

SAN JOSE STATE UNIVERSITY
Department of Chemical and Materials Engineering

MatE 195
W. Richard Chung

Fall 2000
Engr.-385E

Mechanical Behavior of Materials

Objectives: The course is designed to help materials engineering seniors understand the basic mechanical responses of engineering materials. Emphasis will be placed on how to perform various mechanical tests, how to apply statistical methods to the analysis of mechanical properties data, and how mechanical behavior influences the load-bearing limit for a selected material in a given application.

Prerequisites: CE 99, MatE 115 and MatE 141.

Class Hours: Lecture on Mondays from 0830 to 1020, in IS113
Laboratory on Wednesdays from 0830 to 1120, in E-225

Office Hours: Mondays & Wednesdays: 1300-1500, other times by appointment only.

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Textbook: Norman E. Dowling, **Mechanical Behavior of Materials**, Prentice-Hall, Upper Saddle River, New Jersey, 2nd Edition, 1999. (ISBN0-13-905720-X)

References: S.D. Antolovich, R.O. Ritchie, and W.W. Gerberich (editors), **Mechanical Properties and Phase Transformations in Engineering Materials**, A Publication of the Metallurgical Society, Warrendale, Pennsylvania, 1986. (ISBN 0-87339-012-1) TA 401.3 M4155

Craig R. Barrett, William D. Nix, and Alan S. Tetelman, **The Principles of Engineering Materials**, Prentice-Hall, Englewood Cliffs, New Jersey, 1973. (ISBN 0-13-709394-2) TA403.B24.

David Broek, **Elementary Engineering Fracture Mechanics**, Martinus Nijhoff Publishers, Hingham, Massachusetts, 3rd Edition, 1984. (ISBN 90-247-2656-5)

Thomas H. Courtney, **Mechanical Behavior of Materials**, McGraw Hill, New York, 2nd Edition, 2000. (ISBN0-07-028594-2) TA405.C859

George E. Dieter, **Mechanical Metallurgy**, McGraw Hill, New York, 3rd Edition, 1986. (ISBN 0-07-016853-8) TA405.D53

W.A. Green and M. Micunovic (editors), **Mechanical Behavior of Composites and Laminates**, Elsevier Applied Science Publishing, New York, 1986. (ISBN 1-85166-144-1) TA418.9C6 E976

James M. Gere and Steven P. Timoshenko, **Mechanics of Materials**, PWS-KENT Publishing, Boston, Massachusetts, 3rd Edition, 1990. (ISBN 0-534-92174-4) TA405.G44

Richard W. Hertzberg, **Deformation and Fracture Mechanics of Engineering Materials**, John Wiley & Sons, New York, 3rd Edition, 1989. (ISBN 0-471-63589-8) TA417.6H46

Donald Peckner (editor) **The Strengthening of Metals**, Reinhold Publishing, New York, 2nd Edition, 1967.

Grading Basis: There will be two midterm examinations and one final examination. Examinations are comprehensive; including subjects from all assigned readings, lectures, laboratory activities, and classroom demonstrations. Homework assignments will consist of essay questions and problem solving cases. The laboratory component affects 25% of the course grade. A term project must be completed and submitted by November 29th. The details will follow.

Homework assignments.....	15%
Two midterm exams at 15% each.....	30%
Laboratory activities.....	25%
Term project with oral presentation.....	15%
Final Examination.....	15%
Total:	100%

For all graded work, course letter grades will be assigned according to the corresponding ranges of cumulative averages listed below.

A+ 97 -- 100	A 94 -- 96	A- 90 -- 93
B+ 87 -- 89	B 84 -- 86	B- 80 -- 83
C+ 77 -- 79	C 74 -- 76	C- 70 -- 73
D+ 67 -- 69	D 64 -- 66	D- 60 -- 63
F below 60		

Add/Drop Policy: Students wanting to enroll in the class must sign the roster and receive an enrollment code, provided space is available. Students may drop this class from now until September 15 without “W” grade assigned.

Important Dates:

Midterm examination dates: **October 11** and **November 15**
 Final exam date: Tuesday, **December 19**, 0715-0930

Term project report submission date: **Nov. 29**

Reserve Desk: The Reserve Desk is located by the book checkout area in the Clark Library. To help your study in the course material, the instructor has reserved some reference books, technical articles, and supplemental lecture notes.

Homework: Work the homework problems on one side of a sheet of paper only. You need to number all the pages if more than one page is submitted. On top of each page write down your name, the course number, the semester, and the submission date. List the problem numbers in the Dowling textbook and restate the statement of the problem including simple sketches, if applicable. Show your working steps and circle the numeric solutions. It is very important to have one or two sentences describing your conclusions. This is a brief statement used to state the physical significance or implication of your answer. Underline them and don't forget units! The instructor will pay additional attention to this requirement. The homework assignments are collected in class on **Sept. 25, Oct. 23, and Nov. 20**. No late assignments will be accepted, as the problem solutions will be posted immediately after the class due date.

