MECHANICS OF COMPOSITE MATERIALS

Subject Code: 13ME2207 **L P C**
4 0 3

Pre requisites: Material science and Mechanics of solids

Course Educational Objectives:

To make the student understand

1. composite materials and its applications
2. transformation of stress and strain in different composite materials
3. analysis of laminated composite materials
4. failure modes of unidirectional composites
5. the knowledge about different types of fabrication methods of composite materials
6. effect of properties on composite materials

Course Outcomes:

The student will be able to

1. know experimental characterization and testing methods of composite materials
2. study of importance of micromechanics of failure
3. explain vibration analysis of laminated composite plates using finite element method
4. analyze single and multiple fracture analysis of composite materials
5. determine tensile and compressive strength of unidirectional fibre composites
6. know fracture modes in composites

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.