]

* There are deadlines for the quizzes, and you **earn up to 1.5 bonus points** towards your final grade if you complete all of them on time.
* There are 9 sets of quizzes available in HuskyCT.
* Each quiz contains questions relevant to the chapters you have completed (Example: Quiz-1 is from chapter 1 materials)
* You will have 2 attempts to complete each quiz. You see your wrong answers after the first attempt.

Grading Scale: (It is subjected to change)

Undergrad

| Grade | Letter Grade | GPA |
| --- | --- | --- |
| 93-100 | A | 4.0 |
| 90-92 | A- | 3.7 |
| 87-89 | B+ | 3.3 |
| 83-86 | B | 3.0 |
| 80-82 | B- | 2.7 |
| 77-79 | C+ | 2.3 |
| 73-76 | C | 2.0 |
| 70-72 | C- | 1.7 |
| 67-69 | D+ | 1.3 |
| 63-66 | D | 1.0 |
| 60-62 | D- | 0.7 |
| <60 | F | 0.0 |

Due Dates and Late Policy

All course due dates are identified in the calendar available in HuskyCT under Syllabus& Calendars. Deadlines are based on Eastern Standard Time; if you are in a different time zone, please adjust your submittal times accordingly. *The instructor reserves the right to change dates accordingly as the semester progresses. All changes will be communicated in an appropriate manner.*

You may reach out to the instructor up to 2 times during the semester to get an extension **BEFORE** the deadline. No explanation is needed when you need extension. No late assignments will be accepted.

Feedback and Grades

You will receive online feedback on your assignments and quizzes. Midterm and final exam results will be available to you a week after the exam date. In addition, solutions to all homework, quizzes, midterm exams, and final exams will be available in HuskyCT under Course Resources.

Inclusion Statement

I am a member of the INCLUDE program team, an NSF-funded neurodiversity initiative that aspires to create an inclusive learning environment in which all students can thrive. Emphasis is given to providing a strengths-based approach to education that encourages students to identify, develop, and leverage their unique abilities to address complex engineering problems. This course was designed to address the diverse thinking and learning styles that neurodiverse students possess. Several pedagogical innovations will be implemented in this course including, but not limited to peer-learning, alternative examination modalities, project-based learning, etc.

Student Responsibilities and Resources

As a member of the University of Connecticut student community, you are held to certain standards and academic policies. In addition, there are numerous resources available to help you succeed in your academic work. This section provides a brief overview to important standards, policies and resources.

Student Code

You are responsible for acting in accordance with the [University of Connecticut's Student Code](http://www.community.uconn.edu/student_code.html) Review and become familiar with these expectations. In particular, make sure you have read the section that applies to you on Academic Integrity:

* [Academic Integrity in Undergraduate Education and Research](http://www.community.uconn.edu/student_code_appendixa.html)
* [Academic Integrity in Graduate Education and Research](http://web9.uits.uconn.edu/gradschool/current/academic_integrity.html)

Cheating and plagiarism are taken very seriously at the University of Connecticut. As a student, it is your responsibility to avoid plagiarism. If you need more information about the subject of plagiarism, use the following resources:

* [Plagiarism: How to Recognize it and How to Avoid It](http://lib.uconn.edu/instruction/tutorials/plagiarism.htm)
* [Instructional Module about Plagiarism](http://irc.uconn.edu/PlagiarismModule/intro_m.htm)
* [University of Connecticut Libraries’ Student Instruction](http://lib.uconn.edu/instruction/students.htm) (includes research, citing and writing resources)

Copyright

Copyrighted materials within the course are only for the use of students enrolled in the course for purposes associated with this course and may not be retained or further disseminated.

Netiquette and Communication

At all times, course communication with fellow students and the instructor are to be professional and courteous. It is expected that you proofread all your written communication, including discussion posts, assignment submissions, and mail messages. If you are new to online learning or need a netiquette refresher, please look at this guide titled, [The Core Rules of Netiquette](http://www.albion.com/netiquette/corerules.html).

Adding or Dropping a Course

If you should decide to add or drop a course, there are official procedures to follow:

* Matriculated students should add or drop a course through the [Student Administration System](https://student.studentadmin.uconn.edu/).
* Non-degree students should refer to [Non-Degree Add/Drop Information](http://nondegree.uconn.edu/options.htm) located on the registrar’s website.

You must officially drop a course to avoid receiving an "F" on your permanent transcript. Simply discontinuing class or informing the instructor you want to drop does not constitute an official drop of the course. For more information, refer to the:

* [Undergraduate Catalog](http://catalog.uconn.edu/)
* [Graduate Catalog](http://graduatecatalog.uconn.edu/)

Academic Calendar

The University's [Academic Calendar](http://www.registrar.uconn.edu/calendar.htm) contains important semester dates.

Academic Support Resources

[Technology and Academic Help](http://ecampus.uconn.edu/help.html) provides a guide to technical and academic assistance.

