I YEAR M. TECH (MACHINE DESIGN) FIRST SEMESTER

17MEMD1T1 ADVANCED MECHANICS OF SOLIDS Credits 4

Lecture: 4 periods/week **Internal assessment: 40 marks**

Tutorial: - - **Semester end examination: 60 marks**

COURSE OBJECTIVES:

- Understand the theory of elasticity including strain/displacement and Hooke's law relationships and apply various failure criteria for general state of stress a point.
- Compute the shear centre for various sections and calculate the bending stresses and deflections of beams under unsymmetrical loading
- Determine the bending stresses in curved beams and stresses in axisymmetric rotating members
- Solve the shear stresses in various cross sections under torsional loading and analyze solid mechanics problems using classical methods and energy methods

COURSE OUTCOMES:

Upon successful completion of this course, the student should be able to

1. Understand the concepts of three-dimensional stress and strain at a point as well as the stress-strain relationships and apply failure theories.
2. Locate the shear centre in beams and compute the stresses and deflections of beams under unsymmetrical loading
3. Analyze the curved beams and Calculate the stresses and strains in rotating disks
4. Solve torsion problems in bars with non circular cross sections and Apply energy methods for the determination of the deflections

Pre-Requisites: Mechanics of Solids

UNIT-I

THREE DIMENSIONAL STRESS AND STRAIN:

Definition of stress at a point, stress notation, stress in arbitrary plane, stress transformation, principal stresses, strain notation, strain displacement relation, strain compatibility relations, principal strains

YIELD CRITERIA:

General concepts, maximum Principal Stress Criterion, Maximum Principal Strain Criterion, Strain Energy Density Criterion, Maximum Shear Stress Criterion, Distortion Energy Density Criterion

UNIT-II

SHEAR CENTER:

Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections

UNSYMMETRICAL BENDING:

Bending stresses in Beams subjected to Nonsymmetrical bending, Deflection of straight beams due to nonsymmetrical bending.

UNIT-III

CURVED BEAM THEORY:

Winkler Bach formula for circumferential stress – Limitations – Location of Neutral axis of cross section–stresses in crane hooks – closed ring subjected to concentrated load-stresses in chain links.

AXI-SYMMETRIC PROBLEMS:

Rotating Discs- Flat discs, Discs of uniform thickness, Discs of uniform strength

UNIT-IV

TORSION

Torsion of a cylindrical bar of Circular cross Section, Saint-Venant's semi-inverse method, Linear elastic solution, Prandtl elastic membrane (Soap-Film) Analogy, Narrow rectangular cross Section, Hollow thin wall torsion members, Multiply connected Cross Section, Thin wall torsion members with restrained ends.

APPLICATION OF ENERGY METHODS

Elastic deflections and statically indeterminate members and structures: Principle of stationary potential energy, Castigliano's theorem on deflections, Castigliano's theorem on deflections for linear load deflection relations, deflections of statically determinate structures.

Learning Resources

Textbooks:

1. Advanced Mechanics of Materials, (6^{th} Edition) by Arthur P. Boresi and Richard J. Schmidt, Wiley India (P.) Ltd, New Delhi, 2012.

References:

1. Advanced strength of materials by Den Hortog J.P., Dover Publications, 1988
2. Advanced Mechanics of Solids by L.S Srinath, Mcgraw Hill Education, 2010.
3. Mechanics of Materials (10^{th} Edition) by B.C Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi Publications, 2015.
4. Strength of Materials (Revised Edition) by R. K. Rajput, S Chand & Pvt. Ltd., 2014.
5. Strength of Materials, (11^{th} Edition) by Dr. Sadhu Singh, Khanna Publishers, New Delhi, 2007.