AEROSPACE STRUCUTRES

IV Semester: AE

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

I. COURSE OVERVIEW:

The primary objective of this course is to understand the different Aircraft structural component loads, and to equip the senior year aerospace engineering students with the relevant infrastructure to carry out the design of aircraft sub-structures like wings, fuselages, landing gears etc.

II. OBJECTIVES:

The course should enable the students to:

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.

III. COURSE OUTCOMES (COs):

COs	Course Outcome
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.

IV. SYLLABUS:

MODULE -I	INTRODUCTION TO AIRCRAFT STRUCTURAL COMPONENTSAND ENERGY METHODS	Classes: 10

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 thinshells; Introductions to energy principles, castiglianos theorems, maxiwells 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: 08**
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.		

V. Text Books:

1. T. H. G. Megson, "Aircraft Structures for Engineering Students", 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.

VI. Reference Books:

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

VII. Web References:

1. https://nptel.ac.in/courses/112101095/
2. https://www.scribd.com/doc/244154727/theory-of-structures-timoshenko-pdf

VIII. E-Text Books:

1. https://www.freeengineeringbooks.com/AeroSpace/Aircraft-Structures-Books.php
2. https://docs.google.com/file/d/0Bw8MfqmgWLS4RlNqaE1oUzdOajQ/view?pref=2&pli=1

Course Home Page: