INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

INTRODUCTION TO COMPOSITE MATERIALS								
VI Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAED44	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Aerospace Structures								

I. COURSE OVERVIEW:

Design and analysis of composite structures discusses about different requirements of composite structures will be discussed within the framework of the course and associated design concepts will be introduced. In particular, the requirements associated with production, assembly and loads occurring during operation will be considered.

II. COURSES OBJECTIVES:

The students will try to learn

I. The fabrication, analysis and design of composite materials & structures.
II. The basic composites technology, including materials and processes, manufacturing, structural design, maintenance, proof of structures and other considerations.
III. The static testing procedure and repairing methodology of composite structural members and joints.
IV. The structural designs using composite materials

III. COURSE OUTCOMES:

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

CO1 Understanding of what composite materials are and how they differ from traditional materials.
CO2 Understand the mechanical, thermal, electrical, and other properties of composite materials
CO3 Classify composite materials based on their matrix and reinforcement types.
CO4 Understand the about various manufacturing processes used for composites, such as hand lay-up, filament winding, pultrusion, and autoclave curing.
CO5 Explore different types of reinforcement materials, including fibres (e.g., carbon, glass, aramid) and particles.
CO6 Gain knowledge of the principals involved in designing composite materials for specific applications.

IV. COURSE CONTENT:

MODULE-I: STRESS STRAIN RELATION (10)

Introduction- Advantages and application of composite materials, reinforcements and matrices; Generalized Hooke's Law; Elastic constants for anisotropic, orthotropic and isotropic materials.

MODULE –II: METHODS OF ANALYSIS (08)

Micro mechanics: Mechanics of materials approach, elasticity approach to determine material properties; Macro Mechanics; Stress-strain relations with respect to natural axis, arbitrary axis; Determination of material properties; Experimental characterization of lamina.

MODULE –III: LAMINATED PLATES, SANDWICH CONSTRUCTIONS AND FABRICATION PROCESS (10)

Governing differential equation for a general laminate, angle ply and cross ply laminates; Failure criteria for composites. Basic design concepts of sandwich construction.

Materials used for sandwich construction; Failure modes of sandwich panels; Various open and closed mould processes; Manufacture of fibbers; Types of resins and properties and applications; Netting analysis.

MODULE –IV: DAMAGE TOLERANCE IN COMPOSITES (09)

Introduction, sources of damage, types of damage, FAR requirements and advisory circulars, building block approach; Impact damages: Damage growth under fatigue loads; residual strength: Tests and analytical methods; Detailed design: Basics of projections, drawing standards and conventions, introduction to CADD, design of composite parts and assembly design; Optimization: Fundamentals of optimization, mathematical concepts in optimization, Optimization of composite plates.

MODULE –V: TESTING OF COMPOSITE STRUCTURES (08)

Factors influencing testing, test environment, test methods and standards, introduction to static testing of composite structures and examples; Repair of composite aircraft structures: Introduction to repair, repair philosophy, repair sequence, repair criteria, damage assessment, classification of repair, selection of repair joints, repair procedures, certification of repair.

V. TEXT BOOKS:

1. Gibson, R.F, "Principles of Composite Material Mechanics", CRC Press, 2nd Edition, 2007.
2. Jones, R.M, "Mechanics of Composite Materials", Taylor & Francis, 2nd Edition, 2010 (Indian Print)
3. Reddy, J.N., "Mechanics of Laminated Composite Plates and Shells-Theory and Analysis", CRC Press, 2nd Edition, 2004.

VI. REFERENCE BOOKS:

1. Agarwal, B.D., and Broutman, L.J, "Analysis and Performance of Fibre Composites", John Wiley and Sons, New York, 1995
2. Lubin, G., "Handbook on Advanced Plastics and Fibre Glass", Von Nostrand Reinhold Co, New York, 1989.
3. AutarK. Kaw "Mechanics of Composite Materials", CRC Press, 2nd Edition, 2005.

VII. ELECTRONICS RESOURCES:

1. www.nptel.ac.in/courses/101104010/
2. www.freevideolectures.com/Course/94/Prestressed-Concrete-Structures/35
3. www.adturtle.biz/LP_TA/index.cfm?T=436857

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank

3. Tech talk topics
4. Open end experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper - II
9. Lecture notes
10. E-learning readiness videos (ELRV)
11. Power point presentation