CE W30 / ME W85: Introduction to Solid Mechanics

Three (3) semester credits

Course Description

The following topics will be covered:

- A review of equilibrium for particles and rigid bodies with applications to trusses
- The concepts of deformation, strain and stress
- Equilibrium equations for a continuum
- Elements of the theory of linear elasticity
- The states of plane stress and plane strain
- Solution of elementary elasticity problems (axial deformation of bars, beam bending, torsion of circular bars, thin-walled vessels)
- Introduction to yield criteria
- Euler buckling in elastic beams

Prerequisites

Mathematics 53 and 54 (may be taken concurrently); Physics 7A.

Course Objectives

After successfully completing this course, you will be able to:

- Discuss principles of engineering design for mechanical systems
- Analyze rigid systems for static equilibrium
- Analyze deformable systems for static equilibrium

Instructor Information, Contact, Office Hours, & Communication

Course Instructor

Professor Sanjay Govindjee

Graduate Student Instructors (GSIs)

While the instructor will interact with the whole class and will oversee all activities and grading, as well as being available to resolve any issues that may arise, the GSIs will be your main point of contact. Your GSIs are responsible for assisting you directly with your questions about assignments and course requirements, as outlined in the Assignments and Calendar. The GSIs will also facilitate ongoing discussion and interaction with you on major topics in each module.

- Ahmed Bakhaty

Office Hours

The course instructor and GSI will offer virtual office hours, when students can communicate real time (synchronously) using Adobe Connect. While these chats are optional they can be valuable for discussion, answering questions, and reviewing for exams. Chats are optional; no points are awarded for participation.

The session will be for one hour. However, if no one shows up in the first 15 minutes, then that office hour will be cancelled.

Please see the "Office Hours" page for dates and times.

Course Mail

Make sure to check the Course Mail for messages from the instructor. You can access course email within the Learning Management System by clicking on the Inbox link on the Corner Help toolbar (see also Canvas Overview Video) or choose to have your course mail forwarded to your personal email account or your cell phone.

Question & Answer Forum

Please use this forum to post questions about the course material, assignments, the learning management system or online homework. **The GSI will monitor this forum,** but you should also feel free to post answers to help other students. This helps to create a general FAQ so that all students in the course may benefit from the exchange.

Course Materials and Technical Requirements

Required Materials

- [GHSWR] Engineering Mechanics 1: Statics by Gross, Hauger, Schröder, Wall, and Rajapakse: Springer, 2nd edition (2013), ISBN: 9783642303180.
- [G] Engineering Mechanics of Deformable Solids by Govindjee: Oxford University Press (2013), ISBN: 9780199651641.
- Scanner or digital camera to create a digital image of your homework and exam answers.
- Ability to create PDF documents. PDF files can be created in MS Word, as well as Google docs. Uploaded homework and exam documents must be in a PDF format.

You are free to purchase your textbooks from any vendor. Please be sure to thoroughly review the return policies before making a purchasing decision as UC Berkeley does not reimburse students for course materials in the event of a textbook change or an unexpected cancellation or rescheduled course section.

Technical Requirements

This course is built on a Learning Management system (LMS) called Canvas and you will need to meet these computer specifications to participate within this online platform.

Technical Support

If you are having technical difficulties please alert one of the GSIs immediately. However, understand that neither the GSIs, nor the professor can assist you with technical problems. You must call or email tech support and make sure you resolve any issues immediately. Be sure to document (save emails and transaction numbers) for all interactions with tech support. **Extensions and late submissions will not be accepted due to "technical difficulties".**

For 24/7 Tech Help Support: Call **1-855-308-2758** or e-mail support@instructure.com

Learning Activities

VERY IMPORTANT

You won't be able to access your course material until you read and make your pledge to Academic Integrity. Click below to navigate to and complete the Academic Integrity pledge.

ACADEMIC INTEGRITY

You are expected to fully participate in all the course activities described here.

