GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICS OF COMPOSITE MATERIALS
SUBJECT CODE: 3710910

Type of course: Post Graduate

Prerequisite: Zeal to learn the Subject

Rationale: The course intents to introduce students to fundamentals of composite materials' mechanics and manufacturing techniques.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Basic concepts and characteristics:** Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites.	2	4%
2	**Constituents:** Reinforcements:Fibres- Glass, Silica, Kevlar, carbon, graphite, boron, silicon carbide, and boron carbide fibres. Matrix Materials: Particulate composites, Polymer composites,Thermosetts, Thermoplastics, Metal matrix and ceramic composites.	2	5%
3	**Macromechanics Behaviour Lamina:** Stress-strain behaviour for anisotropic materials;stiffness, compliance and engineering constants for orthotropic materials; Stress-strain behaviour for plane stress in an orthotropic material; Stress-strain behaviour 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).	9	21%
4	**Micromechanical Behaviour Lamina:** Determination of constants, Elasticity approach to stiffness, particulate composite, Fibre-reinforced composites, tensile and compressive strength in fibre direction, transverse stiffness and strength, prediction of shear strength, Failure modes.	7	16%
5	**Short-Fibre Composites:** Theories of Stress Transfer, Modulus and Strength of Short-Fiber Composites, Ribbon-Reinforced Composites.	4	10%
6	**Analysis of Laminates:** Laminate Stress-Strains behaviour, 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	8	20%

	Initial Failure, Hygrothermal Stresses in Laminates, Bending and Buckling of laminated plates Special Cases: Symmetric, Antisymmetric and Unsymmetric laminates. Design of laminates.		
7	**Performance of Composites:** Static Mechanical Properties (Tensile, Compressive, Flexural, In-plane shear, Interlaminar shear strength), Fatigue performance, Impact properties, Environmental effects, Creep and Fracture behaviour.	**5**	**12%**
8	**Manufacturing:** Degree of Cure, Viscosity, Resin Flow, Consolidation, Gel-Time Test, Shrinkage, Voids; moulding methods, filament winding, pultrusion, Quality inspection.Joining: Pin bearing, adhesive bonding.	**5**	**12%**

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 Outcome:
After learning the course the students should be able to:

1. Analyse FR composites materials of various constituents.
2. Understand fundamentals of manufacturing of composite material.
3. Design components for various applications using composites.

List of Experiments:

1. Determine Tensile, Compressive, Shear, Flexural and hydrothermal properties of lamina.
2. Determine Inter laminar shear strength of composites.
3. Determine fracture strength of composites.
4. Determine Flexural Properties of Sandwich Composite Plate.
5. Evaluate manufacturing process suitability for composite material for a given application.

Major Equipment:

1. Test rig for determining mechanical properties of composites

List of Open Source Software/learning website:

1. http://www.ae.iitkgp.ernet.in/ebooks/