ADVANCED MECHANICS OF MATERIALS

Subject Code: 13ME2203 **L P C**
4 0 3

Pre requisites: Engineering Mechanics and Mechanics of solids

Course Educational Objectives:

To make the student learn

1. three-dimensional nature of stress, strain, displacement and their relationship.
2. advanced methods for the analysis and design of structural components in mechanical engineering field.
3. how to interpret the results for design, analysis and research purposes.

Course Outcomes:

The student will be able to

1. relate loading and deformation states to the proper components of stress and strain, identify direction and magnitude of principal stresses and principal strains.
2. analyze and design the columns
3. understand and apply the concepts of asymmetric bending, shear centre.
4. perform the stress analysis of curved beams
5. apply Castigliano's first and second theorems for predicting deflections and rotations in simple, statically determinate and indeterminate structures.
6. understand the concept of plastic deformation in members under torsion, bending and calculate the residual stresses.
7. analyze the torsion of noncircular cross-sections

UNIT-I

Analysis of stress and strain: Three dimensional state of stress at a point - Stress components on an inclined plane - Principal stresses - Stress invariants - Octahedral stress. Rectangular strain components - State of strain at a point - Principal strains, Stress-strain relations for isotropic materials.

UNIT- II

Columns: Euler's buckling load of a column for different support conditions, effective length of a column, Rankine formula, Column subjected to eccentric loading-Secant formula, Critical load of a column having initial curvature - stresses, Beam column with a concentrated load at mid-span.

UNIT –III

Unsymmetrical bending: Unsymmetrical bending of straight beams having rectangular, I-section, and T-sections – stresses induced – Neutral axis.

Concept of Shear centre – Shear centre of simple thin-walled sections, Shear stresses in thin-walled open sections.

UNIT –IV

Bending of curved beams: Winkler-Bach formula - Shift of neutral axis for various cross-sections - stresses in curved beams, stresses in crane hook, stresses in circular rings.

Energy methods: Castigliano's first and second theorems, application to members subjected to axial, transverse and torsional loads, application to statically indeterminate structures.

UNIT –V

Plastic deformation: Elasto-plastic material - Plastic deformation of circular shafts under torsion - Residual stresses in circular shafts. Plastic deformation of members with a single plane of symmetry under bending - Residual stresses in beams.

Torsion on non circular members: Rectangular, Elliptical and Equilateral triangular cross-sections, Torsion of thin walled tubes.

TEXT BOOKS:

1. L. S. Srinadh, "*Advanced Mechanics of Solids*", 2nd Edition, Tata McGraw Hill, 2004.
2. F. P. Beer, E. R. Johnston, J. T. Dewolf, and D. F. Mazurek, "*Mechanics of Materials*", 6th Edition, McGraw Hill, 2012.

REFERENCES:

1.S. S. Rattan, "*Strength of Materials*", 2nd Edition, Tata McGraw Hill, 2008, 3rd Reprint, 2012.
2.H. J. Shah, S. B. Junnarkar, "*Mechanics of Structures: Strength of Materials* (Vol-1)", 29th Edition, Charotar Publishing House, Anand, Gujarat, 2011.
3.James M. Gere and Barry J. Goodno, "*Mechanics of Materials*", 8th Edition, Cengage Learning, 2012.
4.R. C. Hibbeler, "*Mechanics of Materials*", 8th Edition, Prentice Hall Inc., 2011.
5.P. Haupt, "*Continuum Mechanics and Theory of Materials*", 2nd edition, Springer, 2002.