Aircraft Structural Analysis

Code	Credit Hours
AE-334	3-0

Course Description

This course deals with structural theory that is common to all types of aerospace vehicles. The first part of the course describes the fundamentals of classical elasticity problems. The second part of the course deals with beam theories of bending, extension, torsion and shear of slender beams without structural discontinuities. The last part of the course introduces advanced topics regarding composites, buckling, and aircraft structural load and analysis. Students will be asked to identify correct principles for generation of solution and infer information from results by performing analysis of a complex structure problem and presenting the concept encompassing advanced topics.

Text Book (S):

1. Megson, Thomas Henry Gordon. Aircraft structures for engineering students. Butterworth-Heinemann, Latest Available Edition
2. Donaldson, Bruce K. Analysis of aircraft structures: an introduction. Cambridge University Press, Latest Available Edition
3. TURBINE AEROPLANE STRUCTURES AND SYSTEMS by Aviation Maintenance Technician Certification Series, Latest Available Edition

Reference Book(s):

1. Beer, F. P., et al. "Mechanics of Materials. 8th_Edition." New York. McGraw-Hill Education Ltd (2020).

Prerequisites

Mechanics of Materials

ASSESSMENT SYSTEM:

Quizzes	10%
Assignments	10%
Mid Terms	30%
ESE	50%

Teaching Plan

Lec No	Description	Reference
	Airworthiness requirements for structural strength;	

1-3	Concept of stress and notations of forces and stress Equations of equilibrium Plane stress Boundary conditions	Text 1 Ch 1 1.1-1.5
4-5	Strain Compatibility equations Plane Strain	Text 1 Ch 1 1.9-1.11 Text 2 1.1-1.4
6-7	Stress-strain relationshipsTemperature effects Experimental measurement of surfacestrains Intro to St. Venant's Principle	Text 1 Ch1 1.15,1.16 Ch22.4 Text 2 6.3, 6.4
8-17	Torsion of solid sections Prandtl stress function solution St. Venant warping function solutionThe membrane analogy Torsion of a narrow rectangular strip	Text 1 Ch 3 3.1-3.4 Text 2 Ch 12 12.1- 12.5
18-20	Open Cross-Section Beam TorsionClosed Section Beam Torsion	Text 2 Ch 13 13.1-13.3
21-24	Beam Theory (Kinematics) Bending and extension of beams (StressResultants) - Stresses due to extension and bending	Text 2 Ch 9 9.1-9.3
25-29	Accuracy of beam equation Calculation of area properties of non-homogenous cross section Calculation of equivalent thermal loads Principal axes for the beam cross-section	Text 2 Ch 9 9.4-9.9
30-34	Deflection of beams	
35-37	Thin-Walled Open Cross-Sections The Open Sectior Shear Center Shear Flows in Thin-Walled Closed Cross Sections	Text 2 Ch14 14.1-14.5

38-40	Pure bending of thin plates Plates subjected to bending and twistingPlates subjected to a distributed transverse load Combined bending and in-plane loading of a thin rectangular plate Bending of thin plates having a smallinitial curvature	Text 1 Ch7 7.1-7.5
41-42	Orthotropic materials Isotropic and other linearly elasticmaterials The plane stress constitutive equationsIntroduction to fiber composites Elastic constants of a simple lamina Stress–strain relationships for an orthotropic ply	Text 2 Ch 6 6.2-6.5 & Text 1 Ch25 25.1, 25.2
43-44	Introduction to buckling	Ref 2 10.1-10.1B
45	Euler buckling of columnsInelastic buckling Stability of beams under transverse andaxial loads Tension field beams	Text 1Ch8 8.1-8.2, 8.4 Ch 9 9.7
46	Loads on structural components Function of structural components	Text 1 Ch12 12.1,12.2
47	Aircraft inertia loads Symmetric maneuver loads Normal accelerations associated withvarious types of maneuvers	Ch 14 14.1-14.3