Laboratory: A **Laboratory Activity Logbook** will be purchased and kept by each student. It must be brought to be checked and initialed by the instructor before beginning the first lab exercise. The logbook must be 8 1/2 x 11 inches, NOT spiral bound. You will use it to record a detailed log of all lab activities, data, sketches of experimental setups and results, and records of references used for class projects. Mark it clearly on the cover with your name, group number, class and section, instructor, and semester. **Each page should be numbered and dated** and each lab activity labeled. Record your partners' names, phone numbers, and schedules inside the cover.

Term Project: A **Term Project** must be completed. The term project will involve a material's testing activity, which you design, initiate, and conduct in a group (not more than three members) and must be supported by cost analysis, technical drawings, and related references. A few topics will be discussed in class at a later date. Completed term project reports will be from 10 pages in length, double spaced not including illustrations or appendices, and will follow the class format. A writing format will be provided at a later date. An oral presentation on the term project must be conducted in the end of class (November 27).

A group's oral presentation on the term project is expected to last at least 20 minutes, followed by a 5-minute discussion period. All members of a group project must present together, but are graded separately. The presentation should be technical and include view graphs or visual aids related to the chosen subject area. Transparencies, films, LCD projector, and/or VCR recordings (VHS) can be used, but may not replace spoken reporting. A guideline with tips of presentation requirements will be distributed at a later date.

Mat E 195 Course Activity Outline

Week	Starting Date	Reading: Chapter #	Homework Assignments	Laboratory
1	Aug. 28	Ch.1 Introduction	Prob. 1.1, 1.3, and 1.5	Lab Tour/Safety
2	Sept. 4	Labor Day --No Class on Sept. 4	Prob. 5.2, 5.5, 5.10	Types of Material Failure
3	Sept. 11	Ch.5 Stress-Strain Relationships	Prob. 5.20, 5.22, 5.23	Tension Tests
4	Sept. 18	Ch.5 Stress-Strain Relationships Ch. 4 Mechanical Testing (Tension Test)	Prob. 5.26, 5.30, 5.32	Mechanical Tests (Impact, Izod, Hardness, etc.)
5	Sept. 25	Ch. 4 Mechanical Testing (Tension Test)	Prob. 4.4, 4.5, 4.7	Problem Solving
6	Oct. 2	Ch. 4 Mechanical Testing (Other Tests)	Prob. 4.16, 4.18, 4.28	DMA
7	Oct. 9	Ch. 4 Mechanical Testing (Other Tests)	Prob. 4.31, 4. 34, 4.37, 4.38	Exam 1 – Oct.11
8	Oct. 16	Ch.6 Complex and Principal States of Stress and Strain	Prob. 6.1, 6.7, 6.10	Mohr's Circles/ Term project
9	Oct. 23	Ch.6 Complex and Principal States of Stress and Strain	Prob. 6.14, 6.16, 6.28	SEM Fractography
10	Oct. 30	Ch. 8 Fracture of Cracked Members	Prob. 8.3, 8.4, 8.7	2024-TT6 Aluminum
11	Nov. 6	Ch. 9 Fatigue of Materials	Prob. 9.6, 9.7, 9.14	Fatigue Test
12	Nov. 13	Ch. 9 Fatigue of Materials	Prob. 9.16, 9.20	Exam 2 –Nov. 15
13	Nov. 20	Ch. 11 Fatigue Crack Growth	Prob. 11.4, 11.8, 11.13	Polymers/Composites
14	Nov. 27	Ch. 12 Plastic Deformation Behavior and Models for Materials	Prob. 12.1, 12.13	Term Paper Due (Nov. 29)
15	Dec. 4	Ch. 15 Time-Dependent Behavior: Creep and Damping	Prob. 15.2, 15.6, 15.16	Problem Solving
16	Dec. 11	Review of the Course	Last Day of Instruction	

Final Examination on Tuesday, December 19th from 0715 to 0930 hours

MatE 195 Course Learning Objectives

Upon the completion of this course, the student will be able to:

- 1. Understand the basic test methods to characterize the mechanical behavior of engineering materials: tension, compression, hardness, impact, fatigue, and creep.**
- 2. Apply the basic theory of elasticity and plasticity and the importance of brittle-ductile transformation and elastic and plastic behavior of materials to industrial applications.**
- 3. Learn the concept of fracture mechanics and its application to product design, manufacturing method, and service reliability.**
- 4. Perform the mathematical calculation of a multi-axial or complex stress state and relate it to the uni-axial stress state and the yielding condition.**
- 5. Describe and predict the mechanical behavior of crystalline solids using the concepts of dislocation theory and a micro-mechanical approach.**
- 6. Improve fracture toughness and deflect a crack's propagation through the understanding of the microstructural alignment and the associated mechanical anisotropy.**