CENTRAL POLYTECHNIC COLLEGE, THARAMANI-600 113.
(An Autonomous Institution)

DEPARTMENT OF CIVIL ENGINEERING

QUESTION BANK

ECE31010 – MECHANICS OF MATERIALS

ECE31010	Mechanics of Materials	L	T	P	C
Theory		3	0	0	3

Unit	Content	Hours
Unit I	SIMPLE STRESSES AND STRAINS	
	1. INTRODUCTION TO STRESSES AND STRAINS : Definitions of Force, Moment of force - Types of forces on structural members Mechanical properties of materials –Rigidity, Elasticity, Plasticity, Compressibility, Hardness, Toughness, Stiffness, Brittleness, Ductility, Malleability, Creep, Fatigue, Tenacity, Durability- Definitions of stress and strain-Types of stresses, Tensile, Compressive and Shear stresses- Types of strains-Tensile, Compressive and Shear strains-Elongation and Contraction- Longitudinal and Lateral strains–Poisson's Ratio-Volumetric Strain-Simple problems in computation of stress, strain, Poisson's ratio. Hooke's law- Elastic Constants Definitions of: Young's Modulus of Elasticity–Shear modulus(or)Modulus of Rigidity-Bulk Modulus –Relationship between elastic constants (Derivations not necessary)-Simple problems.	9
Unit II	SHEAR FORCE AND BENDING MOMENT IN BEAMS	
	2.1 TYPES OF BEAMS AND LOADS Definition of a beam–Support conditions and diagrammatic representation – Types of supports-Types of beams based on support conditions– Diagrammatic representation of beams–Static equilibrium equations– Determinate and indeterminate beams- Load-Axial Loads-Transverse Loads- Types of loads(Concentrated, uniformly distributed and varying loads)- Diagrammatic representation of beams with different loads. **2.2 SHEAR FORCE AND BENDING MOMENT** Definition of Shear force and Bending Moment–Conventional signs used for S.F. and B.M - SFD &BMD – S.F and B.M of Cantilever beam with endpoint load/UDL for entire span & simply supported beams with central point load/ UDL for entire span and draw SFD&BMD. Numerical problems on SF& BM for cantilever beams (Maximum Three concentrated loads/UDL for entire span / Combination of Maximum Three-point loads with UDL for entire span /UDL for the half-length from fixed end only/. For simply supported beams (Central point load/Single eccentric point load / Two equal point loads at one-third points /UDL for entire span/Combination of central point load and UDL throughout the beam only).	9
Unit III	**GEOMETRICAL PROPERTIES OF SECTIONS**	
	3.1 CENTROID Geometrical properties–Definitions and examples of Symmetrical, Anti Symmetrical, Asymmetrical shapes - Definitions of center of gravity and centroid – Centroid of Symmetrical shapes (square, rectangular, circular,) Numerical problems determination of centroids of T Section and I Sections only. 3.2 MOMENT OF INERTIA Definitions of: Inertia, Moment of Inertia, Polar moment of inertia, Radius of gyration, Section Modulus, Polar modulus-Parallel and perpendicular axes theorems (statement only) - Numerical problems on M.I about centroidal axis, Section modulus, Radius of gyration of (solid/hollow) square, (solid/hollow) rectangular and(solid/hollow) circular sections (Derivation not required)– Numerical problems on M.I about centroidal axis of T Section and I Sections only.	9
Unit IV	**STRESSES IN BEAMS**	
	STRESSES IN BEAMS DUE TO BENDING Types of Bending stresses–Neutral axis–Theory of simple bending– Assumptions–Moment of resistance – Flexure/bending equation $M / I = E / R = \sigma/y$ (Derivation not required)– Bending stress distribution –Curvature of beam–Position of N.A and centroidal axis–Stiffness equation–Flexural rigidity–	9

Strength equation–Significance of Section modulus–Numerical Problem on simply supported beam with symmetrical loads only.		
UnitV	**PIN JOINTED FRAMES**	
ANALYSIS BY ANALYTICAL METHOD(METHODOFJOINTS) Definitions of: Frame / Truss, Pin Joint, Nodes, Rafters, Ties, Struts, Slings- Determinate and indeterminate frames–Classification of frames-Perfect and imperfect frames–Deficient/Instable and redundant frames-Resolutions of force-Designation of forces-Nature of force in the frame-Identification of member with zero force in a determinate truss- Methods of analysis-Analytical methods-Method of Joints and Method of Sections (Description only) - Problems on Analysis of cantilever (with not more than eight members) with vertical nodal loads by method of joints only) and simply supported perfect frames(with not more than ten members) with vertical nodal loads (Symmetrical frame only) by method of joints only.		9
TOTAL HOURS		**45**

U.NO	Q NO	QUESTIONS
1	1	The ability of a material to deform under load and return to its original shape when the load is removed is known as: (a) Rigidity (b) Elasticity (c) Plasticity (d) Brittleness **Ans: B) Elasticity**
1	2	What is the term for the resistance of a material to scratching or indentation? (a) Hardness (b) Tenacity (c) Malleability (d) Creep **Ans: A) Hardness**
1	3	Which type of stress is a result of forces pulling the material apart? (a) Compressive stress (b) Tensile stress (c) Shear stress (d) Torsional stress **Ans: B) Tensile stress**
1	4	Strain is defined as the ratio of: (a) Change in length to original length (b) Stress to original length (c) Force to area (d) Force to volume **Ans: A) Change in length to original length**
1	5	The ratio of lateral strain to longitudinal strain within the elastic limit is known as: (a) Young's Modulus (b) Shear Modulus (c) Bulk Modulus (d) Poisson's Ratio **Ans: D) Poisson's Ratio**
1	6	For a steel bar under tension, the longitudinal strain is 0.001. What is the magnitude of lateral strain if the Poisson's ratio is 0.3? (a) 0.003 (b) 0.0003 (c) 0.0006 (d) 0.001 **Ans: B) 0.0003**
1	7	The law that states stress is directly proportional to strain within the elastic limit is: (a) Newton's Law (b) Hooke's Law (c) Poisson's Law (d) Pascal's Law **Ans: B) Hooke's Law**
1	8	The slope of the stress-strain curve within the elastic limit represents which of the following? (a) Poisson's Ratio (b) Modulus of Rigidity (c) Bulk Modulus (d) Young's Modulus of Elasticity **Ans: D) Young's Modulus of Elasticity**
1	9	What is the other name for Shear modulus? (a) Bulk Modulus (b) Modulus of Rigidity (c) Young's Modulus (d) Poisson's Ratio **Ans: B) Modulus of Rigidity**

