AEROSPACE STRUCTURES

IV Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAEB07	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: 45				Total Classes: 60		

COURSE OBJECTIVES:

I. Understand the aircraft structural components and its behavior under different loading conditions
II. Obtain knowledge in plate buckling and structural instability of stiffened panels for airframe structural analysis.
III. Explain the thin walled section and structural idealization of panels and differentiate from the type of loads carried.
IV. Solve for stresses and deflection in aircraft structures like fuselage, wing and landing gear.

COURSE OUTCOMES (COs)

CO 1. Describe the concept of Structural components, structural joints, Monocoque and semi monocoque structures and also energy methods and principles.
CO 2. Describe the concept of thin plates subject to different types of loads and also buckling phenomena of thin plates, local instability and instability of stiffened panels.
CO 3. Understand the concept of symmetric and un-symmetric bending of beams shear stresses and shear flow distribution of thin walled sections and Torsion phenomenon.
CO 4. Explore the concept of Structural idealization and stress distribution of idealized thin walled sections.
CO 5. Discuss the concept of idealized thin walled sections, fuselage, Wing spar and box beams.

COURSE LEARNING OUTCOMES (CLOs):

1 Discuss the Aircraft Structural components, various functions of the components and airframe loads acting on it.
2 Discuss different types of structural joints and the effect of Aircraft inertia loads, Symmetric maneuver loads, gust loads on the joints.
3 Differentiate Monocoque and semi monocoque structures and analyze stresses in thin and thick shells.
4 Explain energy principles and its application in the analysis of structural components of Aircraft.
5 Explain the Theory of thin plates and Analyze thin rectangular plates subject to bending, twisting, distributed transverse load, combined bending and in-plane loading.
6 Describe Buckling phenomena of thin plates and derive Elastic, inelastic, experimental determination of critical load for a flat plate.
7 Calculate the local instability, instability of stiffened panels, failure stresses in plates and stiffened panels.
8 Discuss critical buckling load for flat plate with various loading and end conditions
9 Solve for bending and shear stresses of symmetric and un-symmetric beams under loading conditions
10 Solve for deflections of beams under loading with various approaches

11 Calculate the shear stresses and shear flow distribution of thin walled sections subjected to shear loads.
12 Explain Torsion phenomenon, Displacements and Warping associated with Bredt-Batho shear flow theory of beams.
13 Explain the theory of Structural idealization
14 Principal assumptions in the analysis of thin walled beams under bending, shear, torsion.
15 Solve for stress distribution of idealized thin walled sections subjected to bending.
16 Solve for stress distribution of idealized thin walled sections subjected to, shear and torsion.
17 Calculate and analysis of idealized thin walled sections subjected to bending
18 Calculate and analysis of idealized thin walled sections subjected to shear and torsion.
19 Analyze fuselage of variable stringer areas subjected to transverse and shear loads.
20 Analyze Wing spar and box beams of variable stringer areas subjected to transverse and shear loads.

MODULE -I	**INTRODUCTION TO AIRCRAFT STRUCTURAL COMPONENTS AND ENERGY METHODS**	**Classes: 09**

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**	**Classes: 09**

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**	**Classes: 09**

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**	**Classes: 09**

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**	**Classes: 09**

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.

Text Books:

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.

Web References:

1. http://link.springer.com/book
2. http://www.sciencedirect.com/science
3. http://www.e-booksdirectory.com

E-Text Books:

1. https://soaneemrana.org/onewebmedia/AIRCRAFT%20STRUCTURES%20BY%20T.H.G.%20MEGSON%20(4th%20%20Edition).pdf
2. https://www.academia.edu/34820677/AIRCRAFT_STRUCTURES_BY_T.H.G._MEGSON_4th_Edition_.pdf
3. http://164.100.133.129:81/econtent/Uploads/ACD2501_Day%206_Aircraft_Structures.pdf