1. Read the assigned textbook pages
2. Watch and listen to the lecture presentations
3. Complete check-your-understanding (CYU) quizzes
4. Complete and submit required homework assignments
5. Complete both midterm exams and the final exam
6. Read web-based announcements and postings during the course

Weeks and Modules

Introduction to Solid Mechanics is divided into 7 modules, which will be covered over the 8-weeks of the course. Each week starts on Monday and ends the following Sunday at 11:55 p.m. (PT). More than one module may be discussed during a single week.

A module is a grouping of topics related to one area of study, typically with readings, lectures and various kinds of assignments. Each module contains a list of Learning Outcomes for the module. Your assignments reflect the learning activities to perform to reach those outcomes. For an at-a-glance view of due dates and projects, refer to the course Calendar.

You must complete the lecture topic activities in sequential order, before having access to the next topic. Trying to advance to a topic which has not been completed will result in a page display error. It is recommended you complete each topic in the following order; readings, lecture videos, check-your-understanding (CYU) quizzes, homework problems.

Reading Assignments

Reading assignments are required and should be done before the corresponding lectures. Reading assignments often contain material not covered in the lecture; you are responsible for this additional material.

Lecture Videos

Recorded lectures support your readings and assignments but also contain additional material that may be included in the exams. Each lecture has been broken into sections. You are expected to take notes while viewing the lectures as you would in a regular classroom.

Check-Your_Understanding (CYU) Quizzes

Most lectures are followed with a check-your-understanding (CYU) quiz. You have three attempts to pass the quiz. You will receive the average score for the quiz attempts.

Homework Assignments

Homework assignments follow most of the lecture topics. You are required to submit the week's homework problems at the end of each week, Sunday by 11:55 p.m. (PT), with the exception of the Week 8 assignment which is due on Week 8 Wednesday by 11:55 p.m. (PT).

All homework must be submitted in a PDF format.

Limited **Collaboration** is permitted on homework assignments. You may freely discuss the homework with each other, e.g. on the discussion forums, but may not show your written work to others. Similarly, the use of solution keys or solution sets of any type is expressly forbidden with the exception of the solutions manual for GHSWR. All cases of misconduct on homework will be reported to the Student Conduct Office in addition to the assignment of a zero for the entire homework portion of the course grade.

Discussion Forums

Questions and Answers Forum

Please use the Course General Q&A forum to post questions about the course, for example questions about the syllabus, due dates, etc. Reserve email inquires to more personal issues. The questions will be answered in the forum by the course instructor or GSIs. This way, all students benefit from seeing the answers. This is the preferred place to ask and get answers to questions that are likely to be of general interest.

Additionally, there is a weekly Q&A forum available so you can post questions specific to the week's readings, lectures and activities.

Midterm Exam

You will complete 2 online "midterm" exams one during Week 4, the other in Week 6. Within a 24-hour time frame you will have 1.5 hours to complete the exam. During that time you will download the exam problems, after completing the exam you will scan your answers and submit a PDF document in the exam dropbox. Your exam documents must be in a PDF format.

- Midterm 1 will be available on Tuesday July 14 from 12:01 a.m. (PT) until 11:55 p.m. (PT). This exam covers Lectures 1-12.
- Midterm 2 will be available on Tuesday July 28 from 12:01 a.m. (PT) until 11:55 p.m. (PT). This exam cover Lectures 14-25.

It is important to note, that the exams have a time limit, and you must take it within the prescribed 24-hour window. See the Calendar for the date. While the exam is considered an open-book examination, it cannot be taken collaboratively with other students. The learning management system keeps detailed records of log-ins and submissions. Please review the ethics guideline for online courses provided at the beginning of this class and the UC Berkeley code of conduct.

Final Exam

You will take a 3 hour final exam on paper.

