4/4 B.Tech. SEVENTH SEMESTER

ME7T5C MECHANICS OF COMPOSITE MATERIALS Credits: 4

Lecture:- 4 periods/week - Internal assessment: 30marks
Tutorial: 1 periods/week Semester end examination: 70 marks

Objectives:

1. Explain the behavior of constituents in the composite materials
2. Enlighten the students in different types of reinforcement
3. Develop the student's skills in understanding the different manufacturing methods available for composite material.
4. Illuminate the knowledge and analysis skills in applying basic laws in mechanics to the composite materials.

Learning outcomes:

At the end of course the students will be able to:

1. Realize the specifics of mechanical behavior of layered composites compared to isotropic materials.
2. Apply constitutive equations of composite materials and understand mechanical behavior at micro, macro level.
3. Determine stresses and strains in composites materials.
4. Apply failure criteria and critically evaluate the results.
5. Distinguish mechanical behavior of composites due to variation in temperature and moisture.

Pre-Requisites:

Mechanics of solids, Metallurgy& material science

UNIT-I

INTRODUCTION TO COMPOSITE MATERIALS:

Introduction ,Classification: Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber-Reinforced Composites and nature-made composites, and applications.

UNIT-II

REINFORCEMENTS:

Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

UNIT-III

MANUFACTURING METHODS:

Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

UNIT-IV

MACROMECHANICAL ANALYSIS OF A LAMINA:

Introduction, Definitions: Stress, Strain, Elastic Moduli, Strain Energy. Hooke's Law for Different Types of Materials, 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,

UNIT-V

Hooke's Law for a Two-Dimensional Angle Lamina, Engineering Constants of an Angle Lamina, Invariant Form of Stiffness and Compliance Matrices for an Angle Lamina Strength Failure Theories of an Angle Lamina : Maximum Stress Failure Theory Strength Ratio, Failure Envelopes, Maximum Strain Failure Theory ,Tsai–Hill Failure Theory, Tsai–Wu

UNIT-VI

MICROMECHANICAL ANALYSIS OF A LAMINA :

Introduction, Volume and Mass Fractions, Density, and Void Content, Evaluation of the Four Elastic Moduli, Strength of Materials Approach, Semi- Empirical Models ,Elasticity Approach, Elastic Moduli of Lamina with Transversely Isotropic Fibers, Ultimate Strengths of a Unidirectional Lamina, Coefficients of Thermal Expansion

UNIT-VII

MACROMECHANICAL ANALYSIS OF LAMINATES:

Introduction, Laminate Code, Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus of a Laminate.

UNIT-VIII

FAILURE, ANALYSIS, AND DESIGN OF LAMINATES:

Introduction, Special Cases of Laminates, Failure Criterion for a Laminate, and Design of a Laminated Composite,

Learning resources

Text books:

1. Engineering Mechanics of Composite Materials, (2nd edition), by Isaac and M Daniel , Oxford University Press, 2006.
2. Analysis and performance of fibre Composites, (Second Edition), by B. D. Agarwal and L. J. Broutman, John Wiley & sons, , *New* York, , New York, 1990.
3. Mechanics of Composite Materials, (Second Edition), by Autar K. Kaw, CRC, 2010.

Reference books:

1. Mechanics of Composite Materials, (3ed edition), by R. M. Jones, Mc Graw Hill Company, New York, 2006.
2. Analysis of Laminated Composite Structures, by L. R. Calcote, Van Nostrand Rainfold, New York, 1969.