



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3173411

Semester – VII

Subject Name: Composite Technology

Type of course: Professional Elective

Prerequisite: Nil

Rationale:

Composites are used in many industries today to enable high-performance products at economic advantage. These industries range from space to sports and include manufactured products for aircraft, transportation, energy, construction, sports, marine, and medical use. This course provides an introduction to the fundamentals of composite materials for high performance structures. The content of this course are designed to address critical areas of composite technologies that focus on materials, manufacturing, mechanics, design, inspection, and repair. In this course students will learn how composite materials achieve properties of strength, weight ratios and durability that surpass aluminum in aircraft design.

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) | | |
| 03 | 0 | 0 | 3 | 70 | 30 | 0 | 0 | 100 |

Content:

| Sr. No. | Content | Total Hrs |
|---------|---|--------------|
| 1 | Introduction of Composite: Classifications of Engineering Materials, Concept of composite materials, Matrix materials, Functions of a Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermosets and Thermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc. Types of Reinforcements/Fibers: Role and Selection or reinforcement materials, Types of fibres, Glass fibers, Carbon fibers, Aramid fibers, Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc., Mechanical properties of fibres. Material properties that can be improved by forming a composite material and its engineering potential. | 12 |
| | Various types of composites: Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC); Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites, Nanocomposites. Stitched composites. 3D composites. Comparison with Metals, Advantages & limitations of | 10 |



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| | Composites. | |
| 2 | Manufacturing/Fabrication methods: Processing of Composite Materials: Overall considerations, Autoclave curing, Other Manufacturing Processes like filament winding, compression molding, resin-transplant method, pltrusion, pre-peg layer, Fiber-only performs, Combined Fiber-Matrix performs, Manufacturing Techniques: Tooling and Specialty materials, Release agents, Peel plies, release films and fabrics, Bleeder and breather plies, bagging films. | 08 |
| 3 | Properties of Composite: Stiffness and Strength: Geometrical aspects – volume and weight fraction. Unidirectional continuous fibre, discontinuous fibers, Short fiber systems, woven reinforcements – Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear. | 08 |
| 4 | Testing of Composites: Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc. | 07 |
| | Total Hour | 45 |

Suggested Specification table with Marks (Theory):

| Distribution of Theory Marks | | | | | |
|------------------------------|---------|---------|---------|---------|---------|
| R Level | U Level | A Level | N Level | E Level | C Level |
| 20 | 30 | 30 | 20 | 0 | 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) Mechanical Metallurgy by G. Dieter Mc-Graw Hill
- 2) Materials characterization, Vol. 10, ASM hand book
- 3) Engineering Materials: Polymers, Ceramics and Composites A.K Bhargava Prentice Hall India
- 4) Thermal Analysis of Materials by R.F. Speyer, Marcel Decker
- 5) Mechanics of Composite Materials, R. M. Jones, CRC Press
- 6) Mechanics of Composite Materials, M. Mukhopadhyay, University Press
- 7) IEngineering Mechanics of Composite . S. Daniel and Ori Ishai, Material, Oxford University Press
- 8) Fibrous Materials, K K Chawla, Cambridge University Press



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Course Outcomes:

| Sr. No. | CO statement | Marks % weightage |
|---------|---|-------------------|
| CO-1 | Familiarization with the basic expressions and methods used in the mechanics of composite structures. | 25 |
| CO-2 | Demonstrate types and methods of manufacturing for various application. | 35 |
| CO-3 | Describe Mechanical Properties for various application of composite materials. | 25 |
| CO-4 | Describe failure criteria and critically evaluate the results. | 15 |

List of Experiments:

List of experiments should include following topics:

- 1) Study and application of composite materials
- 2) Composite materials types and manufacturing methods
- 3) Demonstration of properties of composite materials
- 4) Testing of composite materials
- 5) Advance technology of composite materials.