

**University Of California, Berkeley**  
**Department of Mechanical Engineering**

**ME 227: Mechanical Behavior of Composite Material (3 units)**

**Graduate Course**

*Syllabus*

**CATALOG DESCRIPTION**

Response of composite materials (fiber and particulate-reinforced materials) to static, cyclic, creep and thermomechanical loading. Manufacturing processes, associated material configurations, and residual stresses. Fatigue behavior, fracture mechanics and damage development. Role of the reinforcement-matrix interface in mechanical behavior. Environmental effects. Dimensional stability, hygrothermal fatigue and residual stresses.

**EXPANDED DESCRIPTION**

Response of composite materials (fiber and particulate-reinforced materials) to static, cyclic, creep and thermomechanical loading. Manufacturing processes, associated material configurations, and residual stresses. Fatigue behavior, fracture mechanics and damage development. Role of the reinforcement-matrix interface in mechanical behavior. Environmental effects. Dimensional stability, hygrothermal fatigue and residual stresses. Application to polymer, metal, ceramic, and carbon matrix composites with examples derived from industry.

**COURSE PREREQUISITES**

Graduate standing or consent of the instructor.

**TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL**

Notes

**COURSE OBJECTIVES**

The primary objective is to provide the student with a basic understanding of how high-performance composite laminates and structures perform when subjected to static, cyclic, time-dependent, and hygrothermal loading. This information will provide the student with guidelines for the design of robust composite structures and to be able to specify appropriate manufacturing processes.

**DESIRED COURSE OUTCOMES**

The student should be able to design composite structural elements (struts, shafts, beams, sandwich panels, pressure vessels, and dimensionally stable precision structures) for various practical and useful applications, while developing an insight into the response of anisotropic materials to thermomechanical loading.

## TOPICS COVERED

Week	Topic
1	Introduction; nomenclature, definitions Fiber and matrix materials
2	Generalized Hooke's law Analysis of a lamina
3	Laminated plate theory Orthotropic laminates
4	Strength theories Examples
5	Thin-walled approximations Design of laminates
6	Sandwich panels Applications
7	Damage in composites Fracture and fracture mechanics
8	Delamination fracture mechanics Fatigue of composite materials
9	Fatigue of composite materials Thermoelastic analysis
10	Thermal stress, dimensional stability Creep and stress relaxation
11	Manufacturing processes Laminate processing
12	Residual stresses Randomly oriented short fiber composites
13	Test methods Metal matrix and carbon/carbon composites
14	Sustainable composites (bio-based and/or recyclable materials) Nanocomposites
15	Review

## CLASS/LABORATORY SCHEDULE

Three hours of lecture per week.

## ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES

A letter grade will be assigned to the student based on his/her performance in assigned homework (20%), two midterm examinations (60%), and an assigned term project (20%).

## PERSON(S) WHO PREPARED THIS DESCRIPTION

Professor Hari Dharan, August 9, 2012

**ABBREVIATED TRANSCRIPT TITLE (19 SPACES MAXIMUM):** MEC BEHAV COMP MAT  
**TIE CODE:** LECT  
**GRADING:** Letter  
**SEMESTER OFFERED:** Fall and Spring  
**COURSES THAT WILL RESTRICT CREDIT:** None  
**INSTRUCTORS:** Dharan  
**DURATION OF COURSE:** 14 Weeks  
**EST. TOTAL NUMBER OF REQUIRED HRS OF STUDENT WORK PER WEEK:** 9  
**IS COURSE REPEATABLE FOR CREDIT?** No  
**CROSSLIST:** None