The final examination is closed book, closed notes, but you may bring 3 sheets of self- prepared notes to the exam. You may write on both sides of the sheets which may not be larger than 8 1/2 x 11 inches in size (or optionally A4 size). The final exam is comprehensive and covers the entire course.

This year's final exam will take place on August 14 from 10:00 a.m. to 1:00 p.m. at 502 Davis Hall on the Berkeley campus.

There will be no make-up exam. Students must take the final examination in person or possibly arrange to have the examination proctored if you cannot come to campus. Review the Proctor Info on the left navigation menu. Off-site proctor applications must be submitted prior to July 17th, 2015.

If you miss taking the final or try to take it in a manner for which you have not received permission, you will fail this class automatically.

Reminder: Your Course End Date

Your course will end on Friday August 14th at 11:55 p.m. (PT). As you work through the course, please keep the end date in mind, and if you want to save any commentary or assignments for future reference, please make sure to print or copy/paste those materials before your access ends.

Grading and Course Policies

Your final course grade will be calculated as follows:

Category	Percentage of Grade
Check-Your-Understanding (CYU) Quizzes	5%
Homework Assignments	15%
Midterm Exam 1	15%
Midterm Exam 2	15%
Final Exam	50%

Table 1: Final Grade Percentages

Per summer session rules, a minimum score of 50% is required to pass the course, independent of your performance in the course prior to the Final Exam.

It is important to note that not all components are graded online and included in the online course grade book. Because of this, the online course grade book will not display your overall course grade at any given time or your final grade. It should simply be used to assess your performance on the components that are included within it: the CYU quizzes, homework assignments and midterm exams. Your final letter grade will be mailed to you by the registrar's office.

Late Work Policy

Late work is not accepted.

Course Outline

Week 1

Week 1 Activities		
Topic	**Reading**	**Lecture Video**
Module 1 Lecture 1: Review of static equilibrium for rigid bodies	M1 Reading 1: [GHSWR] Preface, Chapter 1, Appendix A	M1 Lecture 1
Module 1 Lecture 2: Application of statics for the special case of concurrent forces	M1 Reading 2: [GHSWR] Chapter 2	M1 Lecture 2-A to 2-C
Module 1 Lecture 3: Application of statics for systems with moments	M1 Reading 3: [GHSWR] Chapter 3	M1 Lecture 3-A to 3-C
Module 1 Lecture 4: Theory of alternate reference points		M1 Lecture 4-A to 4-C
Module 1 Lecture 4b: Equilibirum in two dimensions		M1 Lecture 4b-A to 4b-C
Module 1 Lecture 5: Equivalent force systems	M1 Reading 4: [GHSWR] Chapter 4	M1 Lecture 5-A to 5-C

Homework 1 Due: Sunday by 11:55 p.m. (PT)

Week 2

Week 2 Activities		
Topic	**Reading**	**Lecture Video**
Module 1 Lecture 6: Distributed forces		M1 Lecture 6-A to 6-F
Module 1 Lecture 7: Applications of statics: Complex systems	[GHSWR]: Chapters 5, 6, and 9	M1 Lecture 7-A to 7-C
Module 2 Lecture 8: Introduction to deformable bodies	[G]: Preface, Chapter 1	M2 Lecture 8-A
Module 2 Lecture 9: 1-D Stress, Strain, Equilibrium, Constitution	[G]: 2-2.3	M2 Lecture 9-A
Module 2 Lecture 10: Axial Response	[G]: 2.4-2.4.1	M2 Lecture 10-A to 10-E
Homework 2 Due: Sunday by 11:55 p.m. (PT)		

Week 3

Week 3 Activities		
Topic	**Reading**	**Lecture Video**
Module 2 Lecture 11: Axial Response by direct integration	[G]: 2.4.2	M2 Lecture 11-A to 11-E
Module 2 Lecture 12: Conservation of Energy and stress-based design	[G]: 2.5-2.6	M2 Lecture 12-A to 12-D
Module 3 Lecture 14: General Concepts of Stress	[G] 3.1	M3 Lecture 14-A to 14-B
Module 3 Lecture 15: Pointwise stress	[G] 3.2	M3 Lecture 15-A to 15-E
Module 3 Lecture 16: Polar and Spherical Stresses	[G]: 3.3	M3 Lecture 16-A to 16-B
Homework 3 Due: Sunday by 11:55 p.m. (PT) Please note: There is no Lecture 13		

