University Of California, Berkeley
Department of Mechanical Engineering

ME 108 – Mechanical Behavior of Engineering Materials [4 units]

Undergraduate Required Course

Syllabus

CATALOG DESCRIPTION

This course covers elastic and plastic deformation under static and dynamic loads. Failure by yielding, fracture, fatigue, wear, and environmental factors are also examined. Topics include engineering materials, heat treatment, structure-property relationships, elastic deformation and multiaxial loading, plastic deformation and yield criteria, dislocation plasticity and strengthening mechanisms, creep, stress concentration effects, fracture, fatigue, and contact deformation.

COURSE PREREQUISITES

ME C85

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

Required text: N. E. Dowling, *Mechanical Behavior of Materials*, Prentice-Hall.
Class notes: K. Komvopoulos, *Mechanical Behavior of Engineering Materials*.
Lab notes: K. Komvopoulos, *A Guide for Mechanical Testing of Engineering Materials*.

COURSE OBJECTIVES

The central theme of this course is the mechanical behavior of engineering materials, such as metals, ceramics, polymers, and composites, subjected to different types of loading. The main objectives are to provide students with basic understanding of phase transformation by heat treating and stress-induced hardening, linear and nonlinear elastic behavior, deformation under multiaxial loading, plastic deformation and yield criteria, dislocation plasticity and strengthening mechanisms, creep, stress concentration effects, brittle versus ductile fracture, fracture mechanisms at different scales, fatigue, contact deformation, and wear.

DESIRED COURSE OUTCOMES

Understand various types of deformation and failure of engineering materials subjected to various static and dynamic loadings. Correlate microscopic and macroscopic material behaviors. Learn how to engineer the material properties to meet certain specifications. Determine the safety factor for various possible failure modes and loadings. Obtain hands-on-experience with standardized mechanical testing techniques and learn how to present/interpret the measurements in a formal report.

TOPICS COVERED

Lectures: Introduction, Stress and Strain, Complex stress/strain states. Special topics on complex stress states. Elasticity, Isotropic/Anisotropic. Viscoelasticity. Elastic-Plastic Deformation. Mechanical testing. Heat Treatment. Strain Hardening. Strain Rate and Temperature Effects on Deformation. Slip, Dislocations, Twinning, and Hardening. Ductile and Brittle Fracture. Fracture Mechanics. Creep. Fatigue. Cumulative

Fatigue Damage. Wear processes. Special topics: Residual Stresses, Ceramics, Glasses, Polymers, Composites, Mechanical Working, and Micromechanics.

Laboratories: (1) Heat Treatment, phase diagrams, metallography, and hardness, (2) Deformation due to monotonic loading, (3) Time- and rate-dependent deformation, (4) Deformation due to cyclic loading, (5) Fracture toughness, (6) Fatigue, and (7) Wear.

CLASS/LABORATORY SCHEDULE

3 hours lecture, 2 hours laboratory, and 1 hour discussion (per week).

CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT

Students learn the importance of the strength of materials in various engineering disciplines, specifically the design of large- and small-scale mechanical components. The course will also provide students with the ability to identify, formulate, and solve problems related to the behavior of engineering materials, obtain engineering and communication skills, and use methods and mechanical testing approaches for engineering practice.

RELATIONSHIP OF THE COURSE TO ABET PROGRAM OUTCOMES

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(e) an ability to identify, formulate, and solve engineering problems
(i) a recognition of the need for, and an ability to engage in life-long learning
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES

Homework assignments on a weekly basis. Laboratory assignments (approximately one assignment every 2-3 weeks requiring a written report). Midterm examination. Final examination.

PERSON(S) WHO PREPARED THIS DESCRIPTION:

Kyriakos Komvopoulos August 23, 2009.
Lab Edit by Prof. Komvopoulos: May 2016

ABBREVIATED TRANSCRIPT TITLE (19 SPACES MAXIMUM): Mech Beh Eng Mater
TIE CODE: LABS
GRADING: Letter
SEMESTER OFFERED: Fall and Spring
COURSES THAT WILL RESTRICT CREDIT: None
INSTRUCTOR: Professor Kyriakos Komvopoulos
DURATION OF COURSE: 15 weeks
EST. TOTAL NUMBER OF REQUIRED HRS OF STUDENT WORK PER WEEK: 14
IS COURSE REPEATABLE FOR CREDIT? No