GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3160112
Semester –VI
Subject Name: Composite Materials

Type of course: Professional elective course

Prerequisite: Mechanics of Solids

Rationale: Composite materials are extensively used in aviation industry for the manufacturing of various parts of an aircraft. Composites are known to have high strength to weight ratio and they therefore become the material of choice for aircraft manufacturing. There are several other benefits of using composite materials. This subject offers the knowledge and understanding of the engineering behavior of composite materials, preliminary design concepts and their appropriate use.

Teaching and Examination Scheme:

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

Content:

Sr. No.	Content	Total Hrs	Weigh tage
1	**Basics of Composite Materials:** Definitions, Composite material, Fiber, Matrix. Types of fibers and Raw Fiber Properties, Types of Matrix, Prepegs, Fillers and other Additives, Lamina and Laminate, Micromechanics and Micromechanics, Properties of Typical Composite materials, Application of Composite materials, Combinations of Composite materials, Mechanical Behavior of Composite Materials	**06**	**15%**
2	**Aerospace Materials:** Introduction, Physical Metallurgy, Aluminum Alloys, Introduction to FRP, Glass and Carbon Composite, Fibers and Resins, Characteristics and Application: Super Alloys, Emerging Trends in Aerospace Materials, Applications of Composite materials in Aerospace Industry	**08**	**20%**
3	**Micromechanical Analysis of Composite Strength and Stiffness:** Properties of typical composite materials. Volume and Weight Fractions. Longitudinal Strength and Stiffness. Transverse Modulus. In-plane shears Modulus. Poisson's ratio	**09**	**20%**
4	**Elastic Properties of the Unidirectional Lamina:** Stress-strain relationships: Monoclinic material, Specially orthotropic material, Transversely isotropic material, isotropic material Engineering Constants. Stress strain relations of a Thin Lamina.	**10**	**20%**

5	**Analysis of Laminated Composites:** Laminates, Basic Assumptions, Strain-Displacement Relationship, Stress-Strain Relationships, Equilibrium Equations, Laminate Stiffness, Determination of Lamina Stresses and Strains, Types of Laminate Configuration: Symmetric Laminates, Balanced Laminates, Anti- Symmetric Laminates, Quasi-Isotropic Laminate, Un-symmetric Laminates with isotropic layers	**12**	**25%**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
35%	**35%**	**10%**	**10%**	**10%**	**0**

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. Madhujit Mukhopadhyay, "Mechanics of Composite Materials and Structures" University press.
2. R M Jones , "Mechanics of Composite Materials" CRC press.
3. "Aerospace Materials and Material Technologies " Volume 1,Editors: Prasad, N. Eswara, Wanhill, Russell
4. Clyne, T. W. and Withers, P. J., "Introduction to Metal Matrix Composites", Cambridge University Press, 1993.

Course Outcomes:

Upon completion of this course students should be able:

Sr. No.	**CO statement**	**Marks % weightage**
CO1	To define basic terminologies, concepts and behaviour of composite materials and its uses in aerospace industry.	35%
CO2	To explain concepts of micromechanics and lamination theory.	35%
CO3	To identify use of different material to design composites.	10%
CO4	To analyse the elastic properties and simulate the mechanical performance of composite laminates.	10%
CO5	To determine stresses and strains relation in composites materials different Laminates	10%

List of Experiments:

1. To investigate properties of different composite material.
2. To study isotropic, anisotropic and orthotropic composite material.
3. To compare symmetric and unsymmetrical laminates.
4. To create sandwich composite plate with Honeycomb core.

5. To study stresses around discontinuities in composite plate.
6. To evaluate stiffness matrix.
7. Mathematical modelling: strain displacement relationship, stress-strain relationship
8. Formulation of composite fracture analysis.
9. Analysis of Composite materials using ANSYS software.

List of Open Source Software/learning website:
https://nptel.ac.in/