Week 4

Week 4 Activities		
Topic	**Reading**	**Lecture Video**

Module 3 Lecture 17: General Concepts of Strain	[G]: Chapter 4	M3 Lecture 17-A to 17-C
Module 3 Lecture 18: Generalized Hooke's Law	[G]: Chapter 5	M3 Lecture 18-A to 18-C
Module 3 Lecture 19: Axial loading as a multi-dimensional	[G]: 6.1	M3 Lecture 19-A to 19-B
Module 3 Lecture 20: Thin walled pressure vessels and St. Venant's Principle	[G] 6.2-6.3	M3 Lecture 19-C and 20-A
Module 4 Lecture 21:Kinematics and equilibrium of torsion	[G] 7.1-7.2	M4 Lecture 21-AA, 21-A to 21-F
Homework 4 Due: Sunday by 11:55 p.m. (PT)		
Midterm 1: Tuesday, July 14th, Open from 12:01 a.m. to 11:55 p.m. The Midterm 2 Exam will co		

Week 5

Week 5 Activities			
Topic	**Reading**	**Lecture Video**	**CYU Quiz**
Module 4 Lecture 22: Torsion of Circular Elastic Bars	[G]: 7.3 - 7.4	M4 Lecture 22-A to 22-H	M4 L22 CYU

Module 4 Lecture 23: Theory of thin-walled torsion	[G]: 7.7	M4 Lecture 23-A to 23-C	M4 L23 CYU
Module 5 Lecture 24: Kinematics of bending	[G] 8.1	M5 Lecture 24-AA, 24-A to 24-C	M5 L24 CYU
Module 5 Lecture 25: Equilibrium of bending	[G] 8.2	M5 Lecture 25-A to 25-C	M5 L25 CYU
Homework 5 Due: Sunday by 11:55 p.m. (PT)			

Week 6

Week 6 Activities			
Topic	**Reading**	**Lecture Video**	
Module 5 Lecture 26: Elastic response of beams	[G]: 8.3	M5 Lecture 26-A to 26-E	
Module 5 Lecture 27: Beam deflections by integration	[G]: 8.4	M5 Lecture 27-A to 27-C	
Module 5 Lecture 28: Multi-axis bending	[G]: 8.5	M5 Lecture 28-A to 28-C	
Module 5 Lecture 29: Shear stresses in beams	[G]: 8.6	M5 Lecture 29-A to 29-C	

Module 6 Lecture 30: Transformation of vectors and tensors	[G] 9.1-9.2.1	M6 Lecture 30-A to 30-C	
Homework 6 Due: Sunday by 11:55 p.m. (PT)			
Midterm 2: Tuesday, July 28th, Open from 12:01 a.m. to 11:55 p.m. The Midterm 2 Exam will co			

Week 7

Week 7 Activities			
Topic	**Reading**	**Lecture Video**	**C**
Module 6 Lecture 31: Principal values, Maximum Shear, Eigenvalues and Eigenvectorss	[G] 9.2.2-9.2.3	M6 Lecture 31-A to 31-D	
Module 6 Lecture 32: Mohr's circle of stress	[G] 9.2.4-9.2.5	M7 Lecture 32-A to 32-C	
Module 6 Lecture 33: Transformation of strain	[G] 9.3	M7 Lecture 33-A to 33-D	
Module 7 Lecture 34: Yield and Fracture Criteria	[G] 9.4	M7 Lecture 34-A to 34-E	
Homework 7 Due: Sunday by 11:55 p.m. (PT)			