U.NO	Q NO	QUESTIONS
1	10	The bulk modulus is a measure of a material's resistance to: (a) Shear deformation (b) Volumetric change (c) Tensile stress (d) Compressive stress **Ans: B) Volumetric change**
1	11	The relationship between the elastic constants E, G, and K is given by which of the following? (a) E=2G(1+μ) (b) E=3K(1−2μ) (c) E=9KG/(3K+G) (d) All of the above **Ans: D) All of the above**
1	12	The property of a material to withstand permanent deformation without fracture is known as: (a) Elasticity (b) Plasticity (c) Brittleness (d) Toughness **Ans: B) Plasticity**
1	13	The ability of a material to be hammered or rolled into thin sheets without fracturing is called: (a) Ductility (b) Malleability (c) Tenacity (d) Brittleness **Ans: B) Malleability**
1	14	Creep occurs mainly due to: (a) High strain rate (b) Long duration of loading (c) Sudden application of load (d) Removal of load **Ans: B) Long duration of loading**
1	15	If a bar is stretched, the lateral strain will cause the diameter to: (a) Increase (b) Decrease (c) Stay the same (d) First increase then decrease **Ans: B) Decrease**
1	16	The volumetric strain is the change in volume divided by the: (a) Original length (b) Original area (c) Original volume (d) Change in length **Ans: C) Original volume**
1	17	A force of 500 N is applied along the axis of a bar with a cross-sectional area of 10 mm2. The stress is: (a) 50 N/mm2 (b) 5000 N/mm2 (c) 5 N/mm2 (d) 500 N/mm2 **Ans: A) 50 N/mm2**
1	18	Hooke's law is valid only for which part of the stress-strain curve? (a) The plastic region (b) The elastic region (c) The fracture point (d) The ultimate stress point **Ans: B) The elastic region**

U.NO	Q NO	QUESTIONS
1	19	Which of the following is an example of a compressive force? (a) A cable pulling a weight (b) A pillar supporting a roof (c) A rope being stretched (d) A beam being bent **Ans: B) A pillar supporting a roof**
1	20	The property of a material that allows it to absorb energy and plastically deform without fracturing is called: (a) Brittleness (b) Toughness (c) Hardness (d) Ductility **Ans: B) Toughness**
1	21	A material that fractures with little or no plastic deformation is considered to be: (a) Ductile (b) Brittle (c) Tough (d) Malleable **Ans: B) Brittle**
1	22	What is the term for the resistance of a material to fracture under a sudden impact? (a) Brittleness (b) Toughness (c) Fatigue (d) Tenacity **Ans: B) Toughness**
1	23	A bar is stretched by a force along its length. The ratio of the decrease in its diameter to the original diameter is: (a) Longitudinal strain (b) Lateral strain (c) Volumetric strain (d) Shear strain **Ans: B) Lateral strain**
1	24	The ratio of tensile stress to tensile strain within the elastic limit is: (a) Shear Modulus (b) Young's Modulus (c) Bulk Modulus (d) Poisson's Ratio **Ans: B) Young's Modulus**
1	25	What is the ratio of shear stress to shear strain within the elastic limit called? (a) Young's Modulus (b) Shear Modulus (c) Bulk Modulus (d) Poisson's Ratio **Ans: B) Shear Modulus**
1	26	Bulk Modulus is the ratio of: (a) Volumetric stress to volumetric strain (b) Shear stress to shear strain (c) Normal stress to volumetric strain (d) Normal stress to longitudinal strain **Ans: A) Volumetric stress to volumetric strain**
1	27	The relationship between E, G, and K is derived from the assumption of: (a) Homogeneous and isotropic material (b) Anisotropic material (c) Orthotropic material (d) All of the above **Ans: A) Homogeneous and isotropic material**

U.NO	Q NO	QUESTIONS
1	28	A 2 m long bar elongates by 1 mm under a load. What is the linear strain experience by the bar? (a) 0.005 (b) 0.0005 (c) 0.05 (d) 0.5 **Ans: B) 0.0005**
1	29	A cube of side 20 mm is subjected to a shear force of 500 N acting on one face. The shear stress is: (a) 1.25 N/mm2 (b) 2.5 N/mm2 (c) 0.25 N/mm2 (d) 12.5 N/mm2 **Ans: A) 1.25 N/mm2**
1	30	A metal rod contracts by 0.2 mm when a compressive force is applied. If its original length was 400 mm, what is the compressive strain? (a) 0.0005 (b) 0.005 (c) 0.002 (d) 0.0002 **Ans: A) 0.0005**
1	31	A force that causes a body to rotate about a point is known as: (a) Concentrated force (b) Distributed force (c) Moment of force (d) Resultant force **Ans: C) Moment of force**
1	32	The type of force that is evenly spread over an area or length is called: (a) Point load (b) Moment (c) Uniformly distributed load (UDL) (d) Axial force **Ans: C) Uniformly distributed load (UDL)**
1	33	The total resistance offered by a material to indentation or scratching is a measure of its: (a) Toughness (b) Ductility (c) Hardness (d) Stiffness **Ans: C) Hardness**
1	34	The property that allows a material to be plastically elongated without fracture under tensile stress is: (a) Malleability (b) Brittleness (c) Ductility (d) Elasticity **Ans: C) Ductility**
1	35	The failure of a material under repeated cyclic loading below its ultimate strength is called: (a) Creep (b) Fatigue (c) Brittle fracture (d) Plastic yielding **Ans: B) Fatigue**
1	36	The ability of a material to withstand sudden impact without fracture is known as: (a) Hardness (b) Toughness (c) Tenacity (d) Malleability **Ans: B) Toughness**

U.NO	Q NO	QUESTIONS
1	37	Stress is defined as:

(a) Force per unit length (b) Force per unit area
(c) Deformation per unit length (d) Change in volume per unit volume
Ans: B) Force per unit area

1 38 Which type of stress is produced when two equal and opposite forces act tangentially across a resisting section?
(a) Tensile stress (b) Compressive stress
(c) Shear stress (d) Bending stress
Ans: C) Shear stress

1 39 The change in length per unit original length of a body under load is called:
(a) Stress (b) Linear strain
(c) Lateral strain (d) Shear strain
Ans: B) Linear strain

1 40 When a bar is compressed, its length decreases. This deformation is called:
(a) Elongation (b) Contraction
(c) Lateral expansion (d) Shear distortion
Ans: B) Contraction

1 41 For a material, if the magnitude of longitudinal tensile strain is 0.002 and the magnitude of lateral contraction strain is 0.0006, the Poisson's ratio is:
(a) 0.3 (b) 3.33
(c) 0.0003 (d) 0.0012
Ans: A) 0.3

1 42 Volumetric strain for a cube subjected to equal tensile stress on all three axes is approximately:
(a) Half of the linear strain (b) Twice the linear strain
(c) Equal to the linear strain (d) Sum of linear strains in three directions
Ans: D) Sum of linear strains in three directions

1 43 A steel rod of 10 mm diameter is subjected to an axial pull of 15.7 kN. The tensile stress (in N/mm^2) is:
(a) 50 (b) 100
(c) 150 (d) 200
Ans: D) 200

1 44 Hooke's Law states that within the elastic limit, stress is proportional to:
(a) Area (b) Force
(c) Strain (d) Poisson's ratio
Ans: C) Strain

