

## STRENGTH OF MATERIALS - I

### UNIT I - SIMPLE STRESSES AND STRAINS

**Introduction** - Strength of material in civil engineering. **Stress and strain** - Stress, Types of stress, Strain and its types, Poisson's ratio, Mechanical properties of materials, Hooke's law, Relationship between stress and strain in one dimensional, Relationship between stress and strain in two dimensional, Relationship between stress and strain in three dimensional., Analysis of bars of varying sections, Composite sections, Principle of superposition, Analysis of uniformly tapering circular rod, Analysis of uniformly tapering rectangular bar, Problems. **Elastic constant** - Volumetric strain, Volumetric strain of a rectangular bar subjected to three forces which are mutually perpendicular, Volumetric strain of a cylindrical rod, Modulus of elasticity, Modulus of rigidity, Bulk modulus, Relation between young's modulus E and rigidity modulus C, Relation between young's modulus E and bulk modulus K, Relation between young's modulus E, rigidity modulus C and bulk modulus K, problems. **Stress strain diagram** - For mild steel, For concrete, Working stress, Factor of safety, Problem. **Thermal stresses** - Introduction, Thermal stresses in composite bars, Problems. **Strain Energy** - Resilience, Strain energy due to Gradual, Sudden, Impact and Shock loadings, Simple applications.

### UNIT II - SHEAR FORCE AND BENDING MOMENT

**Introduction to beams, loads and supports** - Introduction to beams, Definition of beam, Types of beams, Bending in beams, Types of supports, Types of beam based on support, Types of loads. **Concept of shear force and bending moment** - Shear force, Bending moment, Shear force and bending moment diagram and its importance, Relationship between bending moment and shear force. **S.F and B.M diagrams for cantilever beam** - SFD and BMD for cantilever beam with point load at the free end, SFD and BMD for cantilever beam with point load at a distance of a from fixed end, SFD and BMD for cantilever beam with uniformly distributed load on whole span, SFD and BMD for cantilever beam subjected to UDL over a part of span from fixed end, SFD and BMD for cantilever beam carrying a uniformly varying load, Problems. **S.F and B.M diagrams for simply supported beam** - SFD and BMD for simply supported beam with central point load, SFD and BMD for simply supported beam with eccentric point load, SFD and BMD for simply supported beam with UDL throughout the span, SFD and BMD for simply supported beam with carrying uniformly varying load, Problems. **S.F and B.M diagrams for overhanging beams** - Point of contraflexure, Problems.

### UNIT III - FLEXURAL STRESS

**Theory of simple bending** - Bending stress, Theory of simple bending, Pure bending, Moment of resistance, Derivation of bending equation, Bending stress in symmetrical and unsymmetrical section., Problems on bending equation. **Section modulus** - For square section, rectangular, Triangular, I section, L section, Channel section, T section, Angle section, Problem on section modulus. **Shear stress distribution** - Shear stress, Shear stress distribution in rectangular section, Circular section, I section,

Triangular section, T-section, Problems on shear stress distribution.

#### **UNIT IV – PRINCIPAL PLANE AND STRESS**

**Principal plane and stresses** – A member subjected to a direct stress in one plane, The member subjected to like direct stresses in two mutually perpendicular directions, A member subjected to direct stresses in two mutually perpendicular direction accompanied by a simple shear stress, Problems. **Mohr's circle** - A body subjected to two mutually perpendicular principal tensile stresses of unequal intensities, A body subjected to two mutually perpendicular principal stresses which are unequal and unlike, A body subjected is subjected two mutually perpendicular principal tensile stresses accompanied by a simple shear stress, Problems. **Strain on an oblique plane** - Strain on an oblique plane due to stress, Strain on an oblique plane due to shear stress, Maximum or minimum value of strain on oblique plane, Mohr's strain circle, Problems. **Theories of failure** – Introduction, Various theories of failure, Maximum principal stress theory, Maximum principal strain theory, Maximum shear stress theory, Maximum strain energy theory, Maximum shear strain energy theory, Problems based on theories of failure.

#### **UNIT V - DEFLECTION OF BEAMS**

**Introduction** - Beam deflection, Deflection and slope of a beam subjected to uniform bending moment, Relation between slope, deflection and radius of curvature, Elastic curve. **Double integration method** - Introduction to Double integration method, Deflection of a simply supported beam carrying a point load at the centre, Deflection of a simply supported beam with an eccentric point load, Deflection of a simply supported beam with a uniformly distributed load, Deflection of a simply supported beam with a uniformly varying load, Deflection of cantilever with a point load at the free end, Deflection of a cantilever with a point load at a distance 'a' from the fixed end, Deflection of a cantilever with a uniformly distributed load, Deflection of a cantilever with a uniformly distributed load for a distance 'a' from the fixed end, Deflection of a cantilever with a uniformly distributed load for a distance 'a' from the free end, Deflection of a cantilever with a uniformly varying load, Problems. **Macaulay's method** - Introduction to Macaulay's method, Deflection of a simply supported beam with an eccentric point load, Deflection of a simply supported beam with a uniformly varying load, problems. **Moment area method** - Introduction to moment area method, Derivation for slope and deflection by using moment area method, Slope and deflection of a simply supported beam carrying a point load at the centre by Mohr's theorem, Slope and deflection of a simply supported beam carrying a uniformly distributed load by Mohr's theorem, Problems. **Conjugate beam method** - Introduction to conjugate beam method, Conjugate theorem, Problems.