Subject Code: 01CA0304

Subject Name: Mechanics and Manufacturing of Composites

M.Tech. II Year – (Sem-3) CAD/CAM

Type of course: Program Elective

Prerequisite: Solid Mechanics, Manufacturing Process

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

Teaching and Examination Scheme:

Teaching Scheme (Hours)			Credits	Evaluation Scheme					Total Marks
				Theory Marks			Practical Marks		
Theory	Tutorial	Practical		ESE (E)	IA	CSE	Viva (V)	Term Work (TW)	
3	---	2	4	50	30	20	25	25	150

Course outcome

Students will be able to

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

Sr. No.	Content	Total Hrs	% Weight
1	Basic concepts and characteristics: Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites.	**2**	**5%**
2	Constituents: Reinforcements: Fibers- Glass, Silica, Kevlar, carbon, graphite, boron, silicon carbide, and boron carbide fibers. Matrix Materials: Particulate composites, Polymer composites, Thermostats, Thermoplastics, Metal matrix and ceramic composites.	**2**	**5%**
3	Micromechanics Behavior Lamina: 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).	**9**	**20%**

4	Micromechanical Behavior Lamina: 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.	**7**	**15%**
5	Short-Fiber Composites: Theories of Stress Transfer, Modulus and Strength of Short-Fiber Composites, Ribbon-Reinforced Composites.	**4**	**10%**
6	Analysis of Laminates: 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 Laminate Stresses and Strains, Analysis of Laminates after Initial Failure, Hydrothermal Stresses in Laminates, Bending and Buckling of laminated plates Special Cases: Symmetric, Antisymmetric and Unsymmetrical laminates. Design of laminates.	**9**	**20%**
7	**Performance of Composites:** Static Mechanical Properties (Tensile, Compressive, Flexural, In-plane shear, Inter laminar shear strength), Fatigue performance, Impact properties, Environmental effects, Creep and Fracture behavior.	**5**	**10%**
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.	**6**	**15%**

Distribution of Theory Marks

R Level	U Level	A Level	N Level	E Level	C Level
10	10	20	15	25	20

Legends: R: Remembrance**; U:** Understanding**; A:** Application, **N:** Analyze**, and E:** Evaluate

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

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.