SEMESTER 8

COMPOSITE MATERIALS

Course Code	**PEAOT865**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	5/3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Nil	**Course Type**	Theory

Course Objectives:

1. To understand the characteristics, classifications, and applications of composite materials.
2. To understand the manufacturing processes and techniques used in producing composite materials.
3. To understand the various methods of testing, characterization, and design considerations essential for composite structures.

SYLLABUS

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Module No.	Syllabus Description	Contact Hours
1	**INTRODUCTION TO COMPOSITE MATERIALS** Characteristics and Classifications of Composites: Overview of composite materials, advantages, and limitations. Classification of composites: fibre-reinforced, particle-reinforced, and structural composites. Study of fibres: glass, carbon, aramid, and natural fibres. Particulate composites and flake composites. Basic Concepts in Composite Structures: Matrix materials: thermosetting and thermoplastic resins. Interface and interphase in composites. Surface treatments and their effects on composite performance.	9
2	**MANUFACTURING OF COMPOSITE MATERIALS** Production of Various Fibers: Methods of fiber production: glass, carbon, and aramid fibers. Processing and properties of matrix materials. Surface treatment techniques to enhance fiber-matrix bonding. Fabrication Techniques: Fabrication of thermosetting resin matrix composites. Fabrication of thermoplastic resin matrix composites. Manufacturing of short	9

	fiber composites, metal matrix composites (MMC), and ceramic matrix composites (CMC).	
3	**TESTING AND CHARACTERIZATION OF COMPOSITES** Mechanical Testing of Composites: Uniaxial tension, compression, and shear tests. Determination of inter laminar fracture toughness. Non-Destructive Evaluation (NDE) Techniques: Ultrasonic testing, acoustic emission, X-radiography. Damage identification and health monitoring in composite structures. Mechanical Behaviour of Composites: Longitudinal and transverse strength and stiffness. Failure modes in composite structures. Stress-strain variation in laminated composites.	**9**
4	**DESIGN AND ANALYSIS OF COMPOSITE STRUCTURES** Laminated Composite Structures: Analysis of symmetric laminates, cross-ply laminates, angle-ply laminates, and quasi-isotropic laminates. Design considerations for composite structures in aerospace applications. Repair and maintenance of composites. Advancements in Composite Materials: Carbon-carbon composites, Bucky paper. Nano-composites and smart composites. Application of composites in aerospace, automotive, defence, and industrial sectors. Future trends in composite materials and their impact on design.	**9**

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	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 =24marks)**	• 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 sub divisions. **(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	Understand the fundamental characteristics, classifications, and applications of composite materials.	**K2**
CO2	Understand the manufacturing processes and techniques used for various composite materials.	**K2**
CO3	Understand the mechanical behaviour, testing, and characterization methods for composite structures.	**K2**
CO4	Understanding the principles of design and analysis to composite structures in various engineering applications, particularly in aerospace.	**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	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO2	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO3	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO4	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**

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	2015
2.	Engineering Mechanics of Composite Materials	Daniel I. M. and O. Ishai	Oxford University Press	2006

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

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