1 45 If Young's Modulus (E) for steel is 200 GPa, what stress (in N/mm^2) is required to produce a strain of 0.001?
(a) 200 (b) 20000
(c) 200000 (d) 2000
Ans: A) 200

U.NO	Q NO	QUESTIONS
1	46	The Modulus of Rigidity (G) is a measure of a material's resistance to: (a) Change in volume (b) Axial tension (c) Change in length (d) Change in shape by shear **Ans: D) Change in shape by shear**
1	47	Bulk Modulus (K) is relevant when a body is subjected to: (a) A twisting moment (b) Equal normal stress on all faces (c) A bending moment (d) An axial tensile force **Ans: B) Equal normal stress on all faces**
1	48	For a material with Young's Modulus E and Poisson's ratio μ, the relationship between E and Shear Modulus G is: (a) $E = 2G(1 - \mu)$ (b) $E = 2G(1 + \mu)$ (c) $G = 2E(1 + \mu)$ (d) $G = E / (1 + \mu)$ **Ans: B) $E = 2G(1 + \mu)$**
1	49	A 1 m long aluminum bar stretches by 0.5 mm under tension. The linear strain is: (a) 0.0005 (b) 0.005 (c) 0.05 (d) 0.5 **Ans: A) 0.0005**
1	50	A cube of side 50 mm is subjected to a force that reduces its volume by 12.5 mm^3. The volumetric strain is: (a) 0.0001 (b) 0.001 (c) 0.01 (d) 0.1 **Ans: A) 0.0001**
2	1	A support that resists both vertical and horizontal forces but allows rotation is a: (a) Roller support (b) Hinge support (c) Fixed support (d) Sliding support **Ans: B) Hinge support**
2	2	A beam supported by a hinged support at one end and a roller support at the other is a: (a) Cantilever beam (b) Simply supported beam (c) Propped cantilever beam (d) Overhanging beam **Ans: B) Simply supported beam**
2	3	What does the diagrammatic representation of a cantilever beam show? (a) Two hinged supports (b) One fixed support and one roller support (c) One fixed support and no other support (d) Two roller supports **Ans: C) One fixed support and no other support**
2	4	A beam that cannot be analyzed using only the static equilibrium equations is called a/an: (a) Determinate beam (b) Indeterminate beam (c) Stable beam (d) Unstable beam **Ans: B) Indeterminate beam**

U.NO Q NO QUESTIONS

2 5 The internal resisting force that acts parallel to the cross-section of a beam is called:
(a) Bending moment (b) Shear force
(c) Normal force (d) Torsional force
Ans: B) Shear force

2 6 For a cantilever beam with an endpoint load, the maximum shear force is at the:
(a) Free end (b) Fixed end
(c) Mid-span (d) Entire-span
Ans: B) Fixed end

2 7 A cantilever beam with a UDL over its entire span has its maximum bending moment at the:
(a) Free end (b) Fixed end
(c) Mid-span (d) Quarter-span
Ans: B) Fixed end

2 8 For a simply supported beam with a central point load, the maximum bending moment is at the:
(a) Supports (b) Quarter-span
(c) Mid-span (d) Free end
Ans: C) Mid-span

2 9 A simply supported beam with a UDL over its entire span has a shear force diagram that is a:
(a) Horizontal line (b) Vertical line
(c) Inclined straight lines (d) Parabolic curve
Ans: C) Inclined straight lines

2 10 The shear force for a cantilever beam with three concentrated loads is a series of:
(a) Straight lines (b) Parabolic curves
(c) Inclined lines (d) Triangle
Ans: A) Straight lines

2 11 For a cantilever beam with a UDL over the half-length from the fixed end, the shear force diagram is a:
(a) Rectangle (b) Triangle
(c) Parabola (d) Cubic parabola
Ans: B) Triangle

2 12 What is the maximum bending moment of a simply supported beam of length L carrying a point load W on the mid span?
(a) WL (b) WL/2
(c) WL/4 (d) WL/8
Ans: C) WL/4

2 13 In a simply supported beam, the shear force at the supports due to a central point load is equal to:
(a) The total load (b) Half the total load
(c) Zero (d) Twice the total load
Ans: B) Half the total load

U.NO Q NO QUESTIONS

2 14 What is the bending moment at the fixed end of a cantilever beam of span L with a single point load W at its free end?

(a) WL (b) WL/2
(c) WL/4 (d) WL/8

Ans: A) WL

2 15 Which of the following is a type of uniformly varying load?

(a) A trapezoidal load (b) A UDL
(c) A concentrated load (d) An axial load

Ans: A) A trapezoidal load

2 16 A simply supported beam with a central point load has its bending moment diagram in the shape of a:

(a) Rectangle (b) Triangle
(c) Parabola (d) Inclined line

Ans: B) Triangle

2 17 For a cantilever beam with an endpoint load, the Bending Moment Diagram is a:

(a) Straight line (b) Parabolic curve
(c) Triangular shape (d) Horizontal line

Ans: C) Triangular shape

2 18 A load that is spread over a specific length of the beam is a:

(a) Concentrated load (b) Point load
(c) Distributed load (d) Axial load

Ans: C) Distributed load

2 19 What is the bending moment at the fixed end of a cantilever beam with a UDL over its entire span?

(a) wL^2/2 (b) wL/2
(c) wL (d) wL2

Ans: A) wL^2/2

2 20 The maximum bending moment for a simply supported beam with a UDL of 'w' over its entire span 'L' is:

(a) wL^2/8 (b) wL2/2
(c) wL2/4 (d) wL

Ans: A) wL^2/8

2 21 A cantilever beam of length L is subjected to a point load P at the free end. The shear force at any section throughout its length is:

(a) PL/2 (b) P
(c) PL (d) PL

Ans: B) P

2 22 The bending moment at the fixed end of a cantilever beam of length L with a point load P at the mid-span is:

(a) P (b) PL
(c) PL/8 (d) PL/2

Ans: D) PL/2

U.NO	Q NO	QUESTIONS
2	23	What is the bending moment at the supports of a simply supported beam? (a) Positive (b) Negative (c) Zero (d) Maximum **Ans: C) Zero**
2	24	The Shear Force Diagram of a simply supported beam with a central point load takes the shape of: (a) A triangle (b) A rectangle (c) Two rectangles (d) A parabola **Ans: C) Two rectangles**
2	25	In a simply supported beam, a point of zero shear force corresponds to the point of: (a) Zero bending moment (b) Maximum bending moment (c) Zero slope (d) Maximum slope **Ans: B) Maximum bending moment**
2	26	A simply supported beam of length 4 m has a central point load of 20 kN. What is the maximum shear force? (a) 10 kN (b) 20 kN (c) 40 kN (d) 80 kN **Ans: A) 10 kN**
2	27	A simply supported beam with a UDL load on entire span has zero shear force at: (a) The supports (b) The mid-span (c) One support (d) The quarter-span **Ans: B) The mid-span**
2	28	In a simply supported beam with a UDL, the maximum bending moment is at the: (a) Supports (b) Quarter-span (c) Mid-span (d) One end **Ans: C) Mid-span**
2	29	Which of the following is a determinate beam? (a) Cantilever beam (b) Simply supported beam (c) Overhanging beam (d) All of the above **Ans: D) All of the above**
2	30	The bending moment diagram for a simply supported beam with a UDL over its entire span is a: (a) Straight line (b) Parabola (c) Triangle (d) Rectangle **Ans: B) Parabola**
2	31	A support that resists only vertical forces and allows horizontal movement is a: (a) Hinge support (b) Fixed support (c) Sliding support (d) Roller support **Ans: D) Roller support**

