ME 108: ***Mechanical Behavior of Engineering Materials***

Professor Grace O'Connell, 5122 EH, g.oconnell@berkeley.edu.
Office Hours – Thursday 12:30-2:00pm or by appointment
Lectures: MWF 2-3pm, Hearst Mining 390

DESCRIPTION
This course covers elastic and plastic deformation under static and dynamic loads. Failure by yielding, fracture, fatigue, wear, and environmental factors are also examined. Topics include engineering materials, heat treatment, structure-property relationships, elastic deformation and multiaxial loading, plastic deformation and yield criteria, dislocation plasticity and strengthening mechanisms, creep, stress concentration effects, fracture, fatigue, and contact deformation.

CLASS/LABORATORY SCHEDULE: Three hours of lecture, one hour of discussion, and four hours of laboratory per week.
COURSE PREREQUISITES: C85

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL:
Lab Text: K. Komvopoulos, Mechanical Testing of Engineering Materials, Cognella Academic Publishing, San Diego, CA, 2010.
Note: There are errors in the original version of the lab textbook and changes made to some of the lab. Corrections to errors and differences will be provided before the lab. However, there is a revised version of the text that can be purchased (https://store.cognella.com/80122-2A-NI-003)

Text Book: Available on reserve in the Engineering Library (2 hour checkout)
Mechanical Behavior of Materials, Dowling (2013).

Suggested Texts:
Mechanics of Biomaterials, Pruitt and Chakravartula (2011).
Materials Science and Engineering: An Introduction, Callister Wiley (2009).

COURSE OBJECTIVES:
To introduce the design mindset, skillset and toolset, their scope, and their limitations.
To provide exposure to the practice of design through application in multiple settings.
To encourage understanding of the broader implications of designs that you create.

DESIRED COURSE OUTCOMES:
Development of a mindset around material properties under various loading condition.
Development of an appreciation for different perspectives of mechanical testing (i.e., uniaxial, biaxial, fatigue, creep, etc.).
Development of basic capabilities to analyze and represent results in a professional manner.
Development of fundamental skills for working effectively in a diverse team environment.

CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT
Students learn the basic experimental process, but also learn limitations and expectations from social, political, ethical, and legal perspectives through various case studies. Students will be formally trained in how to work effectively in diverse teams.

TOPICS COVERED:
I: Overview of basic materials science and mechanical testing
Overview of engineering materials used in structural applications
Review of bonding and microstructures: metals, ceramics, polymers, and composites

Defects, dislocations, slip systems, grain boundaries, twinning and phase transformations
Deformation of materials and strengthening mechanisms
Alloying, hardenability and heat treatments
Mechanical Testing
Case Studies of Engineering Failures
Exam I: Friday, February 28th (closed book/notes)

II: Constitutive Behavior
Elastic behavior, multiaxial loading, and complex stress-strain states
Time-dependent behavior (viscoelasticity)
Yield criteria and plastic deformation
Fracture criteria and linear elastic fracture mechanics
Cyclic loading and damage accumulation (fatigue)
Fatigue design: Total life (stress and strain based approaches) vs. defect-tolerant philosophies
Case Studies of Engineering Failures
Exam II: Wednesday April 8th (closed book/notes).
Final Exam: Tuesday May 12, 2020 (11:30-2:30pm). Location TBA. (closed book/notes)

GSIs:
Travis King (teking@berkeley.edu; Office hours (OH): Mondays 11-12pm),
Gabriel López-Marcial (gabriel_lopezmarcial@berkeley.edu; OH: Tuesdays 3:30-4:30pm),
Brian Muldoon (brianmuldoon@berkeley.edu; OH: TBD)

All GSI office hours are held in Hesse Hall (GSI Room/GSI Bubble).

Email Policy: If you email a question to the instructor or GSI, we will work to respond to your email within 24 hours during the week. Some questions/issues may take longer to respond to. The subject line must start with 'ME108:'

LABS:
Location: 70 Hesse Hall. Monday, Tuesday, Thursday, and Friday 8-10am; Tuesday, Thursday and Friday 10-12pm.
Laboratory assignments are team based. *We create within the first week of the semester;* ***therefore, you cannot change your lab section.***
You are expected to read the labs prior to coming to lab to better understand what you and your teammates will be doing during the lab period.
Each group will be responsible for submitting a self and peer- evaluation for each laboratory assignment, which will count towards your course participation grade.

Reports: Each lab report (6 page maximum) will be due a week after the completion of the particular lab assignment (5 pm on your lab day). ***One*** professionally written lab report per group must be submitted for each laboratory. Each lab member is expected to contribute to data collection, data analysis, and writing the report. Late lab reports are not accepted.

Self & Peer Evaluations: For each lab report you will be expected to submit a self and peer evaluation, *which will count towards your final grade*.

Lab Schedule: See the table on the right.

Week of	Lab Topic	Team
20-Jan		
27-Jan	CH0 - Teaming	All
3-Feb	CH1 - Heat Treatment & CH2 - Hardness	Blue
10-Feb		Gold
17-Feb	NONE	
24-Feb	CH 3 - Monotonic Testing & CH 4 - Fracture	Blue
2-Mar		Gold
9-Mar	CH 5 - Time and Rate Dependent Deformation	Blue
16-Mar		Gold
23-Mar	Spring Recess	
30-Mar	CH 6 - Cyclic Loading	Blue
6-Apr		Gold
13-Apr	CH 7 - Fatigue	Blue
20-Apr		Gold
27-Apr	NONE	
4-May	RRR Week - NONE	

DISCUSSIONS: Discussions: 150 Goldman School of Public Policy (GSPP) T&Th 5-6pm (Section 101 and 102, respectively).

EXAMS: There are two midterms and one final exam. The final exam is cumulative. All exams are closed book/notes.

ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES

- Laboratory 20%
- Homework 15%
- Course Participation & Team Participation: 5%
- Midterm Exams (2) 40%
- Final examination 20%

RELATIONSHIP OF THE COURSE TO ABET PROGRAM OUTCOMES

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(d) an ability to function on multi-disciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.