Introduction to Solid Mechanics, CE W30 2018

Three (3) semester credits

Course Description

This course covers a review of equilibrium for particles and rigid bodies. Additionally students will study application to truss structures, 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 (beam bending, torsion of circular bars), and 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

Instructor Name: Sanjay Govindjee, Ph.D.

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.

- TBD

Office Hours

The course instructor and GSIs will offer virtual office hours, where students can communicate in real time (synchronously) using the Chat tool. 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. In person office hours may be offered at the discretion of the instructor and GSIs.

Day: TBD

Hours (PST): TBD

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 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 instructor/GSIs 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.

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

Course Materials and Technical Requirements

Required Materials

[GHSWR] *Engineering Mechanics 1: Statics* by Gross, Hauger, Schroder, Wall, and Rajapakse: Springer, 2nd edition (2013).

[GHSWR] has an optional solution manual which is available as an e-book from Amazon: Engineering Mechanics 1, Supplementary Problems: Statics. Note also that [GHSWR] is available as a PDF download from the library at http://link.springer.com/book/10.1007%2F978-3-642-30319-7 ; to access the URL one needs to be on the campus network or connected to the campus via VPN. Further, at this link one can also purchase a (new) printed copy of the book for only $25.
    - ISBN: 9783642303180.
- [G] *Engineering Mechanics of Deformable Solids* by Govindjee: Oxford University Press (2013). It is recommended to get the 2nd Impression: Reprinted 2017 (with corrections). If you purchase an e-book version, you should automatically get this impression. If you are on the campus network or connected to the campus via VPN, then the library offers electronic access to the 1st Impression (hopefully to be updated soon). The typesetting on this e-version is not that great, but it is functional. If you are using the first impression, please download the errata sheet for it at http://faculty.ce.berkeley.edu/sanjay/Corrections_08_19_2015.pdf
    - ISBN: 9780199651641

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.

Optional

Canvas allows you to record audio or video files of yourself and upload them in the course. Although doing so is not required for any of the activities, using these features will enhance your engagement in the course. If you would like to use these features, you will need to have a webcam and a microphone installed on your computer. Note: These items are needed to participate in the virtual office hours.

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.

In your course, click on the "Help" button on the bottom left of the global navigation menu. 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."

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 the button below to navigate to and complete the Academic Integrity pledge.

ACADEMIC INTEGRITY PLEDGE

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. Read web-based announcements and postings assigned during the course
4. Compose and post assigned responses to lectures and readings
5. Complete the midterm exam and final exam
6. Complete problem sets

Modules

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**

Reading Assignments

Reading assignments often contain material not covered in lecture. You are responsible for this additional material; it may appear on exams.

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.

Homework Assignments

Assignments are due every Wednesday and Sunday before 8:00pm (Pacific Time). 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. Misconduct on examinations will likewise be reported to the Student Conduct Office and result in an automatic failing grade for the course.

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.

Midterm Exams

Midterm 1 will be on July 12 and cover Lectures 1-13. Midterm 2 will be on July 26 and cover Lectures 14-25.

Final Exam

You will take a 3 hour final exam on paper. The final exam is comprehensive and covers the entire course.

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). Misconduct on examinations will be reported to the Student Conduct Office and result in an automatic failing grade for the course.

This year's final exam will take place on Friday August 10th from 10:00 a.m. to 1:00 p.m. (PT) at 277 Cory 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 13, 2018 (PT).

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. You must pass the final to pass the course.

Reminder: Your Course End Date

Your course will end on August 10. 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:

Table 1: Final Grade Percentages

Category	Percentage of Grade
Homework Assignments	15%
Check-Your-Understanding (CYU) quizzes	5%
Midterm Exam 1	15%

Midterm Exam 2	15%
Final Exam	50%

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

It is important to note that 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. Your final letter grade will be mailed to you by the registrar's office.

Late Work Policy

Late work is not accepted.

Course Policies

Promptness

All assignments 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 busy, 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.

Academic Integrity

The University of California at Berkeley has a Campus Code of Student Conduct and a Center for Student Conduct both of which can guide you through any queries regarding Academic Integrity.

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

Incomplete Course Grade

The grade I (Incomplete) may be assigned if your work in a course has been of passing quality, but is incomplete for reasons beyond your control. Prior arrangements must be made with the instructor. Incomplete grades from the Summer semester must be cleared before the first day of instruction of the next Spring 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 summer_online_support@berkeley.edu

End of Course Evaluation

Before your course end date, please take a few minutes to participate in our Course Evaluation to share your opinions about this course. You will be receiving the Course Evaluation via email. The evaluation does not request any personal information, and your responses will remain strictly confidential. You may only take the evaluation once. It will close August 9.

