MECHANICS OF COMPOSITE MATERIALS

Course Code	**22MEMD1T6B**	**Year**	I	**Semester**	I
Course Category	Programme Elective	**Branch**	ME	**Course Type**	Theory
Credits	4	**L-T-P**	4-0-0	**Prerequisites**	Material Science and Metallurgy
Continuous Internal Evaluation:	40	**Semester End Evaluation:**	60	**Total Marks:**	100

Course outcomes: At the end of the course, the student will be able to:

CO	**Statement**	**BTL**	**Units**
CO1	Understand the types, manufacturing processes, and applications of composite materials	L2	1
CO2	Analyze problems on macro mechanical behavior of lamina	L4	2
CO3	Analyze problems on micromechanical behavior of lamina	L4	3
CO4	Apply failure criteria and critically evaluate their behavior	L3	4

Contribution of Course outcomes towards achievement of programme outcomes & Strength of correlations (High:3, Medium: 2, Low:1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	1	1	2					1			1	3	1
CO 2	3	2	1	2					1			1	3	1
CO 3	3	2	1	2					1			1	3	1
CO 4	3	2	1	2					1			1	3	1

Syllabus		
Unit	**Contents**	**Mapped CO**
1	BASIC CONCEPTS AND CHARACTERISTICS: Geometric and Physical definitions, natural and man-made composites, applications, types and classification of composites. Reinforcements: Fibers – Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibers. Particulate composites,	**CO1**

	Thermoplastics, Thermosetts, Metal matrix and ceramic matrix composites. Manufacturing Methods for Composite Materials, Autoclave Molding, Filament Winding, Resin Transfer Molding.	
2	ELASTIC BEHAVIOR OF UNIDIRECTIONAL LAMINA: Stress-Strain Relations-General Anisotropic Material, Specially Orthotropic Material, Transversely Isotropic Material, Orthotropic Material Under Plane Stress, Isotropic Material, Relations Between Mathematical and Engineering Constants, Stress-Strain Relations for a Thin Lamina (Two-Dimensional), Transformation of Stress and Strain (Two-Dimensional), Transformation of Elastic Parameters (Two-Dimensional), Transformation of Stress-Strain, Relations in Terms of Engineering Constants (Two-Dimensional), Transformation Relations for Engineering Constants (Two-Dimensional), Micromechanical predictions of elastic constants STRENGTH OF UNIDIRCETIONAL LAMINA Longitudinal Tension-Failure Mechanisms and Strength, Longitudinal Compression, Transverse Tension, Transverse Compression, In-Plane Shear, Out-of-Plane Loading, General Micromechanics Approach. Macro-mechanical strength parameters, macromechanical failure theories, maximum stress theory, maximum strain theory, Tsai- hill, TsaiWu theory.	**CO2**
3	ELASTIC BEHAVIOR OF MULTIDIRECTIONAL LAMINATES: Laminates, Basic assumptions, Strain-Displacement Relations, Stress-Strain Relations of a Layer Within a Laminate, Force and Moment Resultants, General Load-Deformation Relations: Laminate Stiffness, Inversion of Load-Deformation Relations: Laminate Compliances. Symmetric Laminates: Symmetric Laminates with Isotropic Layers, Symmetric Laminates with Specially Orthotropic Layers (Symmetric Cross-ply Symmetric Angle-Ply Laminates Anti symmetric Laminates, Anti symmetric Cross-ply Laminates, Anti symmetric Angle-Ply Laminates, Balanced Laminates,	**CO3**
4	FAILURES AND LIFE PREDICTIONS: Possible modes of failure, stress analysis of first ply failure, ultimate laminate failure or analysis of last ply failure: Total- ply failure method and partial-ply failure method, inter laminar stress. FAILURE MODES: Matrix cracking, Delamination, Tensile fiber failure, Micro buckling, global instability, Common Features of Life Prediction Methodology, Damage Characterization.	**CO4**

Learning Resources
Text Book(s): 1. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994. 2. Mechanics of Composite Materials by R. M. Jones, Mc Graw Hill , New York, 1975. 3. Mechanics of composite materials by Madhujit Mukhopadhyay, Universities press.
References:

1. Analysis and performance of fibre Composites by B. D. Agarwal and L. J. Broutman, Wiley Inter-science, New York, 1980.

2. Mechanics of Composite Materials (2nd Edition) by Autar K. Kaw, Publisher: CRC Taylor and Francis