Week 8

Week 8 Activities			
Topic	**Reading**	**Lecture Video**	**CYU**
Module 7 Lecture 35: Stability Introduction	[G] 12.1-12.2	M7 Lecture 35-AA, 35-A to 35-C	M7 CYU
Module 7 Lecture 36: Euler Loads for Columns	[G] 12.3	M7 Lecture 36-A	M7 CYU
Homework 8 Due: Wednesday August 12th by 11:55 p.m. (PT)			
Final Exam on August 14th from 10:00 a.m. to 1:00 p.m. (PT) at [ADD LOCATION]			

Course Policies

Promptness

Homework assignments and Midterm exams all have specific final due dates and times. You will not receive full credit if assignments are submitted after the indicated due date.

Further, each online activity must be submitted through the course website by the due date. Fax or mail submission will not be accepted. Students who wait until the final hours prior to a submission deadline risk having problems with their ISP, hardware, software, or various other site access difficulties. Therefore, it is advisable to submit assignments and tests through the course website early. The multiple days allowed for submission are to accommodate the busy schedules of working professionals, not to accommodate procrastination. Students should plan accordingly and get into the habit of checking the course website several times each week, and submitting and posting early.

Honor Code

The student community at UC Berkeley has adopted the following Honor Code: "As a member of the UC Berkeley community, I act with honesty, integrity, and respect for others." The expectation is that you will adhere to this code.

Collaboration and Independence

Reviewing lecture and reading materials and studying for exams can be enjoyable and enriching things to do with fellow students. This is recommended. However, unless otherwise instructed, homework assignments and the online exam are to be completed independently and materials submitted as homework should be the result of one's own independent work.

Cheating

A good lifetime strategy is always to act in such a way that no one would ever imagine that you would even consider cheating. Anyone caught cheating on a quiz or exam in this course will receive a failing grade in the course and will also be reported to the University Center for Student Conduct. Exams are to be completed without the assistance of other people, and without reference to texts, notes, and other materials. The expectation is that you will be honest in the taking of exams.

Plagiarism

To copy text or ideas from another source without appropriate reference is plagiarism and will result in a failing grade for your assignment and usually further disciplinary action. For additional information on plagiarism and how to avoid it, explore the resources linked below:

UC Berkeley Library Citation Page, Plagiarism Section

GSI Guide for Preventing Plagiarism

Academic Integrity and Ethics

Cheating on exams and plagiarism are two common examples of dishonest, unethical behavior. Honesty and integrity are of great

importance in all facets of life. They help to build a sense of self-confidence, and are key to building trust within relationships, whether personal or professional. There is no tolerance for dishonesty in the academic world, for it undermines what we are dedicated to doing - furthering knowledge for the benefit of humanity.

Incomplete Course Grade

Students who have substantially completed the course but for serious extenuating circumstances, are unable to complete the final exam, may request an Incomplete grade. This request must be submitted in writing or by email to the GSI and course instructor. You must provide verifiable documentation for the seriousness of the extenuating circumstances. According to the policy of the college, Incomplete grades must be made up within the first three weeks of the next semester.

Students with Disabilities

Any students requiring course accommodations due to a physical, emotional, or learning disability must contact the Disabled Students' Program (DSP). They will review all requests on an individual basis.

- Request your Disabled Student Program Specialist to send the instructor a formal request before the official course start date by email
- In addition, notify the instructor and your Online Learning Support Specialist, which accommodations you would like to use.
    - Your Online Learning Support Specialist is Tracie Allen and her email is twgallen@berkeley.edu

End of Course Evaluation

Before your course end date, please take a few minutes to participate in our End of Course Evaluation to share your opinions about this course. The evaluation does not request any personal information, and your responses will remain strictly confidential. To access the evaluation, please select the "Course End Evaluation" link in the left navigation menu. The evaluation will be available starting on Friday July 31st through Thursday August 13th. You may only take the evaluation once.