U.NO	Q NO	QUESTIONS
2	32	A beam with one end fixed and the other end supported by a roller is called a: (a) Cantilever beam (b) Propped cantilever beam (c) Fixed beam (d) Continuous beam **Ans: B) Propped cantilever beam**
2	33	The minimum number of equilibrium equations required to analyze a 2D statically determinate structure is: (a) 1 (b) 2 (c) 3 (d) 4 **Ans: C) 3**
2	34	A load that remains constant per unit length of the beam is called: (a) Concentrated load (b) Uniformly Distributed Load (UDL) (c) Uniformly Varying Load (UVL) (d) Triangular load **Ans: B) Uniformly Distributed Load (UDL)**
2	35	Which type of load increases linearly from one end to the other? (a) UDL (b) Concentrated load (c) Triangular load (d) Trapezoidal load **Ans: C) Triangular load**
2	36	The algebraic sum of all forces to the left or right of a section is called: (a) Bending moment (b) Shear force (c) Axial force (d) Torsional moment **Ans: B) Shear force**
2	37	According to the standard sign convention used in beam analysis, shear force causing clockwise rotation of the beam segment is considered: (a) Positive (b) Negative (c) Zero (d) Maximum **Ans: A) Positive**
2	38	For a cantilever beam with UDL over entire span, the shape of the Bending Moment Diagram is: (a) Rectangular (b) Triangular (c) Parabolic (d) Trapezoidal **Ans: C) Parabolic**
2	39	A simply supported beam of length 6m carries a central point load of 12kN. The maximum bending moment is: (a) 18 kNm (b) 24 kNm (c) 36 kNm (d) 48 kNm **Ans: A) 18 kNm ($M = PL/4 = 12\times6/4$)**
2	40	A cantilever beam 2m long has a UDL of 5kN/m over its entire length. The shear force at the fixed end is: (a) 5 kN (b) 10 kN (c) 15 kN (d) 20 kN **Ans: B) 10 kN (Total load = 5×2 = 10kN)**

U.NO	Q NO	QUESTIONS
2	41	A simply supported beam 8m long carries a UDL of 4kN/m. The maximum shear force is: (a) 8 kN (b) 16 kN (c) 24 kN (d) 32 kN **Ans: B) 16 kN (Reaction = wL/2 = 4×8/2)**
2	42	For a cantilever with three point loads, the Shear Force Diagram consists of: (a) A single triangle (b) Multiple rectangles (c) A parabola (d) A trapezoid **Ans: B) Multiple rectangles**
2	43	A simply supported beam with two equal point loads at one-third points has how many points of maximum bending moment? (a) 1 (b) 2 (c) 3 (d) 4 **Ans: B) 2 (under each load)**
2	44	A cantilever beam has UDL over half its length from the fixed end. The shear force at the free end is: (a) Zero (b) Maximum (c) Equal to total load (d) Half of total load **Ans: A) Zero**
2	45	In a simply supported beam with eccentric point load (other than mid-span), the maximum bending moment occurs: (a) At the load point (b) At mid-span (c) At supports (d) At quarter-span **Ans: A) At the load point**
2	46	A beam with both ends fixed is statically indeterminate to the: (a) First degree (b) Second degree (c) Third degree (d) Fourth degree **Ans: C) Third degree**
2	47	For a simply supported beam with combination of central point load and UDL, the Shear Force Diagram is: (a) Always linear (b) Always parabolic (c) Combination of linear and parabolic (d) Always rectangular **Ans: C) Combination of linear and parabolic**
2	48	The bending moment at any point in a cantilever beam is always: (a) Positive (b) Negative (c) Zero (d) Variable **Ans: B) Negative (hogging)**
2	49	A simply supported beam 10m long carries a UDL of 3kN/m. The bending moment at 2m from left support is: (a) 6 kNm (b) 12 kNm (c) 18 kNm (d) 24 kNm **Ans: B) 12 kNm (M = wx(L-x)/2 = 3×2×8/4)**

U.NO	Q NO	QUESTIONS
2	50	A cantilever beam 3m long has point loads of 2kN, 4kN and 3kN at 1m, 2m and 3m from fixed end respectively. The shear force just to the right of 4kN load is: (a) 3 kN (b) 5 kN (c) 7 kN (d) 9 kN **Ans: A) 3 kN (Sum of loads beyond that section: 3kN only)**
3	1	Which of the following is an example of a doubly symmetrical shape? (a) T-section (b) L-section (c) I-section (d) Z-section **Ans: C) I-section**
3	2	The point at which the entire weight of a body is assumed to be concentrated is called the: (a) Centroid (b) Center of gravity (c) Polar modulus (d) Radius of gyration **Ans: B) Center of gravity**
3	3	The centroid of a square is located at: (a) One of the corners (b) The midpoint of a side (c) The intersection of its diagonals (d) The midpoint of an edge **Ans: C) The intersection of its diagonals**
3	4	The moment of inertia about an axis perpendicular to the plane of the area is: (a) Polar moment of inertia (b) Moment of inertia (c) Radius of gyration (d) Section modulus **Ans: A) Polar moment of inertia**
3	5	What is the ratio of the Moment of Inertia to the distance of the farthest fiber from the neutral axis? (a) Radius of gyration (b) Section Modulus (c) Polar Modulus (d) Polar moment of inertia **Ans: B) Section Modulus**
3	6	The statement of the parallel axis theorem is used to find the moment of inertia about: (a) A centroidal axis (b) A parallel axis (c) A perpendicular axis (d) An axis passing through the corner **Ans: B) A parallel axis**
3	7	The perpendicular axes theorem states that the moment of inertia about an axis perpendicular to a plane is equal to the _____ of the moments of inertia about any two axes in the plane that are perpendicular to each other and intersect the first axis. (a) average (b) square (c) product (d) sum **Ans: D) sum**
3	8	The moment of inertia of a solid circular section with diameter D is: (a) πD^4/64 (b) πD^4/32 (c) πD^4/16 (d) πD^4/8 **Ans: A) πD^4/64**

