COMPOSITE MATERIALS

(Open Elective)

II Semester

Course Code: 19ME21P2	L	P	C
	2	0	2

Course Outcomes: At the end of the course, the student will be able to

CO1: Explain the advantages and applications of composite materials.

CO2: Describe the properties of various reinforcements of composite materials.

CO3: Summarize the manufacture of metal matrix, ceramic matrix and C-C composites.

CO4: Describe the manufacture of polymer matrix composites.

CO5: Formulate the failure theories of composite materials.

UNIT-I **(7-Lectures)**

Introduction: Definition – Classification and characteristics of Composite materials. Applications of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Learning outcomes:

1. Classify various types of composite materials. (L4)
2. Describe the applications of composite materials. (L2)
3. Explain the roles of reinforcement and matrix in a composite material. (L2)

UNIT-II **(7-Lectures)**

Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. iso-strain and iso-stress conditions.

Learning outcomes:

1. Demonstrate the preparation, layup and curing of composites. (L3)
2. Compare characteristics of various reinforcements. (L5)
3. Formulate methods to compute properties of composites. (L6)

UNIT-III **(7-Lectures)**

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Learning outcomes:

1. Choose manufacturing methods of metal matrix composites. (L5)
2. Recommend manufacturing methods of ceramic matrix composites. (L5)
3. Describe manufacturing methods of C-C composites. (L2)

UNIT-I V **(7-Lectures)**

Manufacturing of Polymer Matrix Composites: Preparation of Molding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression molding – Reaction injection molding. Properties and applications.

Learning outcomes:

1. Explain manufacturing methods of polymer matrix composites. (L2)
2. Choose appropriate manufacturing method to process polymer matrix composites. (L5)
3. Assess properties and applications of polymer matrix composites. (L5)

UNIT-V **(7-Lectures)**

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Learning outcomes:

1. Apply theories for failure of composites. (L3)
2. Evaluate the strength of composite. (L5)
3. Design a composite material for a particular application. (L6)

TEXT BOOKS:

1. R.W.Cahn, *Material Science and Technology – Vol 13 – Composites*, West Germany, 1994.

2. WD Callister, Jr., Adapted by R. Balasubramaniam, *Materials Science and Engineering*, John Wiley & Sons, NY, Indian edition, 2007.

REFERENCE BOOKS:

1. K.K.Chawla, *Composite Materials*, 3rd Edition, springer, 2012.

2. Deborah D.L. Chung, *Composite Materials Science and Applications*, 2nd Edition, springer, 2010.