COURSE CONTENT

AIRCRAFT STRUCTURAL MECHANICS								
II Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BAED14	**Core**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Mechanics of Solids								

I. COURSE OVERVIEW:

Aircraft Structural Mechanics" is a fundamental component of aerospace engineering and focuses on the principles and analysis of aircraft structures. It provides students with a deep understanding of how aircraft components and systems are designed, analyzed, and maintained to ensure safety and reliability. This course provides students with a solid foundation in the mechanics and design of aircraft structures, preparing them to contribute to the development, maintenance, and safety of aircraft systems in the aerospace industry.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The fundamental principles of aircraft structural analysis and design.
II. The stress analysis and load calculations for aircraft components.
III. Evaluate and assess the structural integrity and safety of aircraft.

III. COURSE OUTCOMES:

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

CO 1 Utilize the Impact Strength and Fatigue Strength concept for interpreting stresses due to axial, bending, and torsional loads.
CO 2 Choose Strain Energy and Columns concept for predicting the to axial, bending and Torsional loads, various end conditions, Euler's Column curve, Rankine's formula, and Column with initial curvature.
CO 3 Inspect the Bending of thin-walled beams to find the Mechanical Behaviors.
CO 4 Develop the torsion and shear of the thin plate for predicting the mechanical properties.
CO 5 Illustrate the concepts of stability problems of thin-walled structures.
CO 6 Make use of the concept of Aircraft Loads - Symmetric maneuver loads - Load factor determination for the aircraft structure.

IV. COURSE CONTENT:

MODULE-I: BENDING OF BEAMS (09)

Elementary theory of pure bending - Stresses in beams of symmetrical and unsymmetrical sections - Box beams - Generalized theory of bending - Methods of bending stress determination - Principal axes method - Neutral axis method - 'k' method - Deflection of unsymmetrical beams - Stresses in Composite Beams - Idealization of cross-section - Wing spar sizing.

MODULE-II: SHEAR FLOW IN THIN-WALLED SECTION (10)

General stress, strain and displacement relationships for open section thin-walled beams - Concept of shear flow - Shear flow in thin-walled open sections - Determinations of the shear centre - Symmetrical and unsymmetrical cross-sections - Shear flow due to bending in open sections - Torsion of thin-walled open section members & determination of stresses - Design of thin-walled members

MODULE-III: SHEAR FLOW IN CLOSED SECTIONS (10)
Shear flow in thin-walled closed sections - Symmetrical and unsymmetrical sections - Flexural shear flow in two flanges, three flange and multi-flange box beams - Determinations of the shear center

Bredt-Batho theory - Torsional shear flow in multi-cell tubes - Shear flow due to combined bending and torsion - Stress analysis of aircraft components - Tapered wing spar - Introduction to shear lag

MODULE-IV: STABILITY PROBLEMS (09)
Stability problems of thin-walled structures - Buckling of sheets under compression, shear, and combined loads - Plate buckling coefficient - Inelastic buckling of plates - Sheet-stiffener panels - Effective width - Failure stress in plates and stiffened panels - Crippling stress estimation - Local Buckling - Wagner beam theory - Experimental determination of critical load for a flat plate - Principles of stiffener/web construction

MODULE-V: ANALYSIS OF AIRCRAFT STRUCTURAL COMPONENTS (10)
Aircraft Loads - Symmetric maneuver loads - Load factor determination - Inertia loads - Aerodynamic loads & Schrenk's curve - The flight envelope - Shear force, bending moment and torque distribution along the span of the wing and fuselage - Structural parts of wing and fuselage and their functions - Analysis of rings and frames -- Introduction to aeroelasticity and shells.

V. TEXT BOOKS:

1. Bruce. K. Donaldson, "Analysis of Aircraft Structures: An Introduction", Cambridge University Press, 2nd edition, 2012.
2. Bruhn. EF, "Analysis and Design of Flight Vehicle Structures", Tristate Offset Co., 1980.
3. Megson, TMG, "Aircraft Structures for Engineering Students", Elsevier, Aerospace Engineering, Series, 7th edition, 2021.

VI. REFERENCE BOOKS:

1. Peery, DJ. And Azar, JJ, "Aircraft Structures", 2nd edition, McGraw-Hill, New York, 1993.
2. Rivello, R.M, "Theory and Analysis of Flight structures", McGraw-Hill, N.Y., 1993.
3. Sun. CT, "Mechanics of Aircraft Structures", Wiley publishers, 2nd edition, 2006.

VII. ELECTRONICS RESOURCES:

1. https://mitpress.mit.edu/books/aircraft /structural analysis
2. https://www.edx.org/course/flight-vehicle-/structural analysis-mitx-16-110x-0
3. https://www.mooc-list.com/course/16110x- /structural analysis -edx?static=true

VIII. MATERIALS ONLINE

1. Course template.
2. Assignments.
3. Tutorial question bank.
4. Model question paper – I.
5. Model question paper – II.
6. Lecture notes.
7. Power point presentations.