**III B. Tech – I Semester**
**(20ME5315) COMPOSITE MATERIALS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|
| 30 | 70 | 100 | 3 | - | - | 3 |

**Pre-Requisites:** Material science

**Course Objective:**

- Composites are a relatively new class of materials.
- In this course the students learn about the benefits gained when combining different materials into a composite. The Motive is to make the students to understand different processing methods, issues, properties and testing methods of different composite materials

**UNIT-I: Introduction to Composites**

Fundamentals of composites – need for composites – enhancement of properties –classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – particle reinforced composites, Fibre reinforced composites. Applications of various types of composites. Fiber production techniques for glass, carbon and ceramic fibers

**UNIT-II: Polymer Matrix Composites**

Polymer resins – thermosetting resins, thermoplastic resins – reinforcement fibres – rovings – woven fabrics – non-woven random mats – various types of fibres. PMC processes - hand layup processes – spray up processes– compression moulding – reinforced reaction injection moulding - resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre reinforced plastics (FRP), Glass Fibre Reinforced Plastics (GFRP). Laminates- Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates.-applications of PMC in aerospace, automotive industries

**UNIT- III: Metal Matrix Composites**

Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, advantages of MMC, limitations of MMC, Reinforcements – particles – fibres. Effect of reinforcement –volume fraction – rule of mixtures. Processing of MMC – powder metallurgy process - diffusion bonding stir casting – squeeze casting, a spray process, Liquid infiltration In-situ reactions-Interface measurement of interface properties- applications of MMC in aerospace, automotive industries

**UNIT-IV: Ceramic Matrix Composites and Special Composites**

Engineering ceramic materials – properties – advantages – limitations – monolithic ceramics - need for CMC – ceramic matrix - various types of ceramic matrix composites- oxide ceramics – non-oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres- whiskers. Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing).applications of CMC in aerospace, automotive industries –Carbon / carbon composites – advantages of carbon matrix – limitations of carbon matrix carbon fibre – chemical vapour deposition of carbon on carbon fibre perform. Sol-gel technique - Processing of Ceramic Matrix composites.

**UNIT-V: MECHANICS OF COMPOSITES**

Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi Isotropic Laminates. Determination of Lamina stresses within Laminates.

**Course Outcomes:**
After successful completion of the course, the students will be able to:

| S. No | Course Outcome | BTL |
|---|---|---|
| 1. | Describe the basic concept and classification of composite. | L2 |
| 2. | Explain polymer matrix composites and its processing methods. | L2 |
| 3. | Narrate metal matrix composites and its processing methods. | L2 |
| 4. | Illustrate ceramics matrix composites and its processing methods. | L2 |
| 5. | Use of Mathematical techniques to predict the macroscopic properties of different Laminates | L3 |

**Correlation of COs with POs& PSOs:**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 2 |
| **CO2** | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | 2 |
| **CO3** | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 2 |
| **CO4** | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 1 |

**Text Books:**

1. Mathews F.L. and Rawlings R.D, "Composite Materials: Engineering and Science", 1st Edition, Chapman and Hall, London, England, 1994.
2. Chawla K.K., "Composite materials", Second Edition, Springer – Verlag, 1998.


**Reference Books:**

1. Clyne, T.W. and Withers, P.J., "Introduction to Metal Matrix Composites", Cambridge University Press, 1993.
2. Strong, A.B., "Fundamentals of Composite Manufacturing", SME, 1989.
3. Sharma, S.C., "Composite materials", Narosa Publications, 2000.
4. Broutman, L.J.and Krock, R.M., "Modern Composite Materials", Addison-Wesley, 1967.
5. ASM HandBook, "Composites", Vol.21, ASM International, 2001.