COURSE CONTENT

ANALYSIS AND DESIGN OF COMPOSITE STRUCTURES								
I Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
BAEE08	Elective	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Aircraft structures								

I. COURSE OVERVIEW:

The course focuses on properties of constituent materials and composite laminates, and also provides insight into different analysis approaches of composite materials. It imparts knowledge about different theories of analysis of laminated beams and plates. The course is aimed to obtain knowledge also in different failure theories and concepts of composite materials.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The contribution of constituent materials to the mechanical properties of composite laminates.
II. The various analysis approaches of composite plates and beams.
III. The different failure theories of composite materials.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO 1 Apply the knowledge of properties of constituent materials to analyse the composite materials
CO 2 Develop stress-strain relations of isotropic, orthotropic, and anisotropic composite materials to design the composite laminates
CO 3 Apply the knowledge of classical lamination theory for analyzing various composite materials
CO 4 Explain the mechanical behavior of layered composites compared to isotropic materials
CO 5 Develop relationships of mechanical loads applied to a laminate to analyze the strains and stresses in each lamina
CO 6 Identify the failure of individual lamina in a laminate to analyze the failure criteria of composite laminates

IV. COURSE CONTENT:

MODULE-I: PROPERTIES OF CONSTITUENT MATERIALS & COMPOSITE LAMINATES (09)

Introduction to laminated composite plates- mechanical properties of constituent materials such as matrices and filaments of different types. Netting analysis of composite materials, determination of properties of laminates with fibers and matrices.

MODULE-II: MICROMECHANICS OF A UNIDIRECTIONAL COMPOSITE (09)

Volume and Weight Fractions in a Composite Specimen - Longitudinal Behaviour of Unidirectional Composites - Load Sharing - Failure Mechanism and Strength - Factors Influencing Longitudinal Strength and Stiffness - Transverse Stiffness· and Strength - Prediction of Elastic Properties Using Micromechanics -Typical Unidirectional Fiber Composite Properties - Minimum and Critical Fiber Volume Fractions.

MODULE-III: METHODS OF ANALYSIS-I & METHODS OF ANALYSIS -II (09)

Mechanics of materials approach to determine Young's modulus, shear modulus and Poisson's ratio. Brief mention of elasticity approach and macro mechanics of laminates.

Anisotropic elasticity, stress -strain relations in material coordinates - Transformation of geometric axes, strength concepts, biaxial strength theories, maximum stress and maximum strain.

MODULE-IV: ANALYSIS OF LAMINATED BEAMS AND PLATES (09)

Classical plate theory, Classical lamination theory - Special cases of single layer, symmetric, anti-symmetric & unsymmetric composites with cross ply, angle ply layup. Deflection analysis of laminated plates, Analysis of laminated beams and plates.

MODULE-V: SHEAR DEFORMATION ANALYSIS & BUCKLING ANALYSIS (09)

Design consideration – Mechanical properties of composite materials - Analysis of composite beams – Thin-walled composite beams – Bending and Buckling analysis of composite plates - Analysis of sandwich plates - Inter-laminar stresses - Delamination models - Preliminary design of composite structures for aerospace applications - Composite tailoring and design issues – Future scope for composites research.

V. TEXT BOOKS:

1. Agarwal. B.D, Broutman. L.J, "Analysis and Performance of Fiber Composites", John Wileyandsons, NewYork, 1980.
2. Lubin. G,Von. Nostrand, "Advanced Plastics and Fibre Glass", Reinhold Co. New York, 1989.

VI. REFERENCE BOOKS:

1. Gupta.L, "Advanced Composite Materials, Himalayan Books, New Delhi, 1998.
2. Jones.R.M, "Mechanics of Composite Materials, Mc Graw Hill Kogakushal td. Tokyo.

VII. ELECTRONICS RESOURCES:

1. http://onlinelibrary.wiley.com/book.
2. https://www.asme.org/products/courses/design-analysis-fabrication-composite-structures.
3. http://as.wiley.com/WileyCDA/WileyTitle/productCd-1118401603.html

VIII. MATERIALS ONLINE

1. Course template
2. Assignments
3. Tutorial question bank
4. Model question paper – I
5. Model question paper – II
6. Lecture notes
7. Power point presentations