MECHANICS OF COMPOSITE MATERIALS

Subject Code: 13ME2207

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Course Outcomes:

At the end of the course, the student will be able to

CO1: Classify composites, types of reinforcement and matrix phases.

CO2: Compute stress and strain , elastic constants of composites

CO3: Explain different fabrication methods to prepare composite materials.

CO4: Describe methods to characterize composite properties

CO5: Analyse different types of composite laminates using thin plate theory,

UNIT-I

Introduction: classification of composites: fibrous composites, particulate composites, applications.

Raw materials: Resins: polyester, epoxy, metal matrices. Reinforcement: glass fibers, boron fibers, silicon carbide, carbon and graphite fibers, Kevlar, sisal and other vegetable fibers, whiskers, fillers and parting agents.

UNIT-II

Macromechanical behaviour of a lamina: transformation of stress and strain, numerical examples of stress strain transformation, graphic interpretation of stress – strain relations. Off -axis, stiffness modulus, elastic behaviour of unidirectional composites: elastic constants of lamina, relationship between engineering constants and reduced stiffness and compliances, analysis of laminated composites.

Micro mechanics: Introduction, weight and volume fractions, properties of lamina, representative volume element, micro mechanics, analysis of continuous and discontinuous fibres, reinforced composites, failure modes of unidirectional composites.

UNIT- III

Fabrication methods: Hand lay-up: materials, molding, bag molding, mating molds, spray up molding, matched - die molding, perform molding, filament winding, winding patterns and winding machines, pultrusion.

UNIT- IV

Experimental characterization and testing methods of composites: Properties of constituents: single filament tensile properties, matrix tensile properties, density, volume fractions, coefficient of thermal and moisture expansions, properties of composites: tensile test method, compression test method.

Strength of unidirectional lamina: Micro mechanics of failure, failure mechanisms, strength of an orthotropic lamina, strength of a lamina under tension and shear maximum stress and strain criteria, application to design. the failure envelope, first ply failure free-edge effects

UNIT- V

Analysis of laminated composite plates: introduction, thin plate theory, specially orthotropic plate, cross and angle ply laminated plates, bending and vibration analysis of laminated composite plates using finite element method

Fiber composites: Tensile and compressive strength of unidirectional fibre composites, fracture modes in composites: single and multiple fracture, de-bonding, fibre pullout and de-lamination failure, fatigue of laminate composites

TEXT BOOKS:

1.R.M. Jones, "*Mechanics of composite Materials*", Scripta Book company, Washington DC, 2e, 1992.

Madhujit Mukhopadhyay, "*Mechanics of composite materials and structures*", Universalities press, 2e, 2004

REFERENCES:

1. Isaac and M Daniel, "*Engineering Mechanics of Composite Materials*", Oxford University Press, 1994.
2. Autar K.Kaw, "*Mechanics of Composite Materials* ",CRC Publishers,1997.