U.NO	Q NO	QUESTIONS
3	9	A shape that does NOT have any axis of symmetry is: (a) Symmetrical (b) Asymmetrical (c) Anti-symmetrical (d) None of the above **Ans: B) Asymmetrical**
3	10	For a rectangle with width 'b' and height 'd', the section modulus about its major axis (centroidal axis parallel to 'b') is: (a) bd^2/12 (b) b^2d/12 (c) bd^2/6 (d) b^2d/6 **Ans: C) bd^2/6**
3	11	For a rectangle with width 'b' and height 'd', the moment of inertia about its base 'b' is: (a) bd^3/12 (b) b^3d/12 (c) bd^3/3 (d) b^3d/3 **Ans: C) bd^3/3**
3	12	For a rectangle with width 'b' and height 'd', the moment of inertia about its centroidal axis parallel to 'b' is: (a) bd^3/12 (b) b^3d/12 (c) bd^3/3 (d) b^3d/3 **Ans: A) bd^3/12**
3	13	For a triangle with width 'b' and height 'h', the moment of inertia about its centroidal axis parallel to 'b' is: (a) bh^3/12 (b) b^3h/12 (c) bh^3/3 (d) bh^3/36 **Ans: D) bh^3/36**
3	14	The section modulus of a hollow rectangular section is used to determine: (a) Torsional stress (b) Shear stress (c) Bending stress (d) Normal stress **Ans: C) Bending stress**
3	15	The centroid of a square of side 'a' measured from the side is at a distance of: (a) a/2 from any side (b) a from one side (c) a/4 from the center (d) a/8 from the top and bottom **Ans: A) a/2 from any side**
3	16	The section modulus of a solid circular section with diameter 'D' is: (a) πD^3/32 (b) πD^4/64 (c) πD^3/64 (d) πD^2/4 **Ans: A) πD^3/32**
3	17	What is the polar modulus of a solid circular section with diameter 'D'? (a) πD^3/16 (b) πD^3/32 (c) πD^4/32 (d) πD^4/64 **Ans: A) πD^3/16**

U.NO	Q NO	QUESTIONS
3	18	What is the unit of Polar Moment of Inertia? (a) mm4 (b) mm2 (c) mm (d) N/mm2 **Ans: A) mm4**
3	19	What is the unit of Moment of Inertia? (a) mm4 (b) mm2 (c) mm (d) N/mm2 **Ans: A) mm4**
3	20	What is the unit of Radius of Gyration? (a) m3 (b) m4 (c) m2 (d) m **Ans: D) m**
3	21	What is the unit of Section Modulus? (a) m3 (b) m4 (c) m2 (d) m **Ans: A) m3**
3	22	The parallel axis theorem is given by: (a) I=Ixx+Ah^2 (b) I=Ixx+Ah^3 (c) I=Ixx+Ah (d) I=Ixx−Ah **Ans: A) I=Ixx+Ah^2**
3	23	The perpendicular axes theorem is given by: (a) Izz=Ixx+Iyy (b) Izz=Ixx−Iyy (c) Izz=Iyy−Ixx (d) Izz=Ixx+Iyy+Ah **Ans: A) Izz=Ixx+Iyy**
3	24	The radius of gyration is related to Moment of Inertia by: (a) k=sqrt(I/A) (b) k=I/A (c) k=I·A (d) k=A/I **Ans: A) k=sqrt(I/A)**
3	25	The centroid of a circular section with a diameter of 100 mm is located at a distance of: (a) 25 mm from the edge (b) 50 mm from the edge (c) 75 mm from the edge (d) 100 mm from the edge **Ans: B) 50 mm from the edge**
3	26	A rectangular section has a width of 100 mm and a height of 200 mm. What is the moment of inertia about the centroidal horizontal axis? (a) 6.67×10^7 mm4 (b) 8.33×10^7 mm4 (c) 1.33×10^8 mm4 (d) 1.67×10^8 mm4 **Ans: A) 6.67×10^7 mm4**

U.NO	Q NO	QUESTIONS
3	27	A solid circular section has a diameter of 40 mm. What is its moment of inertia? (a) 12.57×10^4 mm4 (b) 12.57×10^3 mm4 (c) 12.57×10^2 mm4 (d) 12.57×10^1 mm4 **Ans: A) 12.57×10^4 mm4**
3	28	The radius of gyration of a solid circular section with diameter 'D' is: (a) D/4 (b) D/16 (c) D/2 (d) D/4 **Ans: A) D/4**
3	29	The radius of gyration of a solid circular section with diameter 100 mm is: (a) 10 mm (b) 20 mm (c) 25 mm (d) 50 mm **Ans: C) 25 mm**
3	30	The maximum moment of inertia of a rectangular section with width 50 mm and height 100 mm is: (a) 4.17×10^6 mm4 (b) 4.17×10^5 mm4 (c) 4.17×10^4 mm4 (d) 4.17×10^3 mm4 **Ans: A) 4.17×10^6 mm4**
3	31	A shape that is symmetrical about both horizontal and vertical axes is called: (a) Singly symmetrical (b) Anti-symmetrical (c) Doubly symmetrical (d) Asymmetrical **Ans: C) Doubly symmetrical**
3	32	The centroid of a T-section (with flange at the top and web below) is generally located: (a) At the geometric center of the section (b) Closer to the flange (c) Outside the section (d) At mid-depth **Ans: B) Closer to the flange**
3	33	For a hollow circular section with outer diameter D and inner diameter d, the polar moment of inertia is: (a) $\pi(D^4+d^4)/64$ (b) $\pi(D^4-d^4)/16$ (c) $\pi(D^4-d^4)/32$ (d) $\pi(D^4+d^4)/32$ **Ans: C) $\pi(D^4-d^4)/32$**
3	34	The radius of gyration of a rectangular section about its centroidal axis parallel to base (width b) is: (a) d/√6 (b) b/√12 (c) d/√12 (d) b/√6 **Ans: A) d/√6**
3	35	A section that is symmetrical about only one axis is: (a) Doubly symmetrical (b) Anti-symmetrical (c) Singly symmetrical (d) Asymmetrical **Ans: C) Singly symmetrical**

