University Of California, Berkeley
Department of Mechanical Engineering

ME 127: Composite Materials--Analysis, Design, Manufacture (3 units)

Elective Course

Syllabus

CATALOG DESCRIPTION

Properties and microstructure of high-strength fiber materials (glass, carbon, polymer, ceramic fibers) and matrix materials (polymer, metal, ceramic, and carbon matrices). Specific strength and stiffness of high-performance composites. Rule of mixtures. Stress, strain transformations. Elastic properties of a single orthotropic ply. Laminated plate theory. Failure criteria. Design of composite structures and components. Manufacturing processes.

COURSE PREREQUISITES

Civil Engineering 130 or equivalent course in mechanics of materials; Engineering 36 and 45.

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

Prerequisite knowledge required in the following areas: freshman courses in engineering mechanics and materials science, and a first course in strength of materials. A reader comprising of selections from the following textbooks is required material for this course:
1. Introduction to composite materials, by Hull and Clyne
2. Mechanics of composite materials, by Robert Jones
3. Composite materials by P. K. Mallick
4. ASM composite materials handbook

COURSE OBJECTIVES

The course objectives are to train students to be able to design composite structures, select composite materials, conduct stress analyses of selected practical applications using laminated plate theories and appropriate strength criteria, and be familiar with the properties and response of composite structures subjected to mechanical loading under static and cyclic conditions.

DESIRED COURSE OUTCOMES

Students completing the course will have the facility for designing robust composite structures subjected to combined loading, including driveshafts, pressure vessels, sandwich panels, and leaf springs. The students will also be able to assess the effects of long-term loading, including damage generation, delamination fracture and fatigue failure.

TOPICS COVERED

1. Review of mechanics of materials
2. Fibers - types, properties and manufacture
3. Matrix materials

TOPICS COVERED (Cont.)

4. Generalized Hooke's law
5. Estimates of moduli
6. Analysis of a lamina
7. Laminated plate theory
8. Orthotropic laminates
9. Thin-walled approximations
10. Strength theories
11. Design of laminates
12. Design of selected applications
13. Manufacturing processes
14. Test methods
15. Sandwich panels - strength and design
16. Joints and inserts
17. Damage in composites
18. Fatigue of composite materials
19. Designing against fatigue and fracture
20. Metal and ceramic matrix composites
21. Case studies and applications

CLASS/LABORATORY SCHEDULE

Three hours of lecture per week.

CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT

A project comprising of the design of a composite component is assigned. The project is based on input from industry involving problems arising from practical applications of composite materials in industrial structural applications, such as, for example, the substitution of composites for metals for mass savings and improved performance.

RELATIONSHIP OF THE COURSE TO ABET PROGRAM OUTCOMES

These are that our graduates have: An ability to apply knowledge of mathematics, science, and engineering; an ability to design a system, component, or process to meet desired needs; an ability to identify, formulate, and solve engineering problems; an understanding of professional and ethical responsibility; a recognition of the need for, and an ability to engage in life-long learning; an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES

Weekly homework assignments, two in-class examinations and a detailed design project report provide an assessment of progress toward the course objectives.

PERSON(S) WHO PREPARED THIS DESCRIPTION: Hari Dharan Feb. 26, 2006