

## ME EN 5530/6530 : Introduction to Continuum Mechanics Tuesday/Thursday 2:00 pm-3:20 pm, WBB 617

**Instructor:** Dr. Claire Acevedo

Office: 1545 MEK

Email through course website (on canvas) only

Office Hours: Tuesday/Thursday 5:00-6:00 pm

**Recommended Textbook:**

*Introduction to Continuum Mechanics*, 3rd Edition, by W. Michael Lai, David Rubin and Erhard Krempl, Pergamon Press, 1999

**Other Useful Textbooks and website:**

*Continuum Mechanics for Engineers*, 3rd Edition, by G. Thomas Mase, Ronald E. Smelser, George E. Mase, CRC Press, 2010 (ISBN13:9781420085389)

*Continuum Mechanics*, 1st Edition, by A.J.M. Spencer, Dover Publication, 1980

<http://www.continuummechanics.org>

**Other required tools:**

An ability to use a symbolic mathematics program, such as Mathematica, Matlab, Python or Maple

## 1 Course Summary

**Course Description:**

This course is a general introduction to the fundamental concepts of the continuum mechanics. The topics covered include the cartesian tensor algebra, state of stress, kinematics of deformation, the conservation laws for mass, momentum and energy. This is followed by an introduction to constitutive theory with applications to well-established models for elastic solids.

**Course Objectives:**

At the conclusion of this course, the student will be able to:

- perform vector and tensor manipulations in Cartesian coordinate systems
- formulate and solve basic problems using the language and methods of continuum mechanics
- describe motion, deformation and forces in a continuum
- derive equations of motion and conservation laws for a continuum
- articulate basic principles and equations applicable to all constitutive models
- set up and solve simple boundary value problems
- articulate the applicability limits of continuum mechanics

**Prerequisites:**

C- or better in ME EN 3300 AND MATH 2210 OR MATH 1260 OR MATH 1321 OR MATH 3140  
AND Full Major Status in Mechanical Engineering

## 2 Course Structure

**Number of credits:** 3

**Type of course:** Lecture (with preparation and homework)

**Course Website:** The course is hosted on CANVAS. The website includes homework, course slides, etc. It is recommended that students check the course website regularly (i.e., at least weekly) as it will be updated throughout the course.

Homeworks will have to be uploaded by students as pdf or images on Gradescope (www.gradescope.com)

**Class preparation and participation:** Students are expected to complete study assignments when given, come to class prepared, and actively participate in classroom discussions. Note that a portion of the course grade will be established based on the student's preparation and participation. (attendance; requested outlines, summaries, notes, and questions: level of classroom participation; written and oral quizzes).

### Homework:

- Homework will be assigned regularly throughout the course and will be due on the specified date (see schedule). **Homework will need to be uploaded on Gradescope by midnight.**
- To receive credit, you must clearly demonstrate the full solution process. Illegible homework will be returned to the student.
- You are encouraged to work with others on the homework, but the work you submit should be your own work and reflect your understanding of the problem.
- Copying answers from online solution manuals is strictly prohibited. Violation of this rule will result in drop in a full letter grade or dismissal from the class with a failing grade.
- Problems will be graded only on completeness, not accuracy. It is your responsibility to compare your solutions against the solutions posted on Canvas. If you have questions on homework grading, provide a brief write-up of why you are requesting a re-grade and turn it back within 2 weeks of it being returned to you.

### Course Project:

By group of 2, students will investigate an advanced topic relevant to the course as an independent project. A written report and oral presentation to the class will be required near the end of the course (**see schedule below**). Students may choose the topic for their course project subject to the approval of the instructor (abstract approval). Students may investigate a relevant topic that we will not discuss in the course, probe deeper into a topic that we do discuss in the course.

This course project will be used to determine 20% of your final course grade. Of this total, 2/3 of your project grade will be based on a written report that summarizes your project. The remaining 1/3 will be based on an oral presentation (10 minutes or less) to be made to the class at the end of the semester.

**Recommendations for homework writing:**

*To write homework in an understandable and intelligible form, follow these guidelines:*

- *Use only the front side of the paper*
- *Number all pages*
- *All pages should be stapled*
- *Add your Name, Homework and Problem numbers, Due Date in the header portion of the every page*
- *Place no more than one problem on a page*
- *Clearly specify the calculation assumptions used (static system, material properties, etc.)*
- *Explain your solution such that the grader can clearly understand your procedure*
- *Use 3 significant digits (do not simply copy down all the digits shown on your calculator!)*
- *If handwritten, use a pencil instead of a pen to easily erase mistakes*
- *The final answer should be clearly demarcated (e.g. in bold, boxed or circled)*