*Subject to Change

Course Outline

Table 2: Week 1: Homework 1 due June 20 (Lectures 1-2). Homework 2 due June 24 (Lectures 3-6)

Lecture	Module	Topic	Reading	HW
1	Statics	Review of static equilibrium for rigid bodies	[GHSWR] Preface, Chapter 1, Appendix A	
2	Statics	Concurrent forces: A special case	[GHSWR] Chapter 2	2.10, 2.15
3	Statics	Application of statics for systems with moments	[GHSWR] Chapter 3	3.12, 3.18
4	Statics	Theory of alternate reference points		
5	Statics	Special considerations for two dimensional problems		
6	Statics	Equivalent force systems	[GHSWR] Chapter 4	4.9a, 4.13

Table 3: Week 2: Homework 3 due June 27 (Lectures 7-9). Homework 4 due July 1 (Lectures 10-11)

Lecture	Module	Topic	Reading	HW
7	Statics	Distributed forces		
8	Statics	Applications of statistics: Complex systems	[GHSWR] Chapters 5, 6, and 9	5.12, 6.4
9	Axial bar	Introduction to deformable bodies	[G] Preface, Chapter 1	1.8
10	Axial	1-D stress, strain, equilibrium,	[G] 2.1-2.3	2.3,

	bar	constitution		2.4
11	Axial bar	Axial response	[G] 2.4-2.4.1	2.9, 2.15

Table 4: Week 3: Homework 5 due July 4 (Lectures 12-13). Homework 6 due July 8 (Lectures 14-16)

Lecture	Module	Topic	Reading	HW
12	Axial bar	Axial response by direct integration	[G] 2.4.2	2.11, 2.16, 2.31
13	Axial bar	Conservation of energy and stress based design	[G] 2.5-2.6	2.33
14	Multi-D	General Concepts of Stress	[G] 3.1	3.4
15	Multi-D	Pointwise Stress	[G] 3.2	3.8, 3.10, 3.15
16	Multi-D	Polar and Spherical Stresses	[G] 3.3	

Table 5: Week 4: Midterm 1 on July 12. Homework 7 due July 11 (Lectures 17-18). Homework 8 due July 15 (Lectures 19-21)

Lecture	Module	Topic	Reading	HW
17	Multi-D	General Concepts of Strain	[G] Chapter 4	4.1, 4.5, 4.12
18	Multi-D	Generalized Hooke's Law	[G] Chapter 5	5.3, 5.11
19	Multi-D	Axial loading as a multi-dimensional phenomena, thin walled pressure vessels	[G] 6.1	6.4

20	Multi-D	Thin walled pressure vessels and St. Venant's Principle	[G] 6.2 – 6.3	6.7, 6.10, 6.11
21	Torsion	Kinematics and Equilibrium of Torsion	[G] 7.1 – 7.2	7.2

Table 6: Week 5: Homework 9 due July 18 (Lecture 22). Homework 10 due July 22 (Lectures 23-25)

Lecture	Module	Topic	Reading	HW
22	Torsion	Torsion of Circular Elastic Bars	[G] 7.3 – 7.4	7.5, 7.8, 7.13, 7.21, 7.26, 7.28
23	Torsion	Thin-Walled Torsion	[G] 7.7	7.41, 7.43
24	Beams	Kinematics of Bending	[G] 8.1	8.2
25	Beams	Equilibrium of Bending	[G] 8.2	8.5

Table 7: Week 6: Midterm 2 on July 26. Homework 11 due July 25 (Lectures 26-27). Homework 12 due July 29 (Lectures 28-30)

Lecture	Module	Topic	Reading	HW
26	Beams	Elastic Response of Beams	[G] 8.3	8.8, 8.13, 8.15
27	Beams	Beam deflections by Integration	[G] 8.4	8.19, 8.34
28	Beams	Multi-axis Bending	[G] 8.5	8.38
29	Beams	Shear Stresses in Beams	[G] 8.6	8.41, 8.47

30	Transformations	Transformation of Vectors and Tensors	[G] 9.1 – 9.2.1	9.1

Table 8: Week 7 Homework 13 due August 1 (Lectures 31 - 32). Homework 14 due August 5 (Lectures 33-34)

Lecture	Module	Topic	Reading	HW
31	Transformations	Principal values, Maximum Shear, Eigenvalues and Eigenvectors	[G] 9.2.2 – 9.2.3	9.2, 9.4
32	Transformations	Mohr's Circle of Stress	[G] 9.2.4 – 9.2.5	9.6, 9.11
33	Transformations	Transformation of Strain	[G] 9.3	9.15, 9.16a, 9.18
34	Failure	Yield and Fracture Criteria	[G] 9.4	9.25, 9.26, 9.28, 9.29

Table 9: Week 8 Homework 15 due August 8 (Lectures 35-36). Final exam August 10

Lecture	Module	Topic	Reading	HW
35	Failure	Stability: Introduction	[G] 12.1 – 12.2	12.4
36	Failure	Euler Loads for Columns	[G] 12.3	12.12, 12.14, 12.15