MECHANICS OF COMPOSITE MATERIALS

Course Code: 15ME2206

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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 (10-Lectures)

Introduction: classification of composites: fibre reinforced 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 (10-Lectures)

Micro mechanics: Introduction, weight and volume fractions, properties of lamina, representative volume element,

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

UNIT- III (10-Lectures)

Fabrication methods: Hand lay-up: molding, bag molding, mating

molds, spray up molding, matched - die molding, perform molding, filament winding, winding patterns and winding machines, pultrusion.

UNIT- IV (10-Lectures)

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.

UNIT- V (10-Lectures)

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, the failure envelope, first ply failure, free-edge effects.

TEXT BOOKS:

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