COURSE CONTENT

COMPOSITE MATERIALS								
III Semester: ME								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
2234024	**Foundation**	3	0	0	3	40	60	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisites: Mechanics of Materials, Materials Science								

Course Overview:

A Composite Materials course provides foundational knowledge in the definition, history, and classification of composites, covering their advantages, disadvantages, and properties compared to traditional materials.

Course Objectives:

1. To identify the properties of fiber and matrix materials used in commercial composites as well as some common manufacturing techniques.
2. To predict the elastic properties of both long and short fiber composites.
3. To understand the stress–strain relations in composite materials.
4. To study the macromechanical analysis of lamina and laminates.
5. To establish the failure criteria for laminated structures.

Course Outcomes:

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

1. Understand and differentiate various types of composites.
2. Identify different types of reinforcements and describe various manufacturing methods of composites.
3. Analyze problems related to the macro and micromechanical behavior of lamina.
4. Analyze problems related to the macromechanical behavior of laminates.
5. Apply the concepts developed in composite analysis to the design of aerospace structures.

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: Fibers- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibers. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites. Manufacturing methods: Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

UNIT -III: Macro mechanical 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-IV: Laminate Mechanics and Hygro-thermal Effects

Introduction, Laminate Code, Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus of a Laminate, Hygro thermal Effects in a Laminate, Warpage of Laminates.

UNIT -V: Laminated Composite Design and Failure

Introduction, Special Cases of Laminates, Failure Criterion for a Laminate, Design of a Laminated Composite, Other Mechanical Design Issues, MMC and PMC.

TEXT BOOKS:

1. Mechanics of Composite Materials, R. M. Jones, McGraw-Hill Company, New York, 1st Edition, 1975.
2. Engineering Mechanics of Composite Materials, Isaac M. Daniel, Oxford University Press, 1st Edition, 1994.

REFERENCEBOOKS:

1. Analysis and Performance of Fiber Composites, B.D. Agarwal and L.J. Broutman, Wiley-Interscience, New York, 1st Edition, 1980.
2. Introduction to Composite Materials Design, Ever J. Barbero, CRC Press,4th Edition, 2023.
3. Engineering Mechanics of Composite Materials, Isaac M. Daniel and OriI shai, Oxford University Press, 3rd Edition, 2023.
4. Composite Materials: Processing, Applications, and Characterization, M. Balasubramanian, Springer, 2nd Edition, 2022.
5. Analysis and Performance of Fiber Composites, Bhagwan D. Agarwal and Lawrence

J. Broutman and K. Chandra shekhara, Wiley, 4thEdition, 2023.

6. Structural Analysis of Composite Materials, Mark E. Tuttle, CRC Press, 3rd Edition, 2022.
7. Mechanics of Composite Materials, Autar K. Kaw, CRC Press, 2nd Edition, 2006

ELECTRONIC RESOURCES:

1. https://nptel.ac.in/courses?searchQuery=composite+materials
2. https://www.coursera.org/courses?query=composite%20materials
3. https://www.edx.org/learn/materials-science
4. https://www.youtube.com/results?search_query=composite+materials+lecture
5. https://www.sciencedirect.com/topics/materials-science/composite-material
6. https://www.azom.com/articles.aspx?ArticleID=120
7. https://ocw.mit.edu/search/?q=materials

MATERIALS ONLINE:

1. Course template
2. Tech talk and Concept Video topics
3. Assignments
4. Model question paper – I
5. Model question paper – II
6. Lecture notes
7. E-Learning Readiness Videos (ELRV)