Mechanical Behavior of Materials

ME 156, Fall 2016
Instructor: **Alex Greaney**
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TA: Aria Hosseini & Heather Salvador

Class: WCH 143, MW 11:10–12:30
Lab: Bourns B213AA, M 8:10–11:00, F 11:10–14:00
Office hours: MSE 339, Mon. 17:00–18:00 or by appt.
Discussion: Organized by TAs.

Course Content

ME 156, *Mechanical Behavior of Materials*, introduces the theory and experimental techniques for testing the mechanical behavior of materials and structures. It covers the fundamental mechanisms of deformation and failure of metals, ceramics, polymers, composite materials, and electronic materials as well as strategies for engineering the mechanical properties of these materials.

Course Units: 4 units, Lecture, 3 hours; laboratory, 3 hours.

Prerequisites: senior standing; and a D- or better in both ME 110 and ME 114.

Office Hours

Office hours will be held in MSE 339 on Monday from 5–6pm, or by appointment if you can not make this time.

Evaluation of Student Performance

Homework — 20%; Lab — 20%; Midterm — 30%; Final Exam (comprehensive) — 30%

If the class median is less than 75% the total scores for the whole class will be adjusted up by an amount to bring the class median to 75%. That is, if scores need to be adjusted, the adjustment will be made using the following formula:

$$\text{Adjusted \%} = \text{Raw \%} + (75 - \text{Median}\,(\text{Class Raw \%}))\,.$$

The final letter grades will be awarded based on the adjusted score using the following table of grade boundaries:

Letter Grade	A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
Adjusted Score	95	90	87.5	85	80	77.5	75	70	67.5	65	60	57.5	0

Announcements and Documents

iLearn will be used as the primary means of communication for announcements, and for posting lab instructions, lecture handouts, homeworks, and their solutions. **Students are encouraged to download and print lecture notes and to bring them to class.**

Homeworks Assignments

Four homework assignments will be given through the term. You will have two weeks to complete each homework set. Solutions to the problem will be provides online on the day following the due date. Late homework will not be graded. Homework problems are a fundamental part of the learning process, and students are strongly urged to complete these learning exercises.

Exam Policy

Every possible effort must be made on the student's part to inform the instructor 1 week prior to missing a midterm exam. Given an appropriate reason, accommodations will be made to provide an alternative time. If the instructor is not informed 1 week prior to the exam, the possibility of a makeup exam will be at the instructor's discretion.

Lab Sessions

Lab work will be conducted in groups of 5 assigned by the instructor. A list of lab groups will be posted on iLearn. The expermental data from each lab group will be coallated and shared in a single online resource. Each lab group will turn in a single lab report that uses all the pooled data.

Text Books

The required text for this class is:

- W.F. Hosford, *Mechanical Behavior of Materials*, 2nd Ed., Cambridge University Press, 2008.

Some alternative books that you might find useful are:

- J. Pelleg, *Mechanical Properties of Materials*, Springer, (2013): This is perhapse an easier introduction to dislocations – and it is available for downlod fro free through the UCR library by following this link.
- W.D. Callister, *Materials Science and Engineering: An Introduction*, 8th Ed., Wiley (2009): A comprehensive, but perhaps a little simplistic, survey of materials structure and properties.
- Barrett, Nix and Tetelman, *The Principles of Engineering Materials*, Prentice Hall (1973): A fantastic grounding in principles of engineering properties of materials.
- R. Tilley, *Understanding Solids: The Science of Materials*, 2nd Ed., Wiley (2013): a good general introduction of structure property relations in materials
- D. Hull and D. J. Bacon, *Introduction to Dislocations*, 5th Ed., Elsevier (2011): A very accessible monograph on discloations and plasticity.
- A. Kelly, G. W. Groves and P. Kidd, *Crystallography and Crystal Defects*, Revised Ed., Wiley (2000): Good for alternative and straightforward viewpoints and a refresher on the basics of crystallography.
- T. H. Courtney, *Mechanical Behavior of Materials*, 2nd Ed., Waveland Press, 2000.

