2/4 B.Tech. THIRD SEMESTER

CE3T3 **MECHANICS OF SOLIDS – I** **Credits: 4**

Lecture: 4 periods/week **Internal assessment: 30 marks**
Tutorial: 1 period /week **Semester end examination: 70 marks**

Objectives:

- To understand the behavior of materials and structural bodies under the action of loads.
- To gain knowledge on the relation between the external loads, internal strength parameters and displacements, this is the basis to study the non-idealized real structures.

Learning outcomes:

At the end of course the student will be able to:

- Assess the internal behavior properties of materials such as simple stresses strains, strain energy, principal stresses & strains.
- Determine shear force, bending moment, deflection of statically determinate beams.
- Evaluate the flexural stresses & shear stresses of different sections and torsional stresses of circular shafts

UNIT – I
SIMPLE STRESSES AND STRAINS:
Elasticity and plasticity – Types of stresses and strains – Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic module and the relationship between them – Bars of varying section – composite bars – Temperature stresses.

UNIT - II
STRAIN ENERGY:
Resilience – Gradual, sudden, impact and shock loadings – simple applications.

UNIT – III
SHEAR FORCE AND BENDING MOMENT:
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, UDL, UVL and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT – IV
FLEXURAL STRESSES:
Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y = E/R 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.

UNIT – V

SHEAR STRESSES:

Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.

UNIT – VI

TORSION OF CIRCULAR SHAFTS:

Theory of pure torsion – Derivation of Torsion equations : $T/J = q/r = N\theta/L$ – Assumptions made in the theory of pure torsion – Torsional moment of resistance – Polar section modulus – Power transmitted by shafts – Combined bending and torsion and end thrust – Design of shafts according to theories of failure.

UNIT – VII

DEFLECTION OF BEAMS:

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 subjected to point loads, - U.D.L. Uniformly varying load.-Mohr's theorems – Moment area method – application to simple cases including overhanging beams.

UNIT – VIII

PRINCIPAL STRESSES AND STRAINS:

Introduction – Stresses on an inclined section of a bar under axial loading – compound stresses – Normal and tangential stresses on an inclined plane for biaxial stresses – Two perpendicular normal stresses accompanied by a state of simple Shear – Mohr's circle of stresses – Principal stresses and strains – Analytical and graphical solutions.

Learning resources

Text books:

1. Introduction to text book of Strength of materials, (4^{th} edition) by Bansal, R.K., Laxmi Publications Pvt. Ltd., New Delhi, 2009.
2. Introduction to text book of Strength of Materials by Jindal, U.C., Galgotia Publications, 2001.

Reference books:

1. Strength of Materials, (16^{th} edition) by Ramamrutham, S. and Narayan, R., Dhanpat Rai Publications, 2010.
2. Strength of materials, (5^{th} edition) by Rajput, R.K., S. Chand and Co, New Delhi 2012.
3. Strength of Materials, (2^{nd} edition) by Basu. A.R., Dhanpat Rai and Co, Nai Sarah, New Delhi , 2010.
4. Strength of Materials, (3^{rd} edition) Bhavi Katti, S.S., Vikas Publications, New Delhi, 2008.