U.NO	Q NO	QUESTIONS
3	36	The section modulus of a hollow rectangular section with outer dimensions B×D and inner dimensions b×d is: (a) $(BD^3+bd^3)/6D$ (b) $(B^3D-b^3d)/6B$ (c) $(BD^3-bd^3)/12D$ (d) $(BD^3-bd^3)/6D$ **Ans: D) $(BD^3-bd^3)/6D$**
3	37	The centroid of a semicircular lamina of radius R is located from the diameter at a distance of: (a) 3R/8π (b) 2R/π (c) 4R/3π (d) 3R/4π **Ans: C) 4R/3π**
3	38	For an I-section, the moment of inertia is maximum about which centroidal axis? (a) Vertical axis (b) Diagonal axis (c) Horizontal axis (d) Both are equal **Ans: C) Horizontal axis**
3	39	The polar moment of inertia of a solid circular section is used primarily in the analysis of: (a) Bending stress (b) Shear stress (c) Torsional stress (d) Compressive stress **Ans: C) Torsional stress**
3	40	In a T-section, if the flange area is much larger than the web area, the centroid shifts toward: (a) Web (b) Flange (c) Neutral axis (d) Bottom **Ans: B) Flange**
3	41	The moment of inertia of a hollow square section about its centroidal axis, with outer side a and inner side b, is: (a) $(a^3-b^3)/12$ (b) $(a^4+b^4)/12$ (c) $(a^4-b^4)/12$ (d) $(a^2-b^2)/12$ **Ans: C) $(a^4-b^4)/12$**
3	42	The section modulus of a square section about its centroidal axis is: (a) $a^4/12$ (b) $a^3/12$ (c) $a^4/6$ (d) $a^3/6$ **Ans: D) $a^3/6$**
3	43	For a circular section, the ratio of polar modulus to section modulus is: (a) 1 (b) 3 (c) 2 (d) 4 **Ans: A) 1**
3	44	An I-section 200mm deep has flange width 150mm, web thickness 10mm, and flange thickness 15mm. Its moment of inertia about horizontal centroidal axis is approximately: (a) 2.5×10^7 mm^4 (b) 6.5×10^7 mm^4 (c) 4.5×10^7 mm^4 (d) 8.5×10^7 mm^4 **Ans: C) 4.5×10^7 mm^4**

U.NO	Q NO	QUESTIONS
3	45	The radius of gyration of a hollow circular section with diameters D and d is: (a) $(D+d)/4$ (b) $\sqrt{(D^2-d^2)}/4$ (c) $(D-d)/4$ (d) $\sqrt{(D^2+d^2)}/4$ **Ans: D) $\sqrt{(D^2+d^2)}/4$**
3	46	Which theorem states that the moment of inertia about any axis is equal to the moment of inertia about a parallel centroidal axis plus the product of area and square of distance between axes? (a) Perpendicular axes theorem (b) Varignon's theorem (c) Parallel axis theorem (d) Pythagoras theorem **Ans: C) Parallel axis theorem**
3	47	A rectangular section 60mm×120mm has its moment of inertia about vertical centroidal axis as: (a) 8.64×10^6 mm^4 (b) 2.16×10^7 mm^4 (c) 8.64×10^7 mm^4 (d) 2.16×10^6 mm^4 **Ans: D) 2.16×10^6 mm^4**
3	48	The centroid of a right-angled triangle is located at a distance from its base equal to: (a) h/2 (b) h/4 (c) h/6 (d) h/3 **Ans: D) h/3**
3	49	For a solid circular section, the polar modulus is: (a) Equal to section modulus (b) Half the section modulus (c) Four times section modulus (d) Twice the section modulus **Ans: D) Twice the section modulus**
3	50	A T-section has overall depth 200mm, flange width 120mm, flange thickness 20mm, and web thickness 15mm. The section modulus about horizontal axis is approximately: (a) 1.5×10^5 mm^3 (b) 4.5×10^5 mm^3 (c) 3.5×10^5 mm^3 (d) 2.5×10^5 mm^3 **Ans: B) 4.5×10^5 mm^3**
4	1	The bending stress on a beam is caused by: (a) Axial force (b) Shear force (c) Bending moment (d) Torsion **Ans: C) Bending moment**
4	2	The longitudinal axis in a beam at which the bending stress is zero is called the: (a) Shear axis (b) Torsional axis (c) Neutral axis (d) Centroidal axis **Ans: C) Neutral axis**
4	3	What is the assumption regarding the material of the beam in the theory of simple bending? (a) It is anisotropic (b) It is homogeneous and isotropic (c) It is brittle (d) It is composite **Ans: B) It is homogeneous and isotropic**

U.NO	Q NO	QUESTIONS
4	4	The bending equation is given by: (a) M/I = E/R = σ/y (b) M/y = E/I = σ/R (c) I/M = E/R = y/σ (d) I/y = E/R = σ/M **Ans: A) M/I = E/R = σ/y**
4	5	In the bending equation, I represents the: (a) Moment of Inertia (b) Section Modulus (c) Radius of gyration (d) Polar moment of inertia **Ans: A) Moment of Inertia**
4	6	In a beam with a symmetrical cross-section, the neutral axis passes through the: (a) Top fiber (b) Bottom fiber (c) Centroid (d) Mid-point **Ans: C) Centroid**
4	7	The product of the Young's Modulus (E) and the Moment of Inertia (I) is called: (a) Stiffness (b) Flexural rigidity (c) Section modulus (d) Bending moment **Ans: B) Flexural rigidity**
4	8	What is the significance of the Section Modulus (Z)? (a) It represents the flexural strength (b) It represents the stiffness of the beam (c) It represents the moment of inertia (d) It represents the radius of gyration **Ans: A) It represents the flexural strength**
4	9	What is the relationship between bending moment (M), bending stress (σ), and Section Modulus (Z)? (a) M=σ×Z (b) Z=M×σ (c) σ=Z×M (d) M=Z/σ **Ans: A) M=σ×Z**
4	10	Which of the following is an assumption in the theory of simple bending? (a) The beam is subjected to axial loads only (b) The material is ductile (c) Plane Sections remain plane (d) The loads are non-uniform **Ans: C) Plane Sections remain plane**
4	11	The bending stress is maximum at the: (a) Neutral axis (b) Centroidal axis (c) Topmost or bottommost fibers (d) Quarter points **Ans: C) Topmost or bottommost fibers**
4	12	What is the unit of Flexural rigidity? (a) N·mm (b) N/mm2 (c) N·mm2 (d) N·mm3 **Ans: D) N·mm2**

U.NO	Q NO	QUESTIONS
4	13	The section modulus is a measure of a beam's ability to resist: (a) Bending (b) Torsion (c) Shear (d) Compression **Ans: A) Bending**
4	14	In a rectangular beam, the neutral axis is located at: (a) d/3 from the top fiber (b) d/2 from the top or bottom fiber (c) d/4 from the top fiber (d) d from the top fiber **Ans: B) d/2 from the top or bottom fiber**
4	15	Bending stresses are: (a) Compressive stresses (b) Tensile stresses (c) Both tensile and compressive stresses (d) Shear stresses **Ans: C) Both tensile and compressive stresses**
4	16	The neutral axis is a line of zero: (a) Shear force (b) Bending moment (c) Bending stress (d) Shear stress **Ans: C) Bending stress**
4	17	What is the significance of a larger Section Modulus? (a) The beam is weaker in bending (b) The beam can resist a larger bending moment (c) The beam is more flexible (d) The beam can carry more shear force **Ans: B) The beam can resist a larger bending moment**
4	18	Flexural rigidity is a measure of: (a) The resistance to bending deformation (b) The resistance to axial deformation (c) The resistance to twisting (d) The resistance to shear deformation **Ans: A) The resistance to bending deformation**
4	19	The flexural rigidity (EI) of a beam with E=200 GPa and a rectangular cross-section of 100x200 mm is: (a) 1333.33×10^9 N·mm2 (b) 133.33×10^7 N·mm2 (c) 13.33×10^9 N·mm2 (d) 1.33×10^7 N·m2 **Ans: D) 1.33×10^7 N·m2**
4	20	The bending stress is compressive at the: (a) Neutral axis (b) Top fibers (for sagging BM) (c) Bottom fibers (for sagging BM) (d) Shear center **Ans: B) Top fibers (for sagging BM)**
4	21	The ratio of moment of inertia to the maximum distance from the neutral axis is known as: (a) Polar moment of inertia (b) Radius of gyration (c) Section modulus (d) Flexural rigidity **Ans: C) Section modulus**