And for those feeling keen or adventurous:

- J. P. Hirth and J. Lothe, *Theory of Dislocations*, Wiley (1982): The definitive text on dislocation

theory. Good for hardcore theory and math — also good for curing insomnia.

Measurable Student Learning Outcomes

Course Objectives

1. To provide and overview of mechanical behavior of materials classes.
2. To familiarize students with concepts of crystaline materials mechanical behavior.
3. To analyze materials stress-strain behavior
4. To provide a basis for students assess plastic deformation in materials
5. To familiarize students with key dislocation concepts.
6. To familiarize students with concepts of fracture mechanics.
7. To familiarize students with concepts in composite materials behavior.
8. To provide an overview of the mechanical behvior of polymers.
9. To provide a basis for students to asses high temperature behavior behavior of materials.
10. To give students a basis for propoer materials selection in design.

Course Schedule

Below is the planned sequence of topics covered. This time tabel is not set in stone and could change as the class progresses:

Wk.	Lect.	Date	Topic	Reading	Lab/Discussion	Assignments
1	1	09/26	Overview & Review of bonding	Ch. 1	—	—
	2	09/28	Atomic arrangment, stress and strain	Ch. 1		HW1 Assigned
2	3	10/03	Elasticity & Viscoelasticity	Ch. 2, 15	Discussion	
	4	10/05	Plasticity & Dislocations I	Ch. 3, 7, 8		HW2 Assigned
3	5	10/10	Dislocations II	Ch. 7, 8, 9	Lab 1: Tensile testing	HW1 Due
	6	10/12	Dislocations III	Ch. 3		
4	7	10/17	Plasticity II	Ch. 5, 9	Discussion	Lb.1 Rep. Due
	8	10/19	Plasticity III	Ch. 4, 9		
	–	10/21	—			HW2 Due
5	9	10/25	Strengthening I & Review	Ch.11	Discussion	
	–	10/28	**Midterm**	Ch. 11		HW3 Assigned
6	10	10/31	Strengthening II	Ch. 10, 11	Discussion	
	11	11/02	Deformation of polymers	Ch. 15, 20		
7	12	11/07	Fracture I	Ch. 13, 14	Discussion	
	13	11/09	Fracture II & Toughening	Ch. 14		HW4 Assigned
	–	11/11	—		Lab 2: Stress concentration	
8	14	11/14	Fatigue I	Ch. 17	Lab 2: Stress	HW3 Due
	15	11/16	Fatigue II & Creep I	Ch. 17, 16	concentration	—
9	16	11/21	Creep II	Ch. 16	Discussion	
	–	11/23	**No Class**			
10	17	11/28	Composites	Ch. 21	Discussion	
	18	11/30	Advanced materials & Review	Ch. 21		Lb.2 Rep. Due
	–	12/02	—			HW4 Due
11		12/05	Comprehensive Final Exam, **3–6 pm, WCH143**			

UCR Academic Resource Center

The Academic Resource Center (ARC) is the central resource for academic support at UCR. All students are strongly encouraged to visit the ARC, which is staffed by professional and student employees who are well trained to provide academic support and dedicated to fostering academic excellence. Resources provided by the ARC include Tutoring, Supplemental Instruction, Study Skills Workshops, as well as several peer mentoring programs. Staff work with all students, at all skill levels, in all stages of their undergraduate careers. Participating in these services is most useful to students when used pro-actively for academic enrichment. Visit arc.ucr.edu or call 951-827-3721 for more information about hours,

location and the schedule of services.

Academic Integrity

As a respected research institution, UCR values academic integrity. UCR students should uphold this value and avoid academic misconduct and its consequences. Academic misconduct is any act that improperly distorts (or could distort) a student's grades or other academic record. Students caught cheating, plagiarizing, or participating in any form of academic dishonesty may receive an F or other penalty on the assignment or test and possibly in the course. The universities definitions of and policies regarding academic misconduct are clearly described here: conduct.ucr.edu/policies/academicintegrity.html.