MECHANICS OF SOLIDS

UNIT I - SIMPLE STRESSES AND STRAINS

Introduction of materials- Materials, Strength of materials, Strength, Mechanical properties of materials, Elasticity, Brittleness, Hardness, Stress, Strain. **Types of loads, stress and strain -** Load, According to the manner of application, According to the nature of application, According to the effect produced, Types of stresses, Tensile force, Types of strains, Tensile strain. **Statement of Hooke's Law and Elastic constant -** Hooke's law, Elastic constants, Modulus of elasticity, Modulus of rigidity, Bulk modulus. **Stress-Strain Diagram for ductile materials -** Stress - strain diagram for ductile material, Features of stress - strain curve. **Problems based on stress and strain in uniform cross section bars -** Problems based on stress and strain in uniform cross section bars.**Lateral strain, Poisson's ratio and factor of safety -** Lateral strain, Poisson's ratio, Factor of safety. **Elastic constants and their relations -** Elastic constants, 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 based on elastic constant - rectangular steel bar.**Analysis on varying cross sections -** Bars of varying cross - sections – Problem based on bars of varying cross, Bars subjected to varying loads – Problem based on subjected to varying loads.**Volumetric strain of different cross - sections -** Volumetric strain, Problem based on volumetric strain.**Temperature Stresses and Strains -** Temperature Stresses and Strains, Problem based on temperature Stresses and Strains, Thermal stresses in composite bars, Problem based on thermal stresses in composite bars.**Introduction to strain energy -** Strain energy, Resilience, Strain energy – gradual load, Problem based on strain energy, Maximum instantaneous stress due to suddenly applied loading, Problem based on maximum instantaneous stress due to suddenly applied loading. **Impact and shock loading -** Impact loading, Problem based on impact loading, Shock loading, Problem based on shock loading.

UNIT II - SHEAR FORCE AND BENDING MOMENT

Introduction to beam- Beam definition, Examples of beam, Classification of beams, Geometric forms of beams, Classification of beams based on support, Types of loads on beams. **Shear force and bending moment for cantilever beams -** Shear force and bending moment in beams, Shear force sign convention, Bending moment sign convention, Shear force and bending moment diagram, Cantilever beam subjected to concentrated load, Cantilever subjected to UDL, Cantilever subjected to UDL and concentrated load, Cantilever subjected to UDL for part of beam, Problem based on s.f and b.m diagrams for cantilever beam, Cantilever subjected to UVL o to w, Cantilever subjected to UVL w to o, Problem based on s.f and b.m diagrams for cantilever beam. **Shear force and bending moment for simply supported beams -** Concentrated load at mid span, Concentrated load placed unsymmentrically, Problem based on simply supported beams, UDL over whole span, Problem based on simply supported beams, UVL o to w at other end, UVL o to w at mid end, Relation between Load, Shear force and Bending moment, Point of contraflexure, Problem based on simply supported beams. **Shear force and bending moment for overhanging beam -** Problem based on left overhanging beam.

UNIT III - FLEXURAL AND SHEAR STRESSES

Simple bending Theory - Bending stress, Theory of simple bending, Pure bending, Moment of resistance, Derivation of bending equation, Bending stress in symmetrical and unsymmetrical section. **Section modulus -** Section modulus, Symmetrical and unsymmetrical section, Section modulus for square section, Section modulus for rectangular section, Section modulus for circular section, Section modulus for triangular section, Other symmetrical sections, Other unsymmetrical sections. **Problem based on section modulus -** Problem based on section modulus. **Problems based on bending equation -** Problems based on bending equation. **Design of simple beam sections -** Problem based on design of symmetrical section for given load. **Shear stress distribution -** Introduction to shear stress, Shearing stress variation on beam, Shear stress in rectangular section, Shear stress in circular section, Shear stress in symmetrical I-section, Shear stress in triangular section. **Problems based on shear stress distribution -** Problems based on shear stress distribution.

UNIT IV - PRINCIPAL STRESSES AND STRAINS AND THEORIES OF FAILURE

Introduction to plane stresses - Introduction, Principal plane and stresses, A member subjected to a direct stress in one plane, The member is 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, Problem based on principle stresses of the metalic column, Problem based on principle stresses in the wall of a container. **Mohr's circle of stresses-** 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 is subjected to two mutually perpendicular principal tensile stresses accompanied by a simple shear stress, Problem based on mohr's circle.**Theories of Failure -** Theory of Strength, Principal Stresses at a Point, Principal Stress-Strain Relation, Biaxial Stress State, Theories of Strength / Failure, Normal Stress Theory (Rankine), Normal Strain Theory (St Venant's), Shear Stress Theory (Coulomb, Guest, Tresca), Strain Energy Theory (Beltrami), Von Mises Theory. **Problems based on theories of failure -** Problems based on theories of failure.

UNIT V - TORSION OF CIRCULAR SHAFTS AND THIN CYLINDERS

Introduction to torsion - Definition of shaft, Torsion in shafts, Assumptions for torsion equations. **Stresses in shafts -**Angle of twist, Stresses in shafts, Torsion equation for solid shafts, Torsion equation for hollow circular shaft, Torsion rigitity, Modulus of rupture, Composite shafts - serial connection, Composite shafts - parallel connection, Comparison of solid and hollow shafts, . **Problems on torsion of circular shafts -** Problem based on torsion, Problem based on shaft fixed at both ends, Problem based on composite shaft, Problem based on torsion. **Combined bending and torsion -** Problem based on bending moment, Problem based on bending moment with torque. **Thin Cylindrical shells -** Thin shells-Introduction,Thin cylindrical shells, Circumferential or hoop stresses, Longitudinal stressesamplifier, Maximum shear stress, Design of thin cylindrical shells, Volumetric strains.**Spherical shells -**Cylindrical

shell with hemispherical ends, Built-up cylindrical shells, Problem based on thin cylindrical shell, Problem based on thin seamless steel tube, Problem based on thin air cylinder tube, Problem based on cylindrical shell, Problem based on hemispherical and boiler drum, Spherical shells-change in dimension, Problem based on thin spherical shell.