

# AE 4791 - Mechanical Behavior of Composites

Hours: 3-0-3

## CATALOG DESCRIPTION (25 words or fewer):

Stress-strain behavior of composites, properties of matrix and reinforcing materials, mechanics of fiber-reinforced composites, lamina and laminate analysis, and mechanical performance.

## PREREQUISITES:

COE3001 Mechanics of Deformable Bodies

**COURSE OBJECTIVES:** Provide students with a basic understanding of the composition and uses of composite materials, their structural and mechanical properties, and the capability to perform basic analysis of the mechanical response of composite materials.

## LEARNING OUTCOMES:

- 1) Students will develop an understanding of what constitutes a composite material:
  - 1.1) a basic understanding of what a composite material consists of, how it behaves, suitable applications, and limitations;
  - 1.2) an understanding of how the structure and mechanical properties of the constituent materials affect the mechanical properties of the composite.
- 2) Students will gain a working knowledge on mechanical behavior of composite materials, mainly on fiber reinforced polymers. Students will demonstrate:
  - 2.1) the ability to apply basic principles of mechanics to composite materials;
  - 2.2) understanding of how to predict the mechanical response of a composite material under hydrothermal and mechanical loadings;
  - 2.3) the ability to select raw materials for a lamina, chose the proper stacking sequence of laminas, and design a laminated composite structure using software to best suit specific applications;
  - 2.4) the ability to find information, summarize, comment, and critique studies on a specific topic related to mechanics of composites and the ability to write technical reports.

## TOPICAL OUTLINE:

- I. Introduction to composites including advantages, disadvantages, and applications
- II. Materials: Fibers and fillers, surface treatment of fibers, fiber content, density, voids
- III. Materials: Polymer matrix, metal matrix, and ceramic matrix
- IV. Mechanics of unidirectional lamina (continuous or discontinuous fibers), including longitudinal and transverse tensile modulus, compressive strength and impact
- V. Micromechanics
- VI. Characteristics of a fiber-reinforced lamina
- VII. Engineering constants for orthotropic materials, plane stress
- VIII. Invariant properties, strengths of an orthotropic lamina
- IX. Laminated structure, interlaminar stresses, macromechanical behavior of a laminate
- X. Classical lamination theory
- XI. Performance: Static, tension, compression, shear, flexure
- XII. Fatigue
- XIII. Impact and other properties
- XIV. Joining: Pin bearing, adhesive bonding
- XV. Design for long term properties
- XVI. Conception and design of laminated composite structures