



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Master of Engineering**

**Subject Code: 3730806**

**Semester – III**

**Subject Name: Mechanics and Manufacturing of Composites**

**Type of course: Program Elective V**

**Prerequisite: Nil**

**Rationale:**

The course intends to introduce students to fundamentals of composite materials' mechanics and manufacturing techniques.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
3	0	0	3	70	30	0	0	100

**Content:**

Sr. No.		Total Hrs
1	<b>Basic concepts and characteristics:</b> Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites.	04
2	<b>Constituents:</b> Reinforcements: Fibers- Glass, Silica, Kevlar, carbon, graphite, boron, silicon carbide, and boron carbide fibers. Matrix Materials: Particulate composites, Polymer composites, Thermosets, Thermoplastics, Metal matrix and ceramic composites.	08
3	<b>Macromechanics Behavior Lamina:</b> Stress-strain behavior for anisotropic materials; stiffness, compliance and engineering constants for orthotropic materials; Stress-strain behavior for plane stress in an orthotropic material; Stress-strain behavior for lamina of arbitrary orientation; strength of an orthotropic lamina; Biaxial strength criteria for an orthotropic materials (Maximum stress, Maximum strain, Tsai- Hill, Hoffman, Tsai-Wu).	08
4	<b>Micromechanical Behavior Lamina:</b> Determination of constants, Elasticity approach to stiffness, particulate composite, Fiber-reinforced composites, tensile and compressive strength in fiber direction, transverse stiffness and strength, prediction of shear strength, Failure modes.	06
5	<b>Short-Fiber Composites:</b> Theories of Stress Transfer, Modulus and Strength of Short-Fiber Composites, Ribbon-Reinforced Composites.	06



# GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code: 3730806

6	<b>Analysis of Laminates:</b> Laminate Stress-Strains behavior, Variation of Stresses in a Laminate, Resultant Forces and Moments: Synthesis of Stiffness Matrix, Laminate Description System, Construction and Properties of Special Laminates, Determination of Laminae Stresses and Strains, Analysis of Laminates after Initial Failure, Hygrothermal Stresses in Laminates, Bending and Buckling of laminated plates Special Cases: Symmetric, Antisymmetric and Unsymmetric laminates. Design of laminates.	06
7	<b>Performance of Composites:</b> Static Mechanical Properties (Tensile, Compressive, Flexural, In-plane shear, Interlaminar shear strength), Fatigue performance, Impact properties, Environmental effects, Creep and Fracture behaviour.	03
8	<b>Manufacturing:</b> Degree of Cure, Viscosity, Resin Flow, Consolidation, Gel-Time Test, Shrinkage, Voids; moulding methods, filament winding, pultrusion, Quality inspection. Joining: Pin bearing, adhesive bonding.	04

**Suggested Specification table with Marks (Theory): (For BE only)**

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	20	20	20	10	10

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

### Reference Books:

1. Agarwal, B.D. and Broutman, L. J., Analysis and Performance of Fiber Composites, Wiley India.
2. Mallick P. K., Fiber-Reinforced Composites Materials, Manufacturing and Design, CRC Press.
3. Jones R M, Mechanics of Composite Materials, CRC Press.
4. Daniel, I. M. and Ishai, O., Engineering Mechanics of Composite Materials, Oxford University Press

### Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Able to analyse FR composites materials of various constituents.	30
CO-2	Understand fundamentals of manufacturing of composite material.	40
CO-3	Design components for various applications using composites	30



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Master of Engineering**  
**Subject Code: 3730806**

## **List of Open Source Software/learning website:**

1. The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester.
2. NPTEL