MECHANICS OF SOLIDS

III Semester: AE & ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAEC01	Core	3	0-	0	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

Prerequisite: Engineering Mechanics

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. COURSE OBJECTIVES:

The students 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 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	**Understand** the concepts of stress-strain, material constitutional relationship and strain energy for solving the stresses and strain induced in the body under various loading conditions	Understand
CO 2	**Illustrate** the shear force and bending moment in beams, for analyzing the structural behavior based on different loading conditions	Apply
CO 3	**Analyze** the effects of various loading conditions on symmetric and un symmetric beams for determining the flexural stresses.	Apply
CO 4	**Illustrate** the effects of various loading conditions on symmetric and un symmetric beams for determining the shear stresses.	Apply
CO 5	**Make use of** different methods such as for finding deflectionsunder different loading conditions.	Apply
CO 6	**Utilize** the concept of stresses on inclined planes using graphical andanalytical method for further comprehension of aircraft structures.	Analyze

IV. COURSE SYLLABUS:

MODULE-I: SIMPLE STRESSES & STRAINS (09)

Elasticity and plasticity, types of stresses and strains, Saint Venant's principle, Hooke's law, stress, strain diagram for mild steel, working stress, factor of safety, lateral strain, Poisson's ratio & volumetric strain, Elastic moduli & the relationship between them, bars of varying section, composite bars, temperature stresses; Strain energy and resilience, gradual, sudden, impact loadings.

MODULE –II: SHEAR FORCE AND BENDING MOMENT (09)

Definition of beam, types of beams, concept of shear force and bending moment, S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l., uniformly varying loads and combination of these loads, point of contra flexure, relation between S.F., B.M.

MODULE –III: FLEXURAL, SHEAR STRESSES (10)

Flexural Stresses: Theory of simple bending, assumptions, derivation of bending equation, neutral axis, determination bending stresses, section modulus of rectangular and circular sections (Solid and Hollow), I, T, angle and channel sections, design of simple beam sections, beams of uniform strength.

Shear Stresses: Derivation of formula, shear stress distribution across various beams sections like rectangular, circular, triangular, I, T and angle sections.

MODULE –IV: DEFLECTION OF BEAMS(09)

Bending into a circular arc, slope, deflection and radius of curvature, differential equation for the elastic line of a beam, double integration and Macaulay's methods, determination of slope and deflection for cantilever and simply supported beams, over hanging beams, propped beams and cantilevers subjected to point loads, U.D.L and uniformly varying load. Beams of variable cross-sections.

MODULE –V: TORSION OF CIRCULAR SHAFTS, PRINCIPAL STRESS AND STRAINS(09)

Torsion of circular Shafts: Introduction, relation between twisting moment twist and shear stress, torque, power, rotational speed, polar moment of inertia, torsional shear stress and polar moment of inertia for solid and hollow circular shafts, design of shafts, combined bending and torsion.

Principal Stress and Strains: Stress components of inclined planes, Biaxial stress with state of simple shear, circular diagram of stress, Mohr circle, principal strains: Computation of principal stresses form principal strains, strain in an inclined direction, Mohr circle of strain, strain measurement, strain Rosettes.

V. TEXT BOOKS

1. B C Punmia, "Mechanics of Materials", Laxmi publications (P) Ltd, 2006
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.

VI. REFERENCE BOOKS:

1. Stephen Timoshenko, "Strength of Materials", Vol I & II, CBS Publishers and Distributors, 3rd Edition, 2004.
2. Timoshenko, S, Young, D. H. "Elements of Strength of Materials", T. Van Nostrand Co. Inc., Princeton N.J, 4th Edition, 1977.
3. Russell C. Hibbeler, "Mechanics of Materials", Pearson, 9th Edition, 2014.
4. Robert L Mott "Applied strength of materials", PHI, 5th Edition, 2009
5. Ferdinand P. Beer, E. Russell Johnston, John T. Dewolf, David F. Mazurek ,"Mechanics of Materials", 6th Edition, McGraw-Hill, 2012

VII. 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/

VIII. 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/