COURSE TITLE : THEORY OF STRUCTURES-I
COURSE CODE : 3021
COURSE CATEGORY : B
PERIODS/WEEK : 6
PERIODS/YEAR : 108
CREDITS : 5

TIME SCHEDULE

MODULE	TOPIC	PERIODS
I	Forces and moments, Centre of gravity, Moment of Inertia, Friction	26
	Test I	1
II	Simple stresses and strains, Strain Energy	26
	Test II	1
III	Torsion, Beams & Bending	26
	Test III	1
IV	Thin cylinders, Columns & Struts, Analysis of trusses	26
	Test IV	1
	TOTAL	**108**

Rationale;
There are different types of structures depending upon type of materials such as concrete, steel, wood, etc. They are subjected to various types of loading such as axial load, shear load, transverse load etc. This subject helps the student to analyze the internal behavior structural members under different types of loading and to analyze trusses .The knowledge gained in this subject is helpful to study then the subject Theory of Structures-ii.

OBJECTIVES

Upon completion of course, student should be able to:

MODULE – I
1.1.0 Define force
1.1.1 Understand the conditions of Equilibrium of forces
1.1.2 Determine Moment of force
1.1.3 Study principle of moments
1.2.0 Determine centroid of geometrical shapes
1.2.1 State the position of centroid of triangle, parallelogram, circle, semi-circle and rectangle
1.2.2 State the position of center of gravity of cylinder, sphere, prism, pyramid, cone and Hemisphere
1.2.3 Determine the centroid of regular and compound plane figures
1.3.0 Understand the concept of moment of Inertia
1.3.1 Determine the moment of inertia of simple and built-up sections applying parallel axis theorem
1.3.2 Calculate the radius of gyration of plane sections.
1.3.3 Determine the Polar moment of inertia of solid and hollow circular shafts applying Perpendicular axis theorem
1.4.0 Understand the significance of frictional forces in a system
1.4.1 Define the term coefficient of friction and angle of friction
1.4.2 Determine the magnitude of frictional forces in systems under equilibriums

MODULE – II

2.1.0 Recognize the different elastic constants and apply the concept of elasticity in solving Problems
2.1.1 Differentiate between various types of stresses and strains
2.1.2 Apply the principle of Hooke's law for elastic materials
2.1.3 Sketch the stress strain curve for mild steel and concrete
2.1.4 Explain the stresses in materials due to change in temperature
2.2.0 Define resilience, proof resilience and modulas of resilience
2.2.1 Determine the stress, strain and strain energy of materials due to gradually applied load.
2.2.2 Determine the stress, strain and strain energy of materials due to suddenly applied load.
2.2.3 Determine the stress, strain and strain energy of materials due to impact load.

MODULE – III

3.1.0 Analyse the effects of pure torsion on solid and hollow circular shafts
3.1.1 Compute the maximum shear stress due to torsion, applying torsion equation.
3.1.2 Calculate the diameter of the shaft to transmit a particular power for a given permissible shear Stress and angle of twist.
3.2.0 Analyze the effects of loading (SF and BM) on beams.
3.2.1 Define the terms 'Shear force' and 'Bending moment'.
3.2.2 Draw the SFD and BMD for cantilever, simply supported and overhanging beams with Concentrated, U.D and uniformly varying loads by analytical method
3.2.3. Apply the relationship between load, SF and BM in solving problems

MODULE – IV

4.1.0 Determine the stresses in thin cylindrical shells.
4.1.1 Differentiate the circumferential and longitudinal stresses.
4.1.2 Calculate the change in volume of thin cylinders due to internal pressure.
4.2.0 Understand the behaviour of columns under vertical loads.
4.2.1 Compute the slenderness ratio for a given size of column, length and end conditions.
4.2.2 Compute the load carrying capacity of a given column with different end conditions by Eulers and Rankine's formulae.
4.3.0, Determine the magnitude and type of forces in various members of the truss due to loading using methods of joints. [Simple problems]
4.3.1 Introduction to method of sections. [Description only]

CONTENT DETAILS

MODULE – I

Forces and Moments

Definition of force – Conditions of Equilibrium of forces – Resolution of forces – Principles of resolution –
Resultant of a number of coplanar forces acting at a point.
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 and uniformly Distributed loads

Centre of Gravity

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

Moment of inertia

Definition of rectangular moment of inertia and polar moment of inertia – radius of gyration parallel axis theorem and perpendicular axis theorem M.I of simple sections, rectangle, triangle, circle

(without proof)
M.I. of composite areas and remainders

Friction:

Static, dynamic and limiting friction – Laws of friction – Angle of friction – coefficient of friction- angle of repose..
Equilibrium of a body on inclined rough surface [simple problems].

MODULE – II

Simple stresses and strains

Stress and strain – types of stresses – Elasticity – Hook's law – Young's modulus – stresses and strains in uniform sections of same and composite materials
Mechanical properties of materials – Elasticity, stiffness, plasticity, toughness, brittleness, ductility, Malleability and hardness – Tensile test on ductile material (mild steel bar) and stress strain curve – Compression test on brittle material (cement concrete) 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 – temperature stress 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

Torsion of circular shafts

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

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

MODULE – IV

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.

Columns and Struts

Strut, column – failure of strut, short and long columns – types of end conditions
Euler's formula for columns of different end conditions (Assumptions and derivation not required) – Slenderness ratio – limitations of Euler's formula – applications (simple problems only)
Derivation of Rankine's formulae from Euler's formulae – Rankine's constant for different materials -applications (simple and built up sections)

A**nalysis of Trusses**

Analysis of truss, determine the magnitude and type of forces in various members of the truss due to loading, using methods of joints.-simple problems.
Introduction to method of sections.[Description only]
Introduction to method of resolution of forces by graphical method-Graphical representation of Vectors-bow's notation (theory only).

REFERENCE BOOKS

1. Applied Mechanics & Strength of Materials – R.S.Khurmi
2. Strength of materials by M.Chakrabroti; S.K Kataria &sons.
2. Strength of Materials – R.K.Rajput