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