

**MECHANICAL ENGINEERING  
COMPOSITE MATERIAL (PhDME 102)**

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**MODULE 1**

**Introduction:** Definition of composite material, Classification based on matrix material, Constituents of composites, Distribution of constituents, Civil constructions of structures/panels, Aerospace industries, Automobile and other surface transport industries, House hold and sports components etc.

**Performance of Structural Composites:** Performance analysis by various models (Law of Mixtures), Stress distribution in fiber and the matrix (shear stress and axial tensile stress in the fiber along its length), Analysis of uni-axial tensile stress-strain curve of unidirectional continuous and short fiber composites, Estimation of the required minimum amount of fiber and critical amount of fiber to gain a composite strength, Analysis of strength of a composite during loading at an angle to the fibers.

**MODULE 2**

**Fabrication Composites :** Fabrication of Metal Matrix Composites: Commonly used Matrices, Basic Requirements in Selection of constituents, solidification processing of composites – land lay-up process, Spray processes - Osprey Process, Rapid solidification processing, Dispersion Processes - Stir-casting & Compo-casting, Screw extrusion, Liquid-metal impregnation technique - Squeeze casting, Pressure infiltration), Principle of molten alloy infiltration, rheological behavior of melt-particle slurry.

Fabrication of Polymer Matrix Composites - Commonly used Matrices Basic Requirements in selection of Constituents, Moulding method, Low pressure closed moulding, Pultrusion, Filament winding

Fabrication of ceramic matrix composites - Various techniques of vapor deposition, Liquid phase method and Hot pressing etc., Fabrication of nano-composites.

**MODULE 3**

**Characterization of Composites:** Control of particle/fiber and porosity content, void fraction determining techniques (theoretical and experimental), particle/fiber distribution, Interfacial reaction of matrix-reinforcing component, Coating of reinforcing component, Strength analysis.

**Secondary Processing and Joining of Composite:** Forging and extrusion of composites – critical issues, dynamic recovery and dynamic recrystallization, Drilling of composites, type and nomenclature of drills, welding of composites (Gas metal arc welding, tungsten inert gas welding techniques), mechanical properties of composites (tensile strength, inter laminar shear strength, flexural strength and impact strength), thermal properties of composites (measuring techniques and applications)

**Reference Books:**

1. Composite materials, K. K. Chawala, 2<sup>nd</sup> ed., (1987) Springer – Verlay, New York.
2. Composite Materials: Engineering and science, F. I. Mathews and R. D. Rawlings, (2012) CRC publications.

3. Mechanics and Analysis of Composite Materials, V.V. Vasiliev and E. V. Morozov (2001), Elsevier Science Limited, Kidlington, Oxford, UK.
4. Ceramic matrix composites, K.K. Chawala, 1st ed., (1993) Chapman & Hall, London.
5. Composite materials, S. C. Sharma, (2013) Narosa Publishing house, New Delhi India.