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 **(8-Lectures)**

Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application 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 relative merits of composite materials. (L2)

3. explain the roles of reinforcement and matrix in a composite material. (L2)

UNIT-II (8-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 (8-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-IV **(6-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 **(6-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.

References:

1. K.K.Chawla, *Composite Materials*, 3rd Edition, springer, 2012.
2. Deborah D.L. Chung, Composite Materials Science and Applications, 2nd Edition, springer, 2010.