

Course Code	Course Name	Credits
MEDLO8051	Composite Materials	03

Objectives

1. To study the manufacturing methods of composite material.
2. To study the behaviour of composite materials, both at micro and macro levels.
3. To study the procedure of designing a composite laminate and structure as a whole for the given application.
4. To study the applicability of composite materials for various industrial/loading applications
5. To study the damage detection and damage repair methods for composite materials

Outcomes: Learner will be able to...

1. Select the type of material for the fibres and matrix in a composite material for the given application.
2. Relate stresses and strains through the elastic constants for a given lamina.
3. Evaluate elastic properties of a lamina based on the properties of its constituents.
4. Predict failure of a lamina under the given loading condition.
5. Select the number of laminae and their stacking sequence in a composite material for the given loading condition.
6. Identify the type of damage occurring in a composite structure and select an appropriate method to repair it.

Module	Contents	Hours
1	Introduction Classifications based on fibres and matrix, Advantages, Applications, Terminology, Manufacturing Methods: Hand layup, Spray layup, Vacuum bagging, Prepregs, Industrial autoclave, Filament winding, Pultrusion, Resin transfer moulding, Vacuum Infusion Processing, Powder metallurgy route for ceramic and metal matrix composites	08
2	Analysis of Lamina Hooke's law for different types of materials, Plane stress assumption, Hooke's law for a two-dimensional unidirectional lamina, Relationship of compliance and stiffness matrix to engineering elastic constants of a lamina, Hooke's law for a two-dimensional angle lamina, Engineering constants of an angle lamina	06
3	Lamina Failure Theories Introduction, Maximum stress failure theory, Maximum strain failure theory, Tsai-Hill failure theory, Tsai-Wu failure theory, Strength ratio, Failure envelopes	04
4	Introduction to Micromechanics of Lamina and Laminate Design Prediction of mechanical properties of lamina based on properties of its constituents (fibre and matrix), Laminate types and their codes, Overview of laminate design (no problems on this topic)	06

5	Inspection of Composites Different types of damages in composites, Non-destructive testing of composites: Ultrasonics inspection, Acoustography, Low frequency Methods, Radiographic inspection, Shearography, Acoustic emission, Thermography	06
6	Repair of Composites Restitution and repair of composites: Selection of Repair method, Repair criteria, Generic repair designs, Matrix cracks, Delamination, Holes and Fiber fracture, Damage removal and surface preparation	06

Text Books:

1. M.Balasubramanian, “Composites materials processing” ,1st edition, CRC press 2013.
2. A.K. Kaw, “Mechanics of Composite Materials”, Taylor and Francis Group, ISBN: 9780815351481
3. Ajay Kapadia, “Non Destructive Testing of Composite Materials”, National Composites Network
4. R.B. Heslehurst, “Defects and Damage in Composite Materials and Structures”, CRC Press 2014.

References:

1. R.M. Jones, “Mechanics of Composite Materials”, 2nd Edition,Taylor and Francis, Inc,ISBN: 9781138571075
2. I.M. Daniel and O. Isai, “Engineering Mechanics of Composite Materials”, 2nd Edition 2005,Oxford University Press, ISBN: 9780195150971
3. D. Gay, S.V. Hoe, and S.W. Tsai, “Composite Materials: Design and Applications”, 3rd Edition 2014, CRC Press, ISBN: 978-1466584877
4. R.B. Heslehurst, “Defects and Damage in Composite Materials and Structures”, CRC Press 2014.
5. [M.M. Schwartz](#), “Composite Materials: Properties, Nondestructive Testing, and Repair”, Prentice Hall PTR (1997), ISBN: 9780133000474