Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech.	Composite Materials and Analysis	MED 522	SM+MT+ET 25+25+50
Semester	**Credits**	**L-T-P**	**Exam.**
II	3	3-0-0	3 Hours

Unit – I

Introduction: Basic concepts and terminology; Classification; polymer matrix composites; Metal matrix composites; Ceramic matrix composites; Carbon–carbon composites; Current and potential advantages and applications of composite materials. **(07 hours)**

Unit – II

Fabrication Techniques for Composites: Polymer composites; Liquid resin impregnation routes; Pressurized consolidation of resin pre-pregs; Consolidation of resin molding compounds; Injection molding of thermoplastics; Hot press molding of thermoplastics; Metal composites: Squeeze infiltration; Stir casting; Spray deposition; Powder blending and consolidation; Diffusion bonding of foils; Physical vapour deposition (pvd)**;** ceramic composites: Powder-based routes; Reactive processing; Layered ceramic composites; Carbon/carbon composites. **(08 hours)**

Unit – III

Characterization and Testing: Characterization of constituent materials; Physical characterization of composite materials; Determination of tensile compressive and shear properties of unidirectional lamina; Determination of inter laminar fracture toughness; Characterization of composite with stress concentration. **(07 hours)**

Unit – IV

Mechanics of Composites: Rule of mixture -volume and mass fractions – density - void content; Evaluation of four elastic moduli based on strength of materials approach and semi-empirical model-longitudinal young's modulus; Transverse young's modulus–major poisson's ratio-in-plane shear modulus; Ultimate strengths of a unidirectional lamina; Characteristics of fiber-reinforced lamina–laminates; Lamination theory; Inter laminar stresses; Micromechanics models for stiffness and strength. **(08 hours)**

Unit – V

Macro-mechanical Behavior of a Lamina: Hooke's law for different types of materials; Anisotropic material; Monoclinic material; Orthotropic material (orthogonally anisotropic) / specially orthotropic; Transversely isotropic material; Isotropic material; Hooke's law for a two-dimensional unidirectional lamina; Plane stress assumption; Reduction of Hooke's law in three dimensions to two dimensions; Relationship of compliance and stiffness matrix to engineering elastic constants of a lamina; Maximum stress failure theory; Strength ratio; Failure envelopes; Maximum strain failure theory; Tsai–hill failure theory; Tsai–Wu failure theory. **(08 hours)**

Unit – VI

Analysis and Design of Laminates: Failure criterion for a laminate; Design of a laminated composite; Other mechanical design issues; Sandwich composites; Long-term environmental effects; Inter laminar stresses; Impact resistance; Fracture resistance; Fatigue resistance.

(07 Hours)

Recommended Books:

1. Fiber Reinforced Composites: Materials; Manufacturing and Design; P. K. Mallick; Marcel Dekker Inc; 1993.
2. Mechanics of Composite Materials; Autar K. Kaw; CRC Press; 2006
3. Analysis and Performance of Fiber Composites; B. D. Agarwal and L. J. Broutman; John Wiley and Sons; New York; 1990.
4. Principles of Composite Material Mechanics; Ronald Gibson; Tata McGraw Hill; 1994.
5. Composite Materials; K. K. Chawla; Springer – Verlag; 1987