MECHANICS OF SOLIDS

III Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB04	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

COURSE OBJECTIVES:

The student will try to learn:

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 aircraft structures

II. The methods of determining shear force - bending moment, twisting moment, flexural Stresses, shear stresses, deflection of beams subjected to various loading and boundary conditions, for identifying the shape, size and material required in designing aircraft components.

III. The mechanism of buckling behavior of the columns under different end conditions along with Eigen modes, effect of direct and eccentric loading in designing long columns.

IV. The equilibrium and compatibility conditions for two-dimensional and three dimensional elastic bodies for analysis of aircraft structures.

COURSE OUTCOMES:

CO1 **Explain** the concepts of stress-strain and their relations in conjunction with elasticity and material properties for solving the stresses and strains induced in the body under various loading conditions.

CO2 **Demonstrate** the effects of temperature and boundary conditions for the bar in determining the induced thermal stresses-strains

CO3 **Explain the** work done and strain energy induced in a body, subjected to gradually, suddenly and with impact loads in analyzing their effects in structural design.

CO4 **Apply the concepts of** the shear stress induced in a circular shaft due to torsion, in designing key and shaft for power transmission in aircraft prolusion system.

CO5 **Illustrte** the shear force and bending moment in beams, for analyzing the structural behaviour based on the principles of equilibrium and material constitutional relationships.

CO6 **Demonstrate** the suitability of double integration Macaulay's methods and moment area method in evaluating the deflection and slope of beams, subjected to various loads.

CO7 **Analyze** the bending and shear stresses induced in simple and composite beams for evaluating bending and shear strengths..

CO8 **Explain** buckling behavior along with eigen modes, effects of direct and eccentric **loads** in designing the long columns under various end conditions

CO9 **Interpret** the analytical and graphical methods on an oblique section of a strained body for determining the principal stresses, shear stresses and their resultant useful in analysis of stresses.

CO10 **Explain** the equilibrium and compatibility conditions of two-dimensional and three dimensional elastic bodies for stability of aircraft structures..

CO11 **Identify** appropriate materials in design by considering engineering properties, sustainability, cost and weight for solving real time problems of aircraft structural design under different loading conditions

Module-I	INTRODUCTION

Properties of Engineering materials, Stresses and strains, Hooke's law, elastic constant, relation between module, working stress, factor of safety, poisons ratio, bars of varying cross section; Thermal stresses. Torsion in solids, Concept of Stain Energy

Module-II	FORCES, DEFLECTION IN BEAMS

Shear force and bending moment diagrams for different types of beams with point load, uniform distributed load and uniform varying load.

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

Module-III	STRESS IN BEAMS

Theory of simple bending, Bending stress, Position of neutral axis, Bending stresses in beams of symmetric and un-symmetric sections, Beams of uniform strength,

Shear stresses: Shearing stresses at a section in a loaded beam, Distribution of shearing stresses over different sections like Rectangular, Triangular, circular, I, L and T-sections

Module-IV	COLUMNS

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.

Module-V	THEORY OF ELASTISITY

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. B C Punmia, "Mechanics of Materials", Laxmi publications (P) Ltd, 2006.
3. T. H. G. Megson, "Aircraft Structures for Engineering Students", Butterworth-Heinemann Ltd, 5th Edition,2012

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.
5. Gere, Timoshenko, "Mechanics of Materials", McGraw Hill, 3rd Edition, 1993.

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/ 1.