**Recommendations for project report writing:**

*A seven to twelve pages (estimated) report that is typed and double-spaced. You are free to determine the proper format for your report (based on what type of project you select). Your report may include the following components:*

- *Cover/title page*
- *Introduction/Background*
- *Description of Topic/ Analysis*
- *Findings/Results*
- *Discussion/Summary*
- *References*
- *Appendices: Sample calculations, reference material, etc.*

**Recommendations for project oral presentation:**

*A 10 minute or less (estimated) presentation to the class that summarizes the most significant findings of your course project. This presentation is meant to be an educational experience to the other students, and thus you will be expected to deliver a presentation that is suited for this audience.*

**Exams:**

- **Date of EXAM 1:** Thursday, Oct 3 from 2:00 pm-3:20 pm, WBB 617
- **Date of EXAM 2:** Tuesday, Nov 26 from 2:00 pm-3:20 pm, WBB 617

There will be two (2) exams during the semester. The exams will be closed notes, closed book exam, occurring during a regularly scheduled course meeting time. They will be comprehensive covering information from the weeks prior.

No aides beyond a calculator, and the provided equation sheet may be used by students on a exam. **The use of cellular phones or other electronic devices during an exam is strictly prohibited.** If you are unable to take an exam because of a conflict, you must contact Prof. Acevedo in advance. All excuses must be verifiable with documentation from the appropriate source. Make-up oral exams will only be given under exceptional circumstances.

### Grading:

<b>Classroom Attendance/Preparation/Participation</b>	20%
<b>Homework</b>	20%
<b>2 Exams</b>	40% (20% each)
<b>Course Project</b>	20%

Final course averages listed below will result in the letter grade as shown. I reserve the right to lower the average required for any letter grade.

Percent	100-93	92-90	89-87	86-83	82-80	79-77	76-73	72-70	69-67	66-63	62-60	59-0
Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F

### Instructor and student responsibilities

As your professor, I am responsible for providing you with the instruction and resources necessary to build a strong foundation in the course topic areas. I am also responsible for assessing whether you are competent in these areas. As the student, you are responsible for making sure that you understand the concepts, which will require you to attend lecture and discussion, read the course textbook, complete the assigned homework problems, compare your solutions to the posted solutions, and seek help early if you do not understand something. If you fail to do these things, you will not be successful in this class.

Below are resources available to help promote success in this course:

- Lecture
- Textbook
- Office hours (listed above or by appointment)

### Academic Integrity

Engineering is a profession demanding a high level of personal honesty, integrity, and responsibility. Therefore, it is essential that engineering students, in fulfillment of their academic requirements and in preparation to enter the engineering profession, adhere to the Department of Mechanical Engineering Policy for Academic Misconduct. This policy is based upon the University of Utah's Policy 6-400: Code of Student Rights and Responsibilities (<https://regulations.utah.edu/academics/6-400.php>) where "Academic misconduct" includes, but is not limited to, cheating, misrepresenting one's work, inappropriately collaborating, plagiarism, and fabrication or falsification of information. It also includes facilitating academic misconduct by intentionally helping or attempting to help another to commit an act of academic misconduct." Academic misconduct and dishonesty will not be tolerated in this course.

As part of the ME policy, students must review and acknowledge the "ME EN Academic Misconduct Policy," which can be downloaded from the course Canvas page. Students must provide acknowledgment of the ME Academic Misconduct policy via the Canvas Academic Integrity Module for this course before the end of the second week of class or they will be asked to drop the class and will otherwise receive an EU grade.

Academic misconduct also includes posting any material derived from this class (your course notes, exams, assignment problems, solutions, slides, etc.) on any websites other than Canvas and Gradescope. As an example, do not post any course material (or seek course materials from previous courses) on websites like Chegg and Course Hero. Doing so will result in an automatic fail for the course and a report of the incident on your academic record.

### 3 Schedule

Topics to be covered in class are listed in the outline below. The schedule is subject to change (changes will be announced in class, and this document will be updated).

