

COURSE SYLLABUS

MTE 556 - Advanced Mechanical Behavior of Materials Spring 2008

Catalog Data:

MTE 556. Strengthening Mechanisms in Materials, three hours (3-0) Three hours. Topics include elementary elasticity, plasticity, and dislocation theory; strengthening by dislocation substructure, and solid solution strengthening; precipitation and dispersion strengthening; fiber reinforcement; martensitic strengthening; grain size strengthening; order hardening; dual phase microstructures, etc.

Prerequisites:

Prerequisite: Permission of instructor

Textbook/references:

Text:

- M.A. Meyers & K.K. Chawla, *Mechanical Behavior of Materials*, Prentice Hall, 1999.
- Mechanical Behavior of Materials Course Notes, 2nd Edition.

Reference texts:

- G. E. Dieter, *Mechanical Metallurgy*, 3rd ed., McGraw Hill, 1986.
- T.H. Courtney, *Mechanical Behavior of Materials*, 2nd Ed., McGraw Hill, 2000.
- R.W. Hertzberg, *Deformation and Fracture Mechanics of Engineering Materials*, 4th Ed., John Wiley & Sons, 1995.
- M. Vable, *Mechanics of Materials*, Oxford University Press, New York, NY, 2003. Any equivalent mechanics of materials book will suffice.
- *Introduction to Dislocations*, 4th ed.; D. Hull and D.J. Bacon; Butterworth-Heinemann, 2001.
- *Mechanical Metallurgy*; M.A. Meyers and K.K. Chawla; Prentice Hall, 1984.
- *Strong Solids*, 3rd ed.; A. Kelly and N.H. Macmillan; Oxford University Press, 1986.
- *Crystallography and Crystal Defects*, Revised Edition; A. Kelly, G.W. Groves, and P. Kidd; John Wiley & Sons, 2001
- *Mechanical Behavior of Materials*, 2nd ed.; T.H. Courtney; Waveland Press, 2005.
- R.E. Reed-Hill and R. Abbaschian, *Physical Metallurgy Principles*, 3rd Ed., PWS Publishing Company, Boston, MA, 1994.
- Various classic technical articles will be handed out and/or assigned throughout the semester. Most are readily available in the MTE departmental library.

Course Objectives:

- Students will learn how to engineer materials to yield the highest strengths at ambient and elevated temperatures in both a macroscopic and microscopic sense.

Topics Covered:

1. Stress, Strain and Deformation
2. Elasticity

3. Strength of Ideal Crystals
4. Dislocation Theories of Strengthening
5. Creep
6. Fatigue
7. Fracture
8. Advanced topics

Class schedule:

Class meets three times a week for 50 minutes per meeting.

For this class, additional lecture sessions will be scheduled and held during the semester.

Prepared by: Mark L. Weaver

Date: January 3, 2008

UNIVERSITY OF ALABAMA
Metallurgical and Materials Engineering Department
Primary Lecture Schedule for 2008
Supplemental lectures will be held for MTE 556

COURSE(S): MTE 455/556 – Me/ADV. Mech. Beh. of Mater.

Primary Lecture Period: MWF 10:00 AM – 10:50 AM; A27 Bevill

Supplementary Lecture Period*: MWF 02:00 PM – 02:50 PM; A27 Bevill

INSTRUCTOR: M.L. Weaver; Rm. A01 Bevill; 348-7073; mweaver@eng.ua.edu

OFFICE HOURS: TR 3:00 PM – 4:00 PM.

ASGT	DAY	DATE	TOPICS	READING
1	W	01/9	Introduction	Module #1
2	F	01/11	Tension test; stress-strain curves; common modes of loading	Module #2
3	M	01/14	HOLIDAY – MLK DAY	NO CLASS
4	W	01/16	Hardness	Module #2a
5	F	01/18	ON TRAVEL TO NSF	NO CLASS
6	M	01/21	Stress-strain behavior; empirical relationships for stress & strain; criteria for necking	Module #3
7	W	01/23	Cont'd	Cont'd
8	F	01/25	Poisson's ratio; elastic stress-strain relations; states of stress	Module #4
9	M	01/28	Stress at a point; tensors; transformation of stresses	Module #5
10	W	01/30	Transformation of stresses in 2d; Mohr's circle for stress in 2d	Module #6
11	F	02/01	Cont'd	Cont'd
12	M	02/04	QUIZ #1 [modules 1-6]	
13	W	02/06	ON TRAVEL TO NSF	NO CLASS
14	F	02/08	ON TRAVEL TO NSF	NO CLASS
15	M	02/11	Triaxial stress; transformation of stress in 3d; Mohr's circle for stress in 3d; yield criteria	Module #7
16	W	02/13	Cont'd	Cont'd
17	F	02/15	Strain; strain deviator; Mohr's circle for strain	Module #8
18	M	02/18	Elasticity	Module #9
19	W	02/20	Theoretical strength; defects in solids	Modules #10, 11
20	F	02/22	Dislocation motion	Module #12
21	M	02/25	Cont'd	Cont'd
22	W	02/27	Dislocation multiplication	Module #13
23	F	02/29	Elastic properties of dislocations	Module #14
24	M	03/03	Cont'd	Cont'd
25	W	03/05	Slip in crystals and other modes of deformation	Module #15
26	F	03/07	Twinning in detail	Module #16
27	M	03/10	TMS MEETING – NEW ORLEANS	NO CLASS
28	W	03/12	TMS MEETING – NEW ORLEANS	NO CLASS
29	F	03/14	QUIZ #2 [modules 6-14]	
30	M	03/17	SPRING BREAK	NO CLASS
31	W	03/19	SPRING BREAK	NO CLASS
32	F	03/21	SPRING BREAK	NO CLASS
33	M	03/24	Yield point effects	Module #17
34	W	03/26	Introduction to strengthening mechanisms	Module #18
35	F	03/28	Work hardening; Solid solution hardening	Modules #19, 20
36	M	03/31	Grain size hardening / Hall-Petch effect; precipitation hardening	Modules #21, 22
37	W	04/02	QUIZ #3 [modules 15-22]	
38	F	04/04	HONORS DAY	NO CLASS
39	M	04/07	Fracture	Module #24
40	W	04/09	Cont'd	Cont'd
41	F	04/11	Cont'd	Cont'd
42	M	04/14	Creep	Module #25

