UNIVERSITY OF CALIFORNIA, DAVIS
Department of Materials Science and Engineering

Professor Gibeling **EMS-174** **Spring 2018**

COURSE INFORMATION

Course Title: Mechanical Behavior of Materials

Instructor: Prof. Jeffery C. Gibeling
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Phone: (530) 752-7037
E-mail: jcgibeling@ucdavis.edu
Office Hours: MWF 9:00-10:00AM

Teaching Assistant: Bing Yuan
Office: 1033 Academic Surge
Email: byyuan@ucdavis.edu
Office Hours: M 11:00AM-12:00PM

Course Meetings: Lecture: MWF 3:10-4:00PM, 2016 Haring
Discussion: W 4:10-5:00PM, 204 Art

Attendance at discussion will be recorded. Students may earn extra credit (see below) by attending discussion meetings. One unexcused absence will be permitted, and excused absences must be cleared in advance with the instructor.

Textbook: Thomas H. Courtney, "Mechanical Behavior of Materials, 2nd Edition", Waveland Press, Inc., Long Grove, IL, 2000.

Brief Description: Microscopic and macroscopic aspects of the mechanical behavior of engineering materials, with emphasis on the relationships between measured properties and the underlying mechanisms that control them. Fundamental aspects of elasticity and plasticity in engineering materials, strengthening mechanisms and mechanical failure modes of materials systems.

Course Outcomes: Upon successful completion of this course, the students are expected to acquire or improve upon their abilities to:

(1) apply knowledge of mathematics, science, and engineering;
(2) identify, formulate, and solve engineering problems;
(3) apply advanced science (such as chemistry and physics) and engineering (such as mechanics of materials) principles to materials systems;
(4) demonstrate an understanding of the microstructural mechanisms that control the macroscopic properties of materials.

Grading Basis:

Homework (6-7 assignments)	20% (due Wednesdays in class) (~ 250 points)
Midterm Examination	30%
Final Examination	50%
Extra Credit	50 points added to homework for attending discussions (1 unexcused absence permitted)

General Policies: Students are encouraged to discuss homework assignments with each other. This may include clarifying the question being asked, discussing the concepts that are addressed in

the problem, and describing strategies for developing an answer to the problem. However, all calculations and derivations submitted for grading are expected to be the individual work of each student. Students are not permitted to copy all or part of a solution from another student, solution manual, online solutions, or former students. Students are expected to be familiar with and abide by the UC Davis Code of Academic Conduct. Suspected instances of cheating and other academic misconduct will be reported to the Office of Student Support and Judicial Affairs.

Requests to review grading of homework or examinations must be submitted to the instructor in writing within one calendar week of the assignment being returned to the student. Grades will only be reviewed if there is evidence of an error in grading and will not be reviewed for any extenuating circumstances the student may have faced.

If academic accommodations are needed, such as for religious holidays or students with documented disabilities, the student is expected to contact the instructor during the first full week of the quarter to make the appropriate arrangements (unless there are extenuating circumstances).

Email Policies: The instructor and TA will endeavor to respond to email questions by the end of the next business day. Responses should not be expected on weekends or late at night. The subject line of any email questions regarding this course should begin with the course number, e.g. "EMS-174: Question Regarding Problem 2".

Additional References: The following books may be of interest to those desiring more information about the course subjects:

1) J. Rösler, H. Harders and M. Bäker, "Mechanical Behaviour of Engineering Materials", Springer, Berlin Heidelberg, 2007 (available online to UC Davis students online at http://link.springer.com/book/10.1007/978-3-540-73448-2).

2) G. E. Dieter and D. Bacon, "Mechanical Metallurgy, revised 3rd Edition", McGraw-Hill, 1990.

3) N. E. Dowling, "Mechanical Behavior of Materials, 4th Edition", Prentice-Hall, 2012.

4) H. W. Hayden, W. G. Moffat and J. Wulff, "The Structure and Properties of Materials, Volume III: Mechanical Behavior", John Wiley and Sons, 1965.

5) R. W. Hertzberg, R. P. Vinci and J. L. Hertzberg, "Deformation and Fracture Mechanics of Engineering Materials, 5th Edition", John Wiley, 2012.

6) W. F. Hosford, "Mechanical Behavior of Materials, 2nd Edition", Cambridge University Press, 2010.

7) M. A. Meyers and K. K. Chawla, "Mechanical Behavior of Materials, 2nd Edition", Cambridge University Press, Cambridge, 2009.

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Course Outline and Reading Assignments

Date	Lecture Topic	Assignment* Chap.	Pages
Apr. 2	Introduction	--	------
Apr. 4	Overview of Mechanical Properties	1	1-16
Apr. 6	Strain Rate Sensitivity and Temperature Effects	--	------
Apr. 9	Elastic Properties of Solids	2	46-56
Apr. 11	Elastic Properties of Solids: Continuous Fiber Composites	6	244-257
Apr. 13	Elastic Properties of Solids: Discontinuous Fiber Composites	6	257-263
Apr. 16	Viscoelastic Behavior	2	65-79
Apr. 18	Dislocation Geometries	3	85-103
Apr. 20	Dislocation Stress Fields and Energies	3	106-110
Apr. 23	Forces on Dislocations	3	110-112
Apr. 25	Dislocation Motion: Kinematics	3	123-131
Apr. 27	Dislocation Motion: Dynamics	3	114-115
		3	132-133
Apr. 30	Crystal Structure & Dislocation Geometry	3	116-122
May 2	Inelastic Deformation: Single Crystals	4	140-155
May 4	Inelastic Deformation: Polycrystalline Solids & Work Hardening	4	156-161
May 7	MIDTERM EXAMINATION	**	*******
May 9	Strengthening Mechanisms: Alloying	5	175-181
May 11	Strengthening Mechanisms: Alloying	5	186-196
May 14	Strengthening Mechanisms: Particles	5	196-210
May 16	Strengthening Mechanisms: Grain Boundaries	5	181-186
May 18	High Temperature Deformation: Phenomenology	7	293-297
		7	324-325
May 21	High Temperature Deformation: Mechanisms	7	297-314
		7	325-331
May 23	High Temperature Deformation: Mechanism Maps	7	295-319
May 25	Fracture Mechanisms: Low Temperature	9	404-418
May 28	MEMORIAL DAY HOLIDAY	**	*******
May 30	Fracture Mechanics	10	418-436
June 1	Toughening Mechanisms	10	454-476
June 4	Fatigue of Engineering Materials	12	566-583
June 6	Fatigue of Engineering Materials	12	584-589

FINAL EXAMINATION: Thursday, June 14, 2018, 1:00 PM - 3:00 PM

* All reading assignments are from the text by Courtney (2nd Edition).