U.NO	Q NO	QUESTIONS
4	22	In a simply supported beam with a central point load, the bending stress is maximum at: (a) The supports (b) The point of application of load (c) The neutral axis (d) The mid-span section **Ans: D) The mid-span section**
4	23	The flexural rigidity is a measure of the beam's: (a) Strength (b) Brittleness (c) Stiffness (d) Ductility **Ans: C) Stiffness**
4	24	The stiffness equation of a beam is a relationship between: (a) Load and deflection (b) Load and bending moment (c) Stress and strain (d) Moment of inertia and section modulus **Ans: A) Load and deflection**
4	25	The maximum bending stress in a beam is given by: (a) M×y/I (b) M/I×y (c) M×I/y (d) I/(M×y) **Ans: A) M×y/I**
4	26	If a beam's cross-section is symmetrical about the y-axis but not the x-axis, its neutral axis will be located at: (a) The centroid (b) A point on the y-axis, but not the centroid (c) The intersection of the y-axis and the top fiber (d) The intersection of the y-axis and the bottom fiber **Ans: A) The centroid**
4	27	The bending stress is directly proportional to the distance from the: (a) Centroidal axis (b) Neutral axis (c) Both A and B (d) Top fiber **Ans: C) Both A and B**
4	28	What is the bending stress at the neutral axis? (a) Maximum (b) Minimum (c) Zero (d) Negative **Ans: C) Zero**
4	29	The flexural rigidity of a beam is a measure of its: (a) Load-carrying capacity (b) Resistance to bending (c) Resistance to shear (d) Resistance to torsion **Ans: B) Resistance to bending**
4	30	The theory of simple bending is also called: (a) Euler-Bernoulli beam theory. (b) Pascals beam theory. (c) Newtons beam theory. (d) Simpsons beam theory. **Ans: A) Euler-Bernoulli beam theory.**

U.NO	Q NO	QUESTIONS
4	31	In the bending equation, R represents the: (a) Radius of neutral axis (b) Radius of curvature (c) Radius of gyration (d) Radius of centroid **Ans: B) Radius of curvature**
4	32	For a rectangular beam subjected to pure bending, the stress distribution across the depth is: (a) Constant (b) Linear (c) Parabolic (d) Cubic **Ans: B) Linear**
4	33	The bending stress at a point in a beam is directly proportional to: (a) Its distance from the shear center (b) Its distance from the neutral axis (c) The shear force at that section (d) The axial force applied **Ans: B) Its distance from the neutral axis**
4	34	A beam with higher flexural rigidity will have: (a) Less deflection under load (b) More deflection under load (c) Higher bending stress (d) Lower shear stress **Ans: A) Less deflection under load**
4	35	The theory of simple bending assumes that the beam material is: (a) Homogeneous only (b) Isotropic only (c) Both homogeneous and isotropic (d) Orthotropic **Ans: C) Both homogeneous and isotropic**
4	36	In a beam under pure bending, the moment of resistance is equal to: (a) Applied bending moment (b) Section modulus (c) Flexural rigidity (d) Product of E and I **Ans: A) Applied bending moment**
4	37	For a simply supported beam with symmetrical loads, maximum bending stress occurs at the section with: (a) Maximum shear force (b) Maximum deflection (c) Maximum bending moment (d) Zero bending moment **Ans: C) Maximum bending moment**
4	38	The relationship between curvature (1/R) and bending moment (M) is given by: (a) $1/R = M/(EI)$ (b) $1/R = EI/M$ (c) $1/R = M \times EI$ (d) $1/R = M^2/(EI)$ **Ans: A) $1/R = M/(EI)$**
4	39	A simply supported rectangular beam (100mm×200mm) carries a central load causing M=20 kNm. If E=200 GPa, the radius of curvature is approximately: (a) 333 m (b) 667 m (c) 1333 m (d) 2667 m **Ans: C) 1333 m**

U.NO	Q NO	QUESTIONS
4	40	In the bending stress formula σ = My/I, 'y' is measured from: (a) Top fiber (b) Bottom fiber (c) Neutral axis (d) Centroidal axis **Ans: C) Neutral axis**
4	41	For a beam with doubly symmetrical cross-section, the neutral axis coincides with: (a) The centroidal axis (b) The axis of symmetry (c) Both A and B (d) Neither A nor B **Ans: C) Both A and B**
4	42	A beam with section modulus $Z=500\times10^3$ mm^3 can safely resist a bending moment of 100 kNm if the allowable bending stress is: (a) 50 MPa (b) 100 MPa (c) 200 MPa (d) 500 MPa **Ans: C) 200 MPa**
4	43	The curvature of a beam under bending is: (a) Constant throughout the beam (b) Maximum where bending moment is maximum (c) Maximum where shear force is maximum (d) Independent of material **Ans: B) Maximum where bending moment is maximum**
4	44	If the depth of a rectangular beam is doubled while keeping width constant, its section modulus increases by a factor of: (a) 2 (b) 4 (c) 6 (d) 8 **Ans: B) 4**
4	45	For a given bending moment, the bending stress in a beam can be reduced by: (a) Increasing the moment of inertia (b) Decreasing the section modulus (c) Moving the neutral axis upward (d) Using a more ductile material **Ans: A) Increasing the moment of inertia**
4	46	In a simply supported beam with UDL, the bending stress is maximum at: (a) The supports (b) Quarter points from supports (c) The mid-span (d) Points of contra flexure **Ans: C) The mid-span**
4	47	The product EI (flexural rigidity) appears in the formula for: (a) Bending stress calculation (b) Beam deflection calculation (c) Shear stress calculation (d) Torsional stress calculation **Ans: B) Beam deflection calculation**
4	48	A rectangular beam 150mm wide×300mm deep has a maximum bending stress of 20 MPa under a certain moment. If the width is reduced to 100mm, the new maximum stress (for same moment) is: (a) 20 MPa (b) 30 MPa (c) 40 MPa (d) 60 MPa **Ans: B) 30 MPa**