Academic and Administrative Standards

GRADING: The final grade is determined approximately as follows:

CATEGORY	Pts.	%
Quiz 1	100	10
Quiz 2	100	10
Quiz 3	100	10
Quiz 4	100	10
Final Exam (cumulative)	300	30
Homework	200	20
Participation in Lab Experiments	100	10
Total	800	100%

GRADING SCALE		
	A+	≥ 95%
90% ≤	A	< 95%
87% ≤	A-	< 90%
84% ≤	B+	< 87%
80% ≤	B	< 84%
77% ≤	B-	< 80%
74% ≤	C+	< 77%
70% ≤	C	< 74%
67% ≤	C-	< 70%
64% ≤	D+	< 67%
60% ≤	D	< 64%
57% ≤	D-	< 60%
57% <	F	

QUIZZES AND FINAL EXAMINATION: Examination questions will be based upon course lectures, laboratory demonstrations, and reading material. Should a make-up examination be required, it must be made up at the next regularly scheduled departmental make-up exam period. Students are permitted to take a make-up exam if permission was obtained from the instructor prior to missing the regularly scheduled exam. ALL EXAMS WILL BE CLOSED BOOK AND CLOSED NOTES.

HOME WORK: Homework assignments will be taken directly from the text. Assignments and due dates for assignments will be given during the semester by the instructor. **They will not be accepted late without a legitimate excuse or special permission. You must obtain permission from the instructor BEFORE the due date.** Assignments will normally be returned at the next class meeting. Copying homework solutions from other student papers and turning it in as your work is dishonest and constitutes grounds for charges of academic misconduct.

COURSE NOTES: Electronic versions of the course notes will be uploaded to the course web site (<http://bama.ua.edu/~mweaver/mte455.htm>) periodically through the semester. Reading assignments from the lecture notes will be given. **You are responsible for everything in the course notes AND the appropriate sections in the textbook.**

LABORATORIES: Demonstration laboratories will be conducted throughout the semester. Students are expected to participate in the laboratories. Attendance and participation are necessary to receive these points. Data generated within the laboratories will be used to create some homework assignments.

POLICY ON ACADEMIC MISCONDUCT: The Code of Academic Conduct states that: “All students in attendance at The University of Alabama are expected to be honorable and to observe standards of conduct appropriate to a community of scholars. The University expects from its students a higher standard of conduct than the minimum required to avoid discipline. All acts of dishonesty in any academic work constitute academic misconduct. This includes, but is not necessarily limited to the following:

- A. Cheating – using or attempting to use unauthorized materials, information, or study aids in any academic exercise.
- B. Plagiarism – representing the words, ideas, or data of another as one’s own in any academic exercise.
- C. Fabrication – unauthorized falsification or invention of any information or citation in an academic exercise.
- D. Aiding and abetting academic dishonesty – intentionally or knowingly helping or attempting to help another student commit an act of academic dishonesty.
- E. Misrepresentation – falsifying, altering, or misstating the contents of documents or other materials related to academic matters, including schedules, prerequisites and transcripts.

The Code of Academic Misconduct disciplinary Procedures will be followed in the event that academic misconduct occurs. Students should refer to the Student Affairs Handbook which can be obtained from the Student Life Office in Ferguson Center.

DIASABILITY ACCESS: To request disability accommodations, please contact disability services (348-4285). After initial arrangements are made with that office, contact your instructor with the proper University forms from the disability services.

FINAL GRADE

The final grade will be determined by the student’s attendance and participation in class, performance on the examinations, and assigned work. Pop quizzes can be administered at any time. Pop quizzes, if given, will be part of homework points.

SPECIAL NOTE: ASSIGNMENT SHEETS AND COURSE CONTENT ARE SUBJECT TO MODIFICATION WHEN CIRCUMSTANCES OR SOUND PEDAGOGY DICTATE AND AS THE COURSE PROGRESSES. IF CHANGES ARE MADE, YOU WILL BE GIVEN DUE NOTICE.

**MTE 556 – Advanced Mechanical Behavior of Materials
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We shall follow the same outline as the undergraduate course (MTE 455).

HOWEVER, graduate students will be required to attend additional lectures scheduled for MWF 2:00 – 2:50PM in A027 Bevill. In those lecture periods we shall address the topics covered by the undergraduates in greater detail. We will also attack topics listed in the notes that go beyond what is expected of an undergraduate student.

Graduate students will complete the same homework assignments as undergraduates unless otherwise noted by the instructor.

Graduate students will have different exams than the undergraduates. The graduate exams will address topics that graduate students will be expected to know about the deformation of materials.

Grading policies shall be the same as the undergraduate course.