INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

ANLAYSIS OF AIRCRAFT STRUCTURES								
V Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAED16	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Aerospace Structures								

I. COURSE OVERVIEW:

The "Analysis of Aircraft Structures" course is designed to provide students with a comprehensive understanding of the principles, methods, and techniques used in analyzing and evaluating the structural integrity of aircraft components. This course covers both theoretical concepts and practical applications, aiming to equip students with the knowledge and skills necessary for the design, analysis, and optimization of aircraft structures. Topics include stress analysis, load distribution, material properties, fatigue, and fracture mechanics, with a focus on the unique challenges presented by aerospace engineering.

II.COURSES OBJECTIVES:

The students will try to learn:

I. Develop a fundamental understanding of the principles governing the behavior of materials and structures under various loading conditions.
II. Learn and apply stress analysis techniques to determine the internal forces and deformations in aircraft components.
III. Examine the concepts of fatigue and fracture mechanics as they apply to aircraft structures.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1 Identify factors contributing to fatigue in materials used in aircraft construction various methods for fatigue analysis in aircraft structures.
CO 2 Understand the fundamental principles and applications of energy methods in structural analysis the principle of virtual work to solve structural engineering problems
CO 3 Understand the principles of torsion and its effects on circular cylinders and calculate torsional deformations in circular cylinders.
CO 4 Understand the stability considerations in thin-walled beam structures thin-walled beams with stability in mind.
CO 5 Apply knowledge to solve engineering challenges related to torsion in thin-walled beams structures with thin-walled beams considering torsional requirements.
CO 6 Explore the torsional characteristics of thin-walled beams and calculate torsional deformations in thin-walled beam structures

IV. COURSE CONTENT:

MODULE–I: FATIGUE OF AIRCRAFT STRUCTURES (10)

Impact Strength: Introduction, Impact stresses due to axial, bending and torsional loads, effect of inertia. Fatigue Strength: Introduction, S-N Diagram, Low cycle fatigue, High cycle fatigue, Endurance limit, modifying factors: size effect, surface effect, Stress concentration effects, Fluctuating stresses, Goodman and Soderberg relationship, stresses due to combined loading, cumulative fatigue damage

MODULE–II: ENERGY METHODS (9)

Strain Energy due to axial, bending and Torsional loads. Composite beam, Clapeyron‘s Three Moment Equation

Columns: Columns with various end conditions, Euler ‘s Column curve, Rankine ‘s formula, Column with initial curvature, Eccentric loading, south-well plot, Beam-column.

MODULE–III: TORSION OF CIRCULAR CYLINDERS. (10)

Kinematic description, the stress field, Sectional constitutive law, Equilibrium equations, Governing equations, torsional stiffness, shearing stress distribution, strain energy, Rational design of cylinders under torsion.

Strength under combining loading, VonMises strength criterion, Numerical, Torsion of bars with arbitrary cross-sections, Saint-Venant’s solution, Numerical. The membrane analogy, Torsion of a thin rectangular section, Torsion of thin-walled open sections.

MODULE–IV: THIN-WALLED BEAMS (10)

Basic equations for thin-walled beams, the thin wall assumption Stress flows, Stress resultants, Local equilibrium equation, Evaluation of sectional stiffnesses, bending of thin-walled beams, shearing of thin-walled beams, shearing of open sections, shearing of closed sections, shearing of multi-cellular sections, Problems, shear centre, Problems, Coupled bending-torsion problems.

MODULE–V: TORSION OF THIN-WALLED BEAMS (8)

Torsion of open sections, Torsion of closed section Comparison of open and closed sections, Torsion of combined open and closed sections, Torsion of multi-cellular sections, Problems, warping of thin-walled beams under torsion, warping of open sections, warping of closed sections, Warping of multi-cellular sections, Equivalence of the shear and twist centre, non-uniform torsion, Problems.

V. TEXTBOOKS:

1. Bauchau, O. A. and Craig, J. I., “Structural Analysis: With Application to Aerospace Structures”, Springer (2009).
2. T. H. G. Megson, “Aircraft Structures for Engineering Students”, Butterworth-Heinemann Ltd, 6th Edition, 2020.

VI. REFERENCEBOOKS:

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. VonNostrand Co., Reprint, 1977.

VII. ELECTRONICSRESOURCES:

1. https://akanksha.iare.ac.in/index?route=course/details&course_id=1261
2. https://courseware.cutm.ac.in/courses/aerospace-structural-analysis/
3. https://onlinecourses.nptel.ac.in/noc22_ae19/preview

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech talk topics
4. Open end experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper - II
9. Lecture notes
10. E-learning readiness videos (ELRV)
11. Power point presentation