MSE 4791: Mechanical Behavior of Composites (required)

Catalog Description: (3-0-3)

Prerequisites: MSE 3005 Mech Behavior-Materials
Stress-strain behavior of composites, properties of matric and reinforcing materials, mechanics of fiber-reinforced composites, lamina and laminate analysis, and mechanical performance.

Text books: Fiber-Reinforced Composites Materials, Manufacturing and Design, 3nd Edition by P.K. Mallick.
Mechanics of Composite Materials, 2nd Edition by Robert Jones.

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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, including longitudinal and transverse tensile modulus, compressive strength and impact, of unidirectional lamina (continuous or discontinuous fibers)
5. Micromechanics
6. Characteristics of a fiber-reinforced lamina
7. Engineering constants for orthotropic materials, Plane Stress
8. Invariant properties, strengths of an orthotropic mamina
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

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.

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 hygrothermal 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 a 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:

Course Outcomes	**Student 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	
Course Outcome 2.2	X				X						
Entire Course	**3**	**0**	**1**	**1**	**2**	**0**	**2**	**0**	**1**	**1**	**1**
0 = None or insignificant; 1 = Some; 2 = Moderate; 3 = Strong											

School of Materials Science and 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.