

MECHANICS OF SOLIDS

| III Semester: AE | | | | | | | | |
|--|----------|------------------------------|---|-------------------------------|---------|--------------------------|-----|-------|
| Course Code | Category | Hours / Week | | | Credits | Maximum Marks | | |
| AAEC01 | Core | L | T | P | C | CIA | SEE | Total |
| | | 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: | | | | | | | | |
| <p>The primary objectives of mechanics of solids is to enable students to acquire the fundamentals for understanding the behavior of structural components commonly used in engineering and machines subjected to various loading and support conditions based on principles of equilibrium and material constitutional relationship. In day-to-day work, an engineer comes across certain materials, i.e., steel girders, angle irons, circular bars, etc., which are used in designing all types of structures and machines. An in-depth understanding of material properties under various loading conditions including temperature and their effects is essential to take suitable protective measures for safe working of designed and fabricated product.</p> | | | | | | | | |
| II. COURSE OBJECTIVES: | | | | | | | | |
| The students will try to learn: | | | | | | | | |
| <ol style="list-style-type: none"> 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 loadings and boundary conditions, for designing the shape, size and material of 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. | | | | | | | | |
| III. 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 from principal strains, strain in an inclined direction, Mohr circle of strain, strain measurement, strain Rosettes.

IV. 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.

V. 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

VI. 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/

VII. 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/