COURSE TITLE : THEORY OF STRUCTURES -I
COURSE CODE : 3013
COURSE CATEGORY : B
PERIODS/WEEK : 6
PERIODS/SEMESTER: 90
CREDITS : 6

TIME SCHEDULE

Module	Topics	Period
1	Moment of forces Support reactions Centre of gravity Moment of inertia	23
2	Simple stresses and strains Mechanical properties Temperature stresses Strain energy	21
3	Beams and bending Torsion of circular shaft	25
4	Thin cylinders Simple bending Columns and struts	21
TOTAL		**90**

COURSE OUTCOME

Sl.	Sub	Student will be able to
1	1	Understand different types of loading
	2	Calculate moment of Inertia of standard plane section & their composites
	3	Calculate stresses in simple and composite sections.
2	1	Calculate strain energy for different applications of loading
	2	Draw shear force and bending moment diagrams
	3	Calculate the power transmitted by circular shaft
3	1	Find the internal stresses in thin cylinders
	2	Calculate the crippling load for short and long columns
	3	Calculate shear stress. & bending stress in a beam cross section

SPECIFIC OUTCOME

MODULE – I

1.1.0 Understand Moment of a force

1.1.1 Identify the various types of forces
1.1.2 State the principle of moments
1.1.3 Calculate the Moment of forces like point load, U.D load, U.V load
1.1.4 Calculate the support reactions in a simply supported beam and over hanging Beam

1.2.0 Understand the Geometrical properties of sections

1.2.1 Define Centroid, and centre of gravity
1.2.2 Locate the centroid of rectangle , triangle, circle and semi-circle
1.2.2 Locate the center of gravity of cylinder, sphere, prism, pyramid, cone and Hemisphere
1.2.3 Locate the centroid of regular and compound plane figures
1.2.4. Define moment of inertia, polar moment of inertia, and radius of gyration
1.2.5 State the parallel axis theorem and perpendicular axis theorem
1.2.6 Determine the moment of inertia of simple and built-up sections using parallel axis theorem
1.2.7 Determine the radius of gyration of plane sections.
1.2.8 Deduce the Polar moment of inertia of solid and hollow circular shaft using Perpendicular axis theorem.

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MODULE – II

2.1.0 Apply the mechanical properties of section

2.1.1 Define the mechanical properties of materials like elasticity, stiffness, plasticity, Toughness, hardness, brittleness, ductility, malleability
2.1.2 Define stresses and strain
2.1.3 Differentiate between various types of stresses and strains
2.1.4 State Hooke's law
2.1.5 Calculate stresses and strains due to static loads
2.1.6 Draw the stress strain curve for mild steel
2.1.7 Determine the stresses in materials due to change in temperature
2.1.8 Define lateral strain, poisson's ratio, volumetric strain, bulk modulus and modulus of rigidity
2.1.9 State the relationship between elastic constants

2.2.0 Understand the concept of strain energy

2.2.1 Define resilience, proof resilience and modulus of resilience
2.2.2 Calculate the stress, strain and strain energy of materials due to gradually Applied load, suddenly applied load and impact load.

MODULE – III

3.1.0 Analyze the effects of loading (SF and BM) on beams.

3.1.1 Define the terms 'Shear force' and 'Bending moment'.

3.1.2 Draw the SFD and BMD for cantilever, simply supported and overhanging beams With Concentrated, U.D and uniformly varying loads by analytical method

3.1.3. State the relationship between load, SF and BM in solving problems

3.2.0 Analyse the effects of pure torsion on solid and hollow circular shaft

3.2.1 .State the assumptions in pure torsion

3.2.2. Derive torsion equation

3.2.3 Compute the maximum shear stress due to torsion.

3.2.4 Calculate the diameter of the shaft to transmit a particular power for a given permissible Shear Stress and angle of twist

3.3.0 Understand the stresses in thin cylindrical shells.

3.3.1 Define the circumferential and longitudinal stresses.

3.3.2. calculate the circumferential and longitudinal stresses.

