FALL 2006: MECHANICAL BEHAVIOR OF MATERIALS

Undergraduate: ME 378K #18565
Graduate: ME 386P-2 #18725

Instructor: Eric M. Taleff, Associate Professor, Department of Mechanical Engineering

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Lectures: MWF 11:00–11:50 AM in ETC 5.132

Office Hours: Tuesday: 2:00–3:00 PM
Wednesday: 2:00–4:00 PM

Required Textbook: Thomas H. Courtney. *Mechanical Behavior of Materials, Second Edition*. (Waveland Press, Inc.: Long Grove, IL) 2000. This is a 2005 reissue of the second edition published in 2000 by McGraw Hill. Either issuing is acceptable.

Prerequisites: Undergraduates must be in the major sequence and have completed ME 311 and ME 111L with a grade of at least C.

Course Description: Elastic deformation; viscoelasticity; yielding, plastic flow, plastic instability, strengthening mechanisms; fracture, fatigue, creep; significance of mechanical properties tests. Applicable systems are metals and alloys, polymeric materials, and ceramics. Both microstructural mechanisms and macroscopic treatments of these phenomena are addressed.

Grading Policy: Grades will be based on three exams, a final exam, and a combination of homeworks, quizzes and class participation, with weights given in the tables below. The final exam is *optional* for undergraduate students.

Item	Weight
Exam I	20%
Exam II	20%
Exam III	20%
Final Exam	30%
HW/Quizzes/Class	10%

Grade	Minimum Score
A	90%
B	80%
C	70%
D	60%

Important Dates: Please make note of the following important dates.

Sep. 15 — Twelfth class day.
Dec. 18 — **Final Exam**, 2:00 PM–5:00 PM in location assigned by U.T.

Library Reserve Texts: The following books are on reserve in the Engineering Library and may be of use in your studies.

1. K. J. Bowman. *Mechanical Behavior of Materials.* (John Wiley: Hoboken, NJ) 2004.
2. T. H. Courtney. *Mechanical Behavior of Materials*, 2nd ed. (McGraw Hill: Boston) 2000.
3. G. E. Dieter. *Mechanical Metallurgy*, 3rd ed. (McGraw-Hill: New York) 1986.

4. N. E. Dowling. *Mechanical Behavior of Materials*, 2nd ed. (Prentice Hall: Upper Saddle River, NJ) 1999.
5. R. W. Hertzberg. *Deformation and Fracture Mechanics of Engineering Materials,* 4th ed. (J. Wiley & Sons: New York) 1995.
6. M. A. Meyers and K. K. Chawla. *Mechanical Metallurgy: Principles and Applications.* (Prentice-Hall: Englewood Cliff, NJ) 1984.
7. J. F. Nye. *Physical Properties of Crystals, Their Representation by Tensors and Matrices.* (Clarendon Press: Oxford) 1986.

Homework: Homework problems will be assigned on either a weekly or biweekly basis. All students are expected to complete and thoroughly understand the homework assignments. Homework solutions will be made available on a secure web site. Homework should be collected in a notebook, corrected using the solutions provided, and turned in for grading upon request of the instructor.

Exams: All exams, except the final exam, will be conducted during normal lecture periods in the assigned classroom on dates specified by the instructor. The final exam will be conducted at the time and location scheduled by the University. Students are allowed to prepare one $8.5'' \times 11''$ sheet of notes, which may include both sides of the paper, for use during each exam. Each note sheet must be handed in with the exam for which it is used.

Attendance: Attendance and participation in lecture are mandatory and will be considered in grading. The instructor must be given written notice a minimum of two weeks in advance for any absences other than emergencies. If absence is required because of an emergency, the instructor should be notified at the earliest convenient opportunity.

Regrades: Errors in grading should be noted *in writing* and provided to the instructor with the graded item for review *no later than one week* after the item is made available to the student. *No regrades will be accepted without a written description* of the grading error, and regrades will only be conducted *in private* by the instructor.

Honesty: Any academic dishonesty will be dealt with according to University policy, including the stiffest penalty which the instructor may assess, usually a failing grade in the course. Dishonesty damages the reputation of the University and its students and will not be tolerated.

Evaluations: The course and instructor will be evaluated using standard evaluation forms at the end of the course. Students are encouraged to provide continuous feedback to the instructor throughout the course. The most effective way to do this is by visiting the instructor during office hours.

> The University of Texas at Austin provides, upon request, appropriate academic adjustments for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259. Web-based, password-protected class sites are associated with all academic courses taught at the University. Syllabi, handouts, assignments and other resources are types of information that may be available within these sites. Site activities could include exchanging e-mail, engaging in class discussions and chats, and exchanging files. In addition, electronic class rosters will be a component of the sites. Students who do not want their names included in these electronic class rosters must restrict their directory information in the Office of the Registrar, Main Building, Room 1.

Course Schedule and Required Readings

Week		Topics	Chapters
1:	8/30	Course Introduction	1
	9/1	Review of Stress and Strain	2
2:	9/4	*Labor Day*	
	9/6	Tensors and Matrix Manipulations	2, HO
	9/8	Principal Values and Invariants	2, HO
3:	9/11	Symmetry Properties and Linear Elasticity	2, HO
	9/13	Linear Elasticity	2
	9/15	Non-linear Elasticity	2
4:	9/18	Anelasticity	2
	9/20	Viscoelasticity	2
	9/22	Continuum Theory of Plasticity	1
5:	9/25	Isotropic Yield Criteria	1
	9/27	Single-Crystal Plasticity	3
	9/29 †	*Exam I*	
6:	10/2	Crystallography of Slip	3, 4
	10/4	Twinning and Polycrystal Plasticity	3, 4
	10/6	Texture Development	4, HO
7:	10/9	Plastic Instability, Other Types of Plasticity	1
	10/11	Dislocation Theory	3
	10/13	Dislocation Character	3
8:	10/16 †	Dislocation Character	3
	10/18 †	Dislocation Motion and Interactions	3
	10/20	Dislocations in Specific Crystal Structures	3
9:	10/22	Strengthening Mechanisms in Crystalline Solids	5
	10/25	Strengthening Mechanisms in Crystalline Solids	5
	10/27	*Exam II*	
10:	10/30	Strengthening Mechanisms, Anisotropic Hardening	5
	11/1	Creep Deformation	7, HO
	11/3	Creep Lifetime Predictions	7, HO
11:	11/6	Steady-State Creep Analysis	7, HO
	11/8	Creep Mechanisms and Mechanism Maps	7, HO
	11/10	Fracture Theory	9
12:	11/13	Fracture Toughness Testing	9
	11/15	Fracture Morphologies	9
	11/17	Fracture Probability Analysis	9
13:	11/20	Fracture Toughening and the R-Curve	9, HO
	11/22	Elastic Deformation of Composites	6
	11/24	*Thanksgiving Holiday*	
14:	11/27	Plastic Deformation and Fracture of Composites	6
	11/29	*Exam III*	
	12/1	Cyclic Fatigue	12
15:	12/4	Cyclic Fatigue	12
	12/6	Fatigue Lifetime Predictions	12
	12/8	Fatigue Lifetime Predictions	12
16:	12/18	*Final Exam*	

†: Guest lecturer
HO: Material covered in handouts and notes