# AEROSPACE VEHICLE STRUCTURES – I

| IV Semester | | | | | | | | |
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| **Course Code** | **Category** | **Hours / Week** | | | **Credits** | **Maximum Marks** | | |
| **A5AE12** | **PCC** | **L** | **T** | **P** | **C** | **CIA** | **SEE** | **Total** |
| | | 3 | - | - | 3 | 30 | 70 | 100 |

## COURSE OBJECTIVES:

Upon the completion of course students should be able to understand.

1. Understanding the basic concepts of stresses and strains on the 3D elastic body
2. Apply the degree of redundancy (DOR) for statically determinate and indeterminate beam structure.
3. Evaluate the deflection and slope using energy methods
4. Demonstrate the knowledge of the critical loading conditions of the columns.
5. Summarize the direct application of concepts of shear flow for a closed thin walled section beam to aircraft structures

| UNIT-I | INTRODUCTION TO THEORY OF ELASTICITY |
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Introduction To Aircraft Structural Components, Equilibrium and Compatibility conditions for elastic solids, 2D elasticity equations for plane stress, plane strain and generalized plane strain causes Airy's stress function. Simple problems in plane stress/plane strain stresses and strains on arbitrary planes and transformations.

| UNIT-II | REDUNDANT STRUCTURES |
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Indeterminate structure, order of redundancy, Introduction to redundant analysis, use of free body diagrams to explain compatibility and redundant analysis principles, moment area method analysis of various types of beams, three moment equation (Clapeyron theorem) of a continuous beams

| UNIT-III | ENERGY PRINCIPLES AND THEORIES OF FAILURE |
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Introduction to energy principle and methods. Principle of virtual Displacements and principle of Virtual Force Castigliano's theorems, maxwell's reciprocal theorem and unit load method.

Introduction – Various theories of failure - Maximum Principal Stress Theory, Maximum Principal Strain Theory, Strain Energy and Shear Strain Energy Theory (Von Mises Theory) and fracture modes

| UNIT-IV | STABILITY OF COLUMNS |
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Stability of structural systems, Models of instability of columns. Euler's formula for critical loads of column, end conditions of a column, Slenderness ratio, Effect of boundary conditions on mode shapes and critical loads. Column with initial curvature, effect of eccentricity Long, Medium and short column ranges. Rankine and Johnson's formulae. Effect of intermediate supports. Concept of beam column.

| UNIT-V | TORSION OF THIN WALLED CLOSED SECTION |
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Bredt- Batho formula. Single and multi-cell closed box structures. Semi monocoque and moncoque structures. Approximate method for box beams. Shear flow in single and multicell monocoque and semi monocoque box beams subject to torsion.

## Text Books:

1. Megson T. H. G (2012), Aircraft Structures for Engineering Students, Elsevier, New York.
2. Strength of Materials by R.K Rajput S. Chand publishers.

**Reference Books:**

1. B. C. Punmia (2011), Theory of Structures, 13th edition, Laxmi Publications Ltd, Hyderabad.
2. S. Ramamrutham, Theory of structures, Dhanpat Rai Publication

**COURSE OUTCOMES:**

This course uses lectures, assignments and home works to the students. The teaching methods include regular class work, Problem solving, technical quiz and seminars to enable the students:

1. Develop stress strain relationships for a three-dimensional body,
2. Analyze indeterminate structures using various methods
3. Determine deflection and slopes using energy methods
4. Estimate buckling loads for different boundary conditions of the columns
5. Analyze the shear flow distribution in an aircraft structural components wings & fuselage