AEROSPACE STRUCTURES

V-Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB07	Core	3	--	--	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The students will try to learn:

I. The application of mathematical principles on aircraft structural components and determination of deflections and stresses under various loading conditions.
II. The concepts of thin plate theory, phenomena of thin plate structural instability, analysis of bending, shear and torsion of thin walled beams
III. The concept of structural idealization and transformation of complex structures to simple structures.
IV. The behavior of wing, fuselage and landing gears under various loading conditions.

COURSE OUTCOMES:

CO 1 **Illustrate** the airplane structural components subjected to different loading conditions for determining its behaviour.
CO 2 **Apply** energy principles to aircraft structural components with different boundary conditions and loads for predicting deflections.
CO 3 **Explain** the concept of thin rectangular plates subject to various boundary conditionsfor obtaining deflection curves.
CO 4 **Analyze** various loads acting on thin plates with different boundary conditions for efficient design of monoques structures.
CO 5 **Apply** beam bending concept on thin walled beam structures for predicting deflections and stresses in out of plane.
CO 6 **Analyze** the deflection and twist produced in thin walled open and closed section beams under torsion loads for designing beams with minimum stresses.
CO 7 **Apply** the concept of elementary bending theory for predicting warping and torsion of aircraft structural components.
CO 8 **Explain** the concepts in structural idealization for transforming complex structural geometries to simple structural geometries.
CO 9 **Apply** the concept of structural idealization for determining deflections in open and closed section beams
CO 10 **Illustrate** the concept of beam bending to tapper wing, and cutout sections in wing and fuselage for predicting deflections and stresses.
CO11 **Apply** the concept of maximum stress theories to aircraft structural components for determining failure loads.
CO12 **Interpret** the load interaction between various aircraft components, for determining maximum stress.

MODULE-I	INTRODUCTION TO AIRCRAFT STRUCTURAL COMPONENTS AND ENERGY METHODS
Aircraft Structural components and loads, functions of structural components, airframe loads; Types of structural joints, type of loads on structural joints; Aircraft inertia loads; Symmetric manoeuvre loads, gust loads. Monocoque and semi monocoque structures, stress in thin and thick shells; Introductions to energy principles, castiglianos theorems, max wells reciprocal theorem, unit load method, Rayleigh Ritz method, total potential energy method, flexibility method.	
MODULE-II	**THIN PLATE THEORY, STRUCTURAL INSTABILITY**
Analysis of thin rectangular plates subject to bending, twisting, distributed transverse load, combined bending and in-plane loading: Thin plates having small initial curvature, energy methods of analysis. Buckling of thin plates: Elastic, inelastic, experimental determination of critical load for a flat plate, local instability, instability of stiffened panels, failure stresses in plates and stiffened panels. Tension field beams- complete diagonal tension, incomplete diagonal tension, post buckling behavior.	
MODULE-III	**BENDING, SHEAR AND TORSION OF THIN WALLED BEAMS**
Unsymmetrical bending: Resolution of bending moments, direct stress distribution, position of neutral axis; Deflections due to bending: Approximations for thin walled sections, temperature effects; Shear loaded thin walled beams: General stress, strain and displacement relationships, direct stress and shear flow system, shear centre, twist and warping. Torsion of beams of closed section: Displacements associated with Bredt-Batho shear flow; Torsion of open section beams; Warping of cross section, conditions for zero warping; Bending, shear, torsion of combined open and closed section beams.	
MODULE-IV	**STRUCTURAL IDEALIZATION**
Structural idealization: Principal assumptions, idealization of panel, effect on the analysis of thin walled beams under bending, shear, torsion loading- application to determining deflection of open and closed section beams. Fuselage frames - bending, shear and torsion.	
MODULE-V	**ANALYSIS OF FUSELAGE, WING AND LANDING GEAR**
Wing spar and box beams, tapered wing spar, open and closed sections beams, beams having variable stringer areas; wings – three boom shell in bending, torsion and shear, tapered wings, deflections, cutouts in wings; Cutouts in fuselages; Fuselage frame and wing rib; principle of stiffener, web constructions. Landing gear and types; Analysis of landing gear.	

TEXTBOOKS:

1. T. H. G. Megson, “Aircraft Structures”, Butterworth-Heinemann Ltd, 5th Edition, 2012.
2. E. H. Bruhn, “Analysis and Design of Flight vehicles Structures”, Tri-state off set company, USA, 4th Edition, 1965.

REFERENCE BOOKS:

1. B. K. Donaldson, “Analysis of Aircraft Structures - An Introduction”, McGraw Hill, 3rd Edition, 1993.
2. S. Timoshenko, “Strength of Materials”, Volumes I and II, Princeton D. Von Nostrand Co., Reprint, 1977.