III Year II Semester	L	T	P	C
17ME632	3	1	0	3

Professional Elective-II

COMPOSITES

Course Objectives:

The objective for this course is to understand the mechanics of different materials. This understanding will include concepts such as anisotropic material behavior, constituent properties and manufacturing processes of different composites. Suitability of smart and nano materials for engineering applications.

Unit – I:

Introduction:

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.

Unit – II:

Types of Reinforcements/Fibers:

Role and Selection of reinforcement materials, Types offibres, 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.

Unit – III:

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.

Unit – IV:

Fabrication methods:

Processing of Composite Materials: Overall considerations, Autoclave curing, Other Manufacturing Processes like filament welding, compression moulding, resin transplant method, pultrusion, pre-peg layer, Fiber-only performs, Combined Fiber-Matrix performs,

Unit – V:

Manufacturing Techniques:

Tooling and Specialty materials, Release agents, Peelplies, release films and fabrics, Bleeder and breather plies, bagging films, maximum stress and strain criteria, Von Mises Yield criterion for isotropic materials.

Unit – VI:

Testing of Composites and Analysis:

Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter- laminar shear testing, Fracture testing etc. Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies.

Text Books:

1. Materials characterization, Vol. 10, ASM hand book.
2. Mechanical Metallurgy, by G. Dieter, McGraw Hill.
3. Analysis and Performance of Fiber Composites, by Agarwal, McGraw Hill.

References:

1. Thermal Analysis of Materials, by R.F. Speyer, Marcel Decker.
2. Engineering Mechanics and Composite Materials, by Daniels, Oxford University Press.
3. Material Science and Engineering (SIE) with CD, by Smith, McGraw Hill.
4. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.
5. Engineering Materials: Polymers, Ceramics and Composites, by A.K Bhargava Prentice Hall India.