3.3.3 Calculate the change in volume of thin cylinders due to internal pressure.

MODULE – IV

4.1.0. Apply the theory of simple bending.

4.1.1 List the assumptions in the theory of simple bending.

4.1.2 Derive the simple bending equation

4.1.3 Explain the terms Neutral Axis, moment of resistance and section modulus .

4.1.4 Locate the neutral axis and calculate moment of resistance of symmetrical simple And compound sections

4.1.5 Derive the formula for shear stress at the section of a loaded beam

4.1.6 Draw the shear stress distribution diagram along the section of a rectangular, symmetrical I section.. .

CONTENT DETAILS

MODULE – I

Forces and Moments

Definition of force –types of forces, Moment of force – types of moments – principle of moments (proof not required) – Determination of Reactions of simply supported beams and overhanging beams with point loads, uniformly Distributed loads, uniformly Varying loads.

Centre of Gravity

Centroid of plane figures –Determination of centroid of rectangle , triangle, circle, semi-circle and compound areas and reminders – Definition of center of gravity (C.G) . C.G. of combination of simple solids.– C.G. of plane in the same straight line and those distributed Over a plane, C.G. of solids.

Moment of inertia

Definition of rectangular moment of inertia and polar moment of inertia – radius of gyration. Determination of radius of gyration of plane sections, parallel axis theorem and perpendicular axis theorem. M.I of simple sections, rectangle, triangle, circle(without proof) . M.I. of composite areas and remainders . Polar moment of inertia of solid and hollow circular shaft

MODULE – II

Mechanical properties of materials

Elasticity, stiffness, plasticity, toughness, brittleness, ductility, Malleability and hardness. Simple stresses and strains – types of stresses – Elasticity – Hook's law – Young's modulus – stresses and strains in uniform sections of same and composite materials like steel, aluminum and copper. Tensile test on ductile material (mild steel bar) and stress strain curve – limit of Proportionality, elastic limit, yield point – ultimate stress – breaking stress – working stress and factor of safety.

Temperature stresses – elongation and contraction due to temperature change –when deformation is fully or partially prevented – temperature stress in composite sections.

Linear strain and lateral strain – Poisson's ratio- volumetric strain –– Bulk modulus – modulus of rigidity – relationship between Elastic constants (No proof) – simple problems.

Strain energy

Resilience- proof resilience – modulus of resilience – stress and strain when load is applied gradually, Suddenly and with impact.

MODULE – III

Beams and bending

Classification of beams – cantilever, simply supported, fixed, overhanging and continuous. Types of loading – concentrated, uniformly distributed and uniformly varying load.

Shear force and bending moment – definition and sign conventions.

Calculation of SF and BM for Cantilever, simply supported and overhanging beams and sketching of SF and BM diagrams (for point load, uniformly distributed load, uniformly varying load and combinations of u.d. and point loads)

Relation between SF and BM. Maximum BM – point of contra flexure

Torsion of circular shafts

Theory of pure torsion –assumptions in pure torsion- derivation of formula – problems. Power transmitted by circular shafts – problems

Thin cylinders

Failure of thin cylindrical shell due to internal pressure – circumferential and longitudinal stresses – Changes in dimension and volume of thin cylinders due to internal pressure.

MODULE – IV

Theory of simple Bending

Theory of simple bending, Explain the terms 'Neutral axis', 'moment of resistance' and 'section modules'. Assumptions in simple bending, derivation of the equation of simple bending. Apply the theory of simple bending to simple and compound sections. Calculate stress, section modulus and moment of resistance. Calculate the shear stress and draw the shear stress distribution diagram for rectangular and I Sections.

REFERENCE BOOKS

1. R.S.Khurmi : Applied Mechanics & Strength of Materials; S. Chand Publishing
2. M.Chakrabroti : Strength of materials ; S.K Kataria &sons.
3. R.K.Rajput : Strength of Materials ; S. Chand Publishing
4. S.S.Bhavikatti : Strength of Materials ; Vikas Publishing House Pvt Ltd,