U.NO	Q NO	QUESTIONS
4	49	In the bending equation, the term E/R represents: (a) Bending stress (b) Longitudinal strain (c) Shear strain (d) Volumetric strain **Ans: B) Longitudinal strain**
4	50	For a beam with asymmetric cross-section (like T-section) under pure bending, the neutral axis passes through: (a) The centroid (b) The geometric center (c) The shear center (d) The point of maximum stress **Ans: A) The centroid**
5	1	A structural member composed of slender elements carrying axial forces joined together at their ends is a: (a) Frame (b) Truss (c) Column (d) Beam **Ans: B) Truss**
5	2	A joint that allows rotation but not translation is called a: (a) Fixed joint (b) Rigid joint (c) Pin joint (d) Welded joint **Ans: C) Pin joint**
5	3	In a truss, the points where members are connected are called: (a) Joints (b) Nodes (c) Supports (d) Purlins **Ans: B) Nodes**
5	4	What is the main purpose of a rafter in a truss? (a) To support the roof covering (b) To resist tensile forces (c) To resist compressive forces (d) To act as a diagonal member **Ans: A) To support the roof covering**
5	5	A truss member that is subjected to tensile force is known as a: (a) Strut (b) Tie (c) Rafter (d) Slings **Ans: B) Tie**
5	6	A truss member that is subjected to compressive force is known as a: (a) Tie (b) Strut (c) Rafter (d) Sling **Ans: B) Strut**
5	7	A frame that cannot be analyzed using only the equations of static equilibrium is called a/an: (a) Determinate frame (b) Indeterminate frame (c) Perfect frame (d) Imperfect frame **Ans: B) Indeterminate frame**

U.NO Q NO QUESTIONS

5 8 A frame for which the number of unknowns can be determined by the equations of static equilibrium is called a/an:

(a) Determinate frame (b) Indeterminate frame
(c) Deficient frame (d) Redundant frame

Ans: A) Determinate frame

5 9 The classification of frames includes:

(a) Perfect and imperfect (b) Determinate and indeterminate
(c) Both A and B (d) None of the above

Ans: C) Both A and B

5 10 A perfect frame satisfies the condition:

(a) $m=2j-3$ (b) $m>2j-3$
(c) $m<2j-3$ (d) $m=3j-2$

Ans: A) $m=2j-3$

5 11 The Method of Joints is based on the principle of:

(a) Moment equilibrium (b) Force equilibrium at each joint
(c) Work-energy principle (d) Virtual work

Ans: B) Force equilibrium at each joint

5 12 The Method of Sections is based on the principles of:

(a) Sum of H=0, sum V=0, sum M=0 (b) Sum of M=0 only
(c) Sum of H=0 and Sum of V=0 (d) None of the above

Ans: A) Sum of H=0, sum V=0, sum M=0

5 13 A perfect frame with 20 joints has how many members?

(a) 15 (b) 37
(c) 19 (d) 20

Ans: B) 37

5 14 A simply supported truss with 8 joints and 13 members is:

(a) Perfect (b) Deficient
(c) Redundant (d) Indeterminate

Ans: A) Perfect

5 15 What is the main assumption of pin joints in truss analysis?

(a) They can transmit moments (b) They can transmit shear forces
(c) They can only transmit axial forces (d) They can only transmit compressive forces

Ans: C) They can only transmit axial forces

5 16 In the Method of Joints, what is the number of equilibrium equations at each joint?

(a) One (b) Two
(c) Three (d) Four

Ans: B) Two

U.NO	Q NO	QUESTIONS
5	17	What is the nature of a force in a bottom horizontal member of a simply supported truss with a central point load? (a) Compression (b) Tension (c) Both (d) Zero **Ans: B) Tension**
5	18	A simply supported truss has a central point load. The horizontal members of the top chord are in: (a) Tension (b) Compression (c) Zero force (d) Cannot be determined **Ans: B) Compression**
5	19	A cantilever truss has a vertical load at the free end. The top chord member is in: (a) Tension (b) Compression (c) Zero force (d) Cannot be determined **Ans: A) Tension**
5	20	A simply supported truss has 10 joints and is a perfect frame. How many members does it have? (a) 15 (b) 17 (c) 19 (d) 21 **Ans: B) 17**
5	21	What is the equation for a redundant frame? (a) $m=2j-3$ (b) $m<2j-3$ (c) $m>2j-3$ (d) $m=3j-2$ **Ans: C) $m>2j-3$**
5	22	What is the equation for a deficient frame? (a) $m=2j-3$ (b) $m<2j-3$ (c) $m>2j-3$ (d) $m=3j-2$ **Ans: B) $m<2j-3$**
5	23	A simply supported truss has 10 members and 6 joints. What is the nature of the truss? (a) Perfect (b) Deficient (c) Redundant (d) Instable **Ans: C) Redundant**
5	24	In a simply supported truss, the bottom chord members are in: (a) Tension (b) Compression (c) Zero force (d) Shear **Ans: A) Tension**
5	25	A cantilever truss with 6 members and 5 joints has a vertical load at the free end. The forces in the members can be found using: (a) Method of sections (b) Method of joints (c) Both A and B (d) Graphical method **Ans: B) Method of joints**

U.NO	Q NO	QUESTIONS
5	26	What is the force in a diagonal member of a simply supported truss with a central point load? (a) Compressive (b) Tensile (c) Both (d) Zero **Ans: C) Both**
5	27	A simply supported frame with 8 members and 5 joints is: (a) Perfect (b) Deficient (c) Redundant (d) Indeterminate **Ans: A) Perfect**
5	28	In the Method of Joints, what is the order of analysis? (a) Start at a joint with one unknown force (b) Start at a joint with two unknown forces (c) Start at a joint with three unknown forces (d) Start at a joint with four unknown forces **Ans: B) Start at a joint with two unknown forces**
5	29	The analysis of a truss assumes: (a) Rigid joints (b) Pin joints (c) Welded joints (d) Bolted joints **Ans: B) Pin joints**
5	30	A cantilever truss with 7 members and 5 joints is: (a) Perfect (b) Deficient (c) Redundant (d) Unstable **Ans: A) Perfect**
5	31	In a truss analysis, members that carry no force under specific loading conditions are called: (a) Redundant members (b) Zero-force members (c) Deficient members (d) Critical members **Ans: B) Zero-force members**
5	32	A frame that has more members than required for perfect frame is called: (a) Deficient frame (b) Perfect frame (c) Redundant frame (d) Unstable frame **Ans: C) Redundant frame**
5	33	For a simply supported perfect frame with 7 joints, the number of members should be: (a) 8 (b) 11 (c) 14 (d) 17 **Ans: B) 11**
5	34	In Method of Sections, the section line should ideally cut: (a) Maximum 2 members (b) Maximum 3 members (c) Maximum 4 members (d) Any number of members **Ans: B) Maximum 3 members**

U.NO Q NO QUESTIONS

5 35 A cantilever truss with 5 members and 4 joints is classified as:
(a) Perfect frame (b) Deficient frame
(c) Redundant frame (d) Indeterminate frame
Ans: A) Perfect frame

5 36 The force in a vertical member at the center of a symmetrical simply supported truss with central vertical load is:
(a) Tensile (b) Compressive
(c) Zero (d) Cannot be determined
Ans: B) Compressive

5 37 In a simply supported truss with symmetrical loading, the forces in symmetrical members are:
(a) Equal in magnitude and same nature (b) Equal in magnitