ADVANCED MECHANICS OF MATERIALS

Subject Code: 13ME2203

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Course Outcomes:

At the end of the course, a student will be able to

CO1: Relate loading and deformation states to the proper components of stress and strain, determine the principal stresses and principal strains

CO2: Analyze and design the columns

CO3: Determine the stresses due to asymmetric bending; locate the shear centre of thin-walled sections

CO4: Determine the stresses in curved beams; apply Castigliano's theorems for deflection of statically determinate and indeterminate structures

CO5: Calculate the residual stresses in members under torsion / bending; 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.