

ME 4791 Mechanical Behavior of Composites (Elective)

Catalog Description: ME 4791 Mechanical Behavior of Composites (3-0-3)
Prerequisites: COE 3001 Mechanics of Deformable Bodies
Crosslisted with AE, CEE, CHBE, MSE, and PTFE.
Stress-strain behavior of composites, properties of matrix and reinforcing materials, mechanics of fiber-reinforced composites, lamina and laminate analysis, and mechanical performance.

Textbook: P. K. Mallick, *Fiber-Reinforced Composites Materials, Manufacturing and Design*, CRC Press, 3rd Edition, 2008.
Robert Jones, *Mechanics of Composite Materials*, CRC Press, 2nd Edition, 1998.

Topics Covered:

1. Introduction to composites including advantages, disadvantages, and applications.
2. Materials: Fibers and fillers, surface treatment of fibers, fiber content, density, voids.
3. Materials: Polymer matrix, metal matrix, and ceramic matrix.
4. Mechanics of unidirectional lamina (continuous or discontinuous fibers), including longitudinal and transverse tensile modulus, compressive strength and impact.
5. Micromechanics.
6. Characteristics of a fiber-reinforced lamina.
7. Engineering constants for orthotropic materials, plane stress.
8. Invariant properties, strengths of an orthotropic lamina.
9. Laminated structure, interlaminar stresses, macromechanical behavior of a laminate.
10. Classical lamination theory.
11. Performance: Static, tension, compression, shear, flexure.
12. Fatigue.
13. Impact and other properties.
14. Joining: Pin bearing, adhesive bonding.
15. Design for long term properties.
16. Conception and design of laminated composite structures.

Course Outcomes:

Outcome 1: The student will develop understanding of what a composite material is.

- 1.1 The student will demonstrate a basic understanding of what a composite material consists of, how it behaves, suitable applications, and limitations.
- 1.2 The student will demonstrate an understanding of how the structure and mechanical properties of the constituent materials affect the mechanical properties of the composite.

Outcome 2: The student will gain a working knowledge on mechanical behavior of composite materials, mainly on fiber reinforced polymers.

- 2.1 The student will demonstrate the ability to apply basic principles of mechanics.
- 2.2 The student will demonstrate understanding of how to predict the mechanical response of a composite material under hydrothermal and mechanical loadings.

- 2.3 The student will demonstrate an 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 student will demonstrate 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.

Correlation between Course Outcomes and Student Outcomes:

ME 4791											
	Mechanical Engineering Student Outcomes										
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Outcome 1.1	X										
Course Outcome 1.2	X				X						
Course Outcome 2.1	X										
Course Outcome 2.2	X				X						
Course Outcome 2.3			X	X			X				X
Course Outcome 2.4							X		X	X	

GWW School of Mechanical Engineering Student 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
- (d) an ability to function on multidisciplinary teams
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (i) a recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Prepared by: Kyriaki Kalaitzidou