SEMESTER 7

COMPOSITE STRUCTURE DESIGN

Course Code	**OEAOT723**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Understand the concepts of composite materials
2. Understand the various manufacturing processes, quality control methods, and testing procedures for composite materials and structures.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	FUNDAMENTALS OF COMPOSITE MATERIALS Introduction to Composites: Definition, classification (polymer matrix, metal matrix, ceramic matrix composites). Constituent Materials: Overview of fibers (glass, carbon, aramid) and matrices (polymer, metal, ceramic). Properties of Composites: Mechanical properties, advantages over traditional materials and limitations.Manufacturing Processes: Overview of fabrication methods (hand lay-up, resin transfer molding, filament winding).	**9**
2	MECHANICS OF COMPOSITE MATERIALS Basic Mechanics: Stress-strain relationships, Hooke's law for anisotropic materials. Micromechanics and Macromechanics: Analysis of a single layer (micromechanics), behaviour of laminates (Macromechanics). Failure Theories: Introduction to common failure criteria (Tsai-Hill, Tsai-Wu), modes of failure in composites. Environmental Effects: Influence of temperature, moisture, and other environmental factors on composite performance.	**9**
3	DESIGN OF COMPOSITE STRUCTURES Design Principles: Considerations for composite structure design, weight optimization, load distribution. Lamination Theory: Basics of Classical	**9**

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	Laminate Theory (CLT), stress-strain analysis in composite laminates. Design Criteria: Design against strength and stiffness, failure criteria application, and safety factors. Finite Element Analysis (FEA): Introduction to FEA in composite design, modeling techniques, and analysis.	
4	FABRICATION AND TESTING OF COMPOSITE STRUCTURES Fabrication Techniques: Detailed exploration of composite manufacturing processes. Quality Control: Non-destructive testing methods, inspection techniques for composite structures. Testing Methods: Mechanical testing procedures (tensile, compression, shear tests) for composite materials. Design Verification: Methods for verifying design through testing, ensuring structural integrity and performance.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

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Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks • (8x3 =24 marks)	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the basic concepts of composite materials.	**K2**
CO2	Describe the mechanical properties of composite materials.	**K2**
CO3	Understand the stress-strain relationships in composites and the fundamentals of failure theories.	**K2**
CO4	Discuss the various fabrication techniques and quality control methods used in composite material production.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

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Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Composite Materials: Science and Engineering	Chawla, K. K.	Springer India	01st January, 2015
2	Engineering Mechanics of Composite Materials	Daniel I. M. and O. Ishai	Oxford University Press	2006
3	Design and Analysis of Composite structures	Christos Kassapoglou	Wiley	2nd edition, 10th May 2013

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fiber-Reinforced Composites: Materials, Manufacturing and Design	Mallick P. K	CRC Press	2007