

Professor Lisa Pruitt: 5134 Etcheverry Hall, E-mail: lp Pruitt@berkeley.edu

Lectures: Tuesdays-Thursdays: 12:30-2 pm, 150 GSSP

Office hours: Tuesdays 2:30-3:30 pm or by appointment, 5134 Etcheverry Hall

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COURSE SYLLABUS

This course covers the fundamental structure and mechanical behavior of engineering materials. Case studies of engineering failures, structural designs, and material behaviors are presented. Emphasis will be placed on failure analysis and prevention.

I. Structure of Engineering Materials

Overview of historic failures and material failure modes

Review of engineering materials: metals, ceramics, polymers, composites

Micromechanisms of deformation in materials

Strengthening mechanisms, alloying, hardenability and heat treatments

Corrosion, degradation and environmental issues

Methods for mechanical characterization (mechanical testing methods)

Failure Mechanisms in engineering materials

Test of Understanding (I): Thursday October 4 (30%)

II. Mechanical Behavior of Engineering Materials

Elastic behavior, multiaxial loading, and complex stress-strain states

Isotropic and anisotropic behavior

Yield criteria and plastic deformation

Time-dependent behavior (viscoelasticity and creep)

Fracture Mechanics

Fatigue design: Total life (stress and strain-based approaches) vs. defect-tolerant philosophies

Failure Analysis and Prevention

Test of Understanding (II): Thursday November 15 (30%)

III. How Things Break (Team Project): Thursday December 6 (30%)

Team project: (i) Educational outreach – development of teaching kit, outreach teaching and/or instructional videos; (ii) failure analysis of component (predictive or forensic); OR (iii) review, analysis and assessment of a historic engineering failure. Projects will have deliverables. **Project will require a professionally written report and oral presentation.**

Course Grade Components: Exam I: Thursday October 4 (30%); Exam II: Thursday November 15 (30%)

Project: How things Break (30%): Thursday December 6

Class participation (10%)

Guest speakers: Dates

Dr. Farzana Ansari (Fractography methods for Failure Analysis, Exponent) September 27

Dr. Glenn Stevick (Deepwater Horizon Failure, Berkeley Engineering and Research) October 9

Dr. Louis Malito (Failure Analysis Case Studies; Exponent) October 18

Professor Rob Ritchie (Aircraft Fatigue, MSE) November 8

Dr. Christine Gregg (3-d printed structures, NASA) November 29

Supplemental Reading: L. Pruitt, Mechanics of Biomaterials, Cambridge University Press, 2011; N. Dowling, Mechanical Behavior of Materials, Mechanical Behavior of Materials, 2013; D. Hull, Introduction to Dislocations, Pergamon Press, 1975; W. Callister, Materials Science and Engineering, Wiley, 1991; S. Suresh, Fatigue of Engineering Materials, Cambridge University Press, 1998; Metals Handbook, 9th Ed., Vol. 11. Failure Analysis and Prevention (American Society for Metals), 1986.