Lecture	Lecture topic	HW due
1 - Aug 20	Introduction	
2 - Aug 22	Mathematical preliminaries	
3 - Aug 27	Tensor algebra and calculus	
4 - Aug 29	Tensor algebra and calculus	HW 1
5 - Sept 3	Tensor algebra and calculus	
6 - Sept 5	Tensor algebra and calculus	
7 - Sept 10	Kinematics	HW 2
8 - Sept 12	Kinematics	
9 - Sept 17	Kinematics	HW 3
10 - Sept 19	Kinematics	
11 - Sept 24	Kinematics	
12 - Sept 26	Kinematics	
13 - Oct 1	Review	
14 - Oct 3	<b>EXAM 1</b>	
15 - Oct 6-13	FALL BREAK	
16 - Oct 15	Stress	
17 - Oct 17	Stress	<b>Project abstract due</b>
18 - Oct 22	Stress	
19 - Oct 24	Stress	
20 - Oct 29	Material behavior	HW 4
21 - Oct 31	Material behavior	
22 - Nov 5	The Elastic Solid	
23 - Nov 7	Guest lecture (?)	
24 - Nov 12	The Elastic Solid	
25 - Nov 14	The Elastic Solid	
26 - Nov 19	The Elastic Solid	HW 5
27 - Nov 21	Review	
28 - Nov 26	<b>EXAM 2</b>	
29 - Nov 28	Thanksgiving-no class	
30 - Dec 3	The Elastic Solid	
31 - Dec 5	Oral Presentation	
32 - Dec 10	Oral Presentation: 1:00 – 3:00 pm	<b>Project report due</b>

## COLLEGE OF ENGINEERING GUIDELINES

<https://www.coe.utah.edu/semester-guidelines>

Fall Semester 2019

### Appeals Procedures

*See the Code of Student Rights and Responsibilities, located in the Class Schedule or on the UofU Web site for more details*

#### Appeals of Grades and other Academic Actions

If a student believes that an academic action is arbitrary or capricious he/she should discuss the action with the involved faculty member and attempt to resolve. If unable to resolve, the student may appeal the action in accordance with the following procedure:

1. Appeal to Department Chair (in writing) within 40 business days; chair must notify student of a decision within 15 days. If faculty member or student disagrees with decision, then,
2. Appeal to Academic Appeals Committee (see <https://www.coe.utah.edu/students/academic-affairs/academics/> for members of committee). See II Section D, Code of Student Rights and Responsibilities for details on Academic Appeals Committee hearings.

### Americans with Disabilities Act (ADA)

The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you need accommodations in a class, reasonable prior notice needs to be given to the instructor and to the Center for Disability Services, 162 Olpin Union, 581-5020 (V/TDD) to make arrangements for accommodations. All written information in a course can be made available in alternative format with prior notification to the Center for Disability Services.

### Adding Classes-Full Term

**Please read carefully:** All classes must be added within **10 academic days** of the beginning of the semester (**deadline: Friday, August 30, 2019**). Late adds will be allowed August 31-September 9, requiring only the instructor's signature. Any request to add a class after September 9th will require signatures from the instructor, department, and Dean, and need to be accompanied by a petition letter to the Dean's office.

**A \$50 FEE WILL BE ASSESSED BY THE REGISTRAR'S OFFICE FOR ADDING CLASSES AFTER September 9th.**\*\*\*

\*\*\*Before you elect to take a class CR/NC you should check with your Advisor. Core classes used to compute your Engineering GPA need letter grades.

### Withdrawal Procedures

*See the Class Schedule or web for more details* \*\* Please note the difference between the terms "drop" and "withdraw". Drop implies that the student will not be held financially responsible and a "W" will not be listed on the transcript. Withdraw means that a "W" will appear on the student's transcript and tuition will be charged. \*\*

#### Drop Period For Full Term Classes- No Penalty

Students may DROP any class without penalty or permission during the FIRST TEN academic days of the term (Friday, August 30, 2019).

#### Withdrawal from Full Term Length Classes

Students may WITHDRAW from classes without petition **Friday, October 18, 2019**. Beginning August 31st until October 18th, a "W" will appear on the transcript AND **tuition will be charged**. Refer to Class Schedule, Tuition and Fees for tuition information.

#### Drop/Withdrawal from Session I & Session II

See the web page for details:

<https://registrar.utah.edu/academic-calendars/fall2019.php>

Withdrawals for term length classes after October 18th will only be granted due to compelling, nonacademic emergencies. A petition and supporting documentation must be submitted to the Dean's Office, 1602 Warnock Engineering Building. Petitions must be received before the last day of classes (**December 5, 2019**).

### Repeating Courses

When a College of Engineering class is taken more than once, only the grade for the second attempt is counted. Grades of **W, I, or V** on the student's record count as having taken the class. Departments enforce these guidelines for other courses as well (e.g., math, physics biology, chemistry). Attempts of courses taken at transfer institutions count as one attempt. This means a student may take the course only one time at the University of Utah. Courses taken at the University of Utah may not be taken a second time at another institution. If a second attempt is needed, it must be at the University of Utah. Please work with your department advisor to determine the value of repeating courses. Students should note that anyone who takes a required class twice and does not have a satisfactory grade the second time may not be able to graduate. It is the responsibility of the student to work with the department of their major to determine how this policy applies in extenuating circumstances.