

ANALYSIS OF AIRCRAFT STRUCTURES

V Semester: AE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAEC15	Core	L	T	P	C	CIA	SEE	Total
		3	1	-	4	30	70	100
Contact Classes: 45		Tutorial Classes: 15		Practical Classes: Nil			Total Classes: 60	
Prerequisite: Engineering Mechanics, Solid Mechanics, Aerospace Structures, Mathematics								
I. COURSE OVERVIEW:								
<p>Analysis of Aircraft structures deals with the behavior of aircraft structural elements subjected to inertial, aerodynamic, and maneuver loads under various flight conditions. This course emphasizes the analysis and design of thin-walled beams, thin plates analysis by using energy methods. Further, the design concepts of structural idealization, load analysis on a wing, fuselage, and landing gear have been introduced to analyze, design, and development of flight vehicles' structural components.</p>								
II. COURSE OBJECTIVES:								
The student will try to learn:								
<p>I The application of mathematical principles on aircraft structural components and determination of deflections and stresses under various loading conditions.</p> <p>II The concepts of thin plate theory, phenomena of thin plate structural instability, analysis of bending, shear and torsion of thin walled beams</p> <p>III The concept of structural idealization and transformation of complex structures to simple structures.</p> <p>IV The behavior of wing, fuselage and landing gears under various loading conditions.</p>								
III. COURSE OUTCOMES:								
After successful completion of the course, students should be able to:								
CO 1 Utilize the energy principles to aircraft structural components for interpreting minimal stress loading conditions.						Apply		
CO 2 Choose the minimum energy principles and Fourier series solutions to thin rectangular plates subject to a given boundary conditions for predicting the stresses and strains.						Apply		
CO 3 Inspect the deflection and twist produced in thin walled open and closed section beams under torsion loads for designing beams with minimum stresses.						Analyze		
CO 4 Develop the elementary beam bending theory to thin walled open and closed section beams for predicting warping and torsion of aircraft structural components.						Apply		
CO 5 Illustrate the concepts in structural idealization in transforming complex structural geometries to simple structural geometries used for interpreting the stress distribution on aircraft structures.						Understand		
CO 6 Make use of maximum stress theories to aircraft structural components for determining failure stresses under various loading conditions.						Apply		
IV. COURSE SYLLABUS:								
MODULE-I: THIN PLATE THEORY, STRUCTURAL INSTABILITY (10)								
<p>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.</p>								
MODULE –II: BENDING, SHEAR AND TORSION OF THIN WALLED BEAMS (08)								
<p>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.</p>								

MODULE –III: STRUCTURAL IDEALIZATION (10)

Structural idealization: Principal assumptions, idealization of panel, effect on the analysis of thin walled beams under bending, shear torsion loading- application.

Determining deflection of open and closed section beams. Fuselage frames - bending, shear and torsion.

MODULE –IV: STRUCTURAL AND LOADING DISCONTINUITIES-CLOSED SECTION BEAMS (09)

General aspects, Shear stress distribution at a built-in end of a closed section beam, Thin-walled rectangular section beam subjected to torsion.

MODULE –V: STRUCTURAL AND LOADING DISCONTINUITIES -OPEN SECTION BEAMS (08)

I-section beam subjected to torsion, Torsion of an arbitrary section beam, Distributed torque loading, Extension of the theory to allow for general systems of loading, Moment couple (bimoment).

V. TEXT BOOKS:

1. T. H. G. Megson, "Aircraft Structures for Engineering Students", Butterworth-Heinemann Ltd, 5th Edition, 2012.
2. David J Perry, J J Azar , "Aircraft Structures" McGraw-Hill Book Company, 2nd Edition, 2012.

VI. REFERENCE BOOKS:

1. B. K. Donaldson, "Analysis of Aircraft Structures - An Introduction", McGraw Hill, 3rd Edition, 1993.
2. E. H. Bruhn, "Analysis and Design of Flight Vehicles Structures", Tri-state off set company, USA, 4th Edition, 1965.
3. S. Timoshenko, "Strength of Materials, Vols I and II", Princeton D. Von Nostrand Co., Reprint, 1977.