THEORY OF STRUCTURES

III Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAE002	**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**		

I. COURSE OVERVIEW:

Mechanics of solids deals with deformable solids, requires basic knowledge of principles of mechanics from Engineering Mechanics course and acts as a pre-requisite to the advanced courses on Aircraft structures and Analysis of aircraft structures. This course introduces the concepts of simple stresses, strains and principal stresses on deformable solids and focuses on the analysis of members subjected to axial, bending, and torsional loads. In a nutshell, the course aims at developing the skill to solve engineering problems on strength of materials. Eventually, through this course content, engineers can analyze the response of various structural members under different loading conditions and design the same, satisfying the safety and serviceability conditions.

II. OBJECTIVES:

The course should enable the students to:

I	The concepts of mechanics of deformable solids and their constitutive relations (including stress – strain relations), principal stresses and strains and resilience produced under various loading conditions for determining the strength of aircraftstructures.
II	The methods of determining shear force - bending moment, twisting moment,flexural Stresses, shear stresses, subjected to various loadings and boundary conditions, for designing the shape, size and material of aircraft components.
III	The methods for determining the slope and deflection of different types of beamssubjected to various loading conditions for determining the strength of aircraft structures.
IV	The twisting moment, torsion, torque, principal stress and strains for designing theshaft and rods for analysis of aircraft structures.

III. COURSE OUTCOMES:

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

CO 1	**Choose** basics of elasticity for determining the mechanical properties in designing aircraft structural components	Understand
CO 2	**Analyze** the effects of various loading conditions on symmetric and un symmetric beams for determining the flexural and shear stresses.	Apply
CO 3	**Make use** of different methods such as for to find deflections underdifferent loading conditions.	Apply
CO 4	**Evaluate** the buckling of a column using Eigen values and Eigenvectors to understand the required strength of a column.	Apply
CO 5	**Differentiate** the different alternative methods available fordetermining the behavior of trusses.	Apply
CO 6	**Utilize** the concept of stresses on inclined planes using graphical and analytical method for further comprehension of aircraft structures.	Analyze

VI. SYLLABUS

UNIT-I	INTRODUCTION	Classes: 10

Mechanical properties of materials; Stresses and strains; Hooke's law, elastic constant, relation between modulii, working stress, factor of safety, poisons ratio ; bars of varying cross section; Thermal stresses. Torsion of solid and hollow circular shafts and shear stress variations; Power transmission in shafts; Shear force and bending moment diagrams for different types of beams with various loads.

UNIT-II	STRESSES IN BEAMS	Classes: 09

Bending stresses and Shear stress variation in beams of symmetric and un-symmetric sections; Beams of uniform strength; Flexural stresses: Bending equations, calculation of bending stresses for different sections of beams like I, L, T, C, angle section.

UNIT-III	BEAMS AND COLUMNS	Classes: 09

Deflection of beams by Double integration method, Macaulay's method, moment area method, conjugate beam method; Principle of superposition.

Columns, types of columns, Euler's formula instability of columns, Rakine's and Jonson's formula, Eigen values and Eigen modes, concept of beam-column.

UNIT-IV	REDUNDANT STRUCTURES	Classes: 08

Trusses, perfect frames, analysis of trusses; Determinate and indeterminate structures, order of redundancy; Redundant analysis, analysis of determinate structures, area movement method, Clayperons method, slope deflection method, moment distribution method.

UNIT-V	THEORY OF ELASTISITY	Classes: 09

Equilibrium and compatibility conditions and constitute relations for elastic solid and plane: generalized plane strain cases Airy's stress function
Stress on inclined planes, stress transformations determination of principal stresses and strains by analytical method and graphical method - Mohr's circles and its constructions.

Text Books:

1. R. K Bansal, "Strength of Materials", Laxmi publications, 5th Edition, 2012.
2. T. H. G. Megson, "Aircraft Structures for Engineering Students", Butterworth-Heinemann Ltd, 5th Edition, 2012.
3. Gere, Timoshenko, "Mechanics of Materials", McGraw Hill, 3rd Edition, 1993.

Reference Books:

1. Dym, C. L, Shames, I. H, "Solid Mechanics", McGraw Hill, Kogakusha, Tokyo, 7th Edition, 2007.
2. Stephen Timoshenko, "Strength of Materials", Vol I & II, CBS Publishers and Distributors, 3rd Edition, 2004.
3. R. K. Rajput, "Strength of Materials", S. Chand and Co., 1st Edition, 1999.
4. Timoshenko, S, Young, D. H. "Elements of Strength of Materials", T. Van Nostrand Co. Inc., Princeton N.J, 4th Edition, 1977.

Web References:

1. www.nptel.ac.in/courses/112107147/
2. www.vssut.ac.in/lecture_notes/lecture1423904647.pdf
3. www.web.mit.edu/emech/dontindex-build/

E-Text Books:

1. www.e-booksdirectory.com/listing.php?category=456
2. www.esag.harvard.edu/rice/e0_Solid_Mechanics_94_10.pdf
3. www.itiomar.it/pubblica/dispense/MECHANICAL%20ENGINEERING%20HANDBOOK/

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