UNIVERSITY OF CALIFORNIA, BERKELEY
College of Engineering
Departments of Materials Science & Engineering and Mechanical Engineering

Spring 2007

COURSE: **MSE C212 — ME C225**

TITLE: **DEFORMATION AND FRACTURE OF ENGINEERING MATERIALS**

UNITS: 4

LECTURES: Monday, Wednesday: 10 – 11:30 AM, 310 Hearst Mining Building

OFFICE HOURS: by appointment

LECTURER: Dr. Anthony W. Thompson
Materials Sciences Division, LBNL
campus mail can be sent to 210 HMB
e-mail: thompsonmarytony@sbcglobal.net

WEB PAGE: to be announced

COURSE DESCRIPTION:

A survey course of the mechanics and microstructural aspects of deformation and fracture in structural metallic, ceramic and composite materials, including linear elastic, nonlinear elastic/plastic and creep deformation from a continuum viewpoint, fracture mechanics of linear elastic, nonlinear elastic and creeping materials, physical basis of intrinsic and extrinsic toughening, environmentally-assisted fracture, cyclic fatigue failure, fatigue-crack propagation, stress-strain/life and damage-tolerant design, creep-crack growth, and fracture statistics.

PREREQUISITES:

Undergraduate level understanding of mechanical behavior of materials (MSE C113, ME C124, or equivalent); general mechanics (CE 130 or equivalent).

PROJECT:

Each student will choose, or be assigned, an individual project on a topic which may or may not relate to his or her research work; the topic could be based on a published paper or a series of papers, or may be a topic of interest. At the end of the semester, a written summary of each project will be required, not to exceed 10 pages; and in addition each project will be reported with a 10-minute oral presentation to the class.

NOTE:

The course has two broad aspects: fracture mechanics, that is, the mechanical circumstances in which fracture occurs, and fracture behavior, including specific fracture phenomena like fatigue, as well as the mechanisms and microstructural processes by which they occur.

TEXT: T. L. Anderson: *Fracture Mechanics: Fundamentals and Applications* (CRC Press, 2004, 3rd ed.)

SUGGESTED REFERENCES

1) **Mechanical Behavior of Materials:**

F. A. McClintock and A. S. Argon: *Mechanical Behavior of Materials* (Addison-Wesley, 1966)

M. A. Meyers and K. K. Chawla: *Mechanical Metallurgy: Principles and Applications* (Prentice-Hall, 1984)

- R.W. Hertzberg: *Deformation and Fracture Mechanics of Engineering Materials* (Wiley, 1989, 4th ed.)

2) **Fracture Mechanics:**

- D. Broek: *Elementary Engineering Fracture Mechanics* (Sijthoff Noordhoff, 1982, 3rd ed.)
- J. F. Knott: *Fundamentals of Fracture Mechanics* (Halstead Press, 1973)

S. T. Rolfe and J. M. Barson: *Fracture and Fatigue Control in Structures* (Prentice-Hall, 1987, 2nd ed.)

H. L. Ewalds and R. J. Wanhill: *Fracture Mechanics* (Arnold, 1984)

- T. L. Anderson: *Fracture Mechanics: Fundamentals and Applications* (CRC Press, 1995, 2nd ed.)

B. R. Lawn: *Fracture of Brittle Solids* (Cambridge Univ. Press, 1993, 2nd ed.)

3) **Handbooks on *K* and *J* Solutions:**

Akram Zahoor: *Ductile Fracture Handbook* (Electric Power Research Inst., 1989)

H. Tada, P. C. Paris, and G. R. Irwin: *Stress Analysis of Cracks Handbook* (Del/Paris Publ., 1985)

4) **Fatigue:**

S. Suresh: *Fatigue of Materials* (Cambridge Univ. Press, 1998, 2nd ed.)

5) **Environmentally-Influenced Failure:**

J. C. Scully: *Fundamentals of Corrosion* (Pergamon, 1975, 2nd ed.)

6) **Mechanical Testing:**

Metals Handbook, 9th ed., vol. 8 (American Society for Metals)

Various volumes of ASTM *Special Technical Publications*, particularly STP 381, 410, 463, 536, 590, 601

7) **Failure Analysis/Fractography:**

Metals Handbook, 9th ed., vol. 12 (American Society for Metals)

8) **Continuum Mechanics/Elasticity (simple treatments):**

S. H. Crandall, N. C. Dahl and T. J. Lardner: *An Introduction to the Mechanics of Solids* (McGraw-Hill, 1978, 2nd ed.)

- Books on reserve