Students with Disabilities

Students needing special accommodations should work with the University's [Center for Students with Disabilities (CSD)](http://www.csd.uconn.edu/index.html). You may contact CSD by calling (860) 486-2020 or by emailing csd@uconn.edu. If your request for accommodation is approved, CSD will send an accommodation letter directly to your instructor(s) so that special arrangements can be made. (Note: Student requests for accommodation must be filed each semester.)

Blackboard measures and evaluates accessibility using two sets of standards: the WCAG 2.0 standards issued by the World Wide Web Consortium (W3C) and Section 508 of the Rehabilitation Act issued in the United States federal government.” (Retrieved March 24, 2013 from

<http://www.blackboard.com/platforms/learn/resources/accessibility.aspx>)

Software Requirements and Technical Help

* Word processing software
* [Adobe Acrobat Reader](http://www.adobe.com/products/acrobat/readstep2.html)
* Internet access

(add additional items as needed and link to <http://ecampus.uconn.edu/plug-ins.html>)

This course is completely facilitated online using the learning management platform, [HuskyCT](http://huskyct.uconn.edu/). If you have difficulty accessing HuskyCT, online students have access to the in person/live person support options available during regular business hours in the Digital Learning Center ([www.dlc.uconn.edu](http://www.dlc.uconn.edu/)). Students also have 24x7 access to live chat, phone and support documents through [www.ecampus24x7.uconn.edu](http://www.ecampus24x7.uconn.edu/).

Minimum Technical Skills

To be successful in this course, you will need the following technical skills:

* Use electronic mail with attachments.
* Save files in commonly used word processing program formats.
* Copy and paste text, graphics or hyperlinks.
* Work within two or more browser windows simultaneously.
* Open and access PDF files.

(add additional items as needed and link to <http://ecampus.uconn.edu/plug-ins.html>)

University students are expected to demonstrate competency in Computer Technology. Explore the [Computer Technology Competencies](http://ctcs.uconn.edu/) page for more information.

Evaluation of the Course

Students will be provided an opportunity to evaluate instruction in this course using the University's standard procedures, which are administered by the[Office of Institutional Research and Effectiveness](http://www.oire.uconn.edu/) (OIRE).

Additional informal formative surveys may also be administered within the course as an optional evaluation tool.

Resources for Students Experiencing Distress

The University of Connecticut is committed to supporting students in their mental health, their psychological and social well-being, and their connection to their academic experience and overall wellness. The university believes that academic, personal, and professional development can flourish only when each member of our community is assured equitable access to mental health services. The university aims to make access to mental health attainable while fostering a community reflecting equity and diversity and understands that good mental health may lead to personal and professional growth, greater self-awareness, increased social engagement, enhanced academic success, and campus and community involvement.

Students who feel they may benefit from speaking with a mental health professional can find support and resources through the [**Student Health and Wellness-Mental Health**](https://nam10.safelinks.protection.outlook.com/?url=https%3A%2F%2Fcounseling.uconn.edu%2F&data=02%7C01%7Csarira.motaref%40uconn.edu%7Cf3ace147d8d548b8245608d84522df47%7C17f1a87e2a254eaab9df9d439034b080%7C0%7C0%7C637335363357731713&sdata=GFIuV91EGixCKPSv%2BCwwKrlhG96S895zDmhv6WH7nPU%3D&reserved=0) (SHaW-MH) office. Through SHaW-MH, students can make an appointment with a mental health professional and engage in confidential conversations or seek recommendations or referrals for any mental health or psychological concern.

Mental health services are included as part of the university’s student health insurance plan and also partially funded through university fees. If you do not have UConn’s student health insurance plan, most major insurance plans are also accepted. Students can visit the Student Health and Wellness-Mental Health located in Storrs on the main campus in the Arjona Building, 4th Floor, or contact the office at (860) 486-4705, or [**https://studenthealth.uconn.edu/**](https://nam10.safelinks.protection.outlook.com/?url=https%3A%2F%2Fcounseling.uconn.edu%2F&data=02%7C01%7Csarira.motaref%40uconn.edu%7Cf3ace147d8d548b8245608d84522df47%7C17f1a87e2a254eaab9df9d439034b080%7C0%7C0%7C637335363357741708&sdata=juM021hU%2Fg8EaFKfw%2BnleG7o6fUlzzygXi%2BE8e3a1g8%3D&reserved=0)for services or questions.

Accommodations for Illness or Extended Absences

Please stay home if you are feeling ill and please go home if you are in class and start to feel ill.  If illness prevents you from attending class, it is your responsibility to notify your instructor as soon as possible. You do not need to disclose the nature of your illness, however, you will need to work with your instructor to determine how you will complete coursework during your absence.

If life circumstances are affecting your ability to focus on courses and your UConn experience, students can email the Dean of Students at dos@uconn.edu to request support.  Regional campus students should email the Student Services staff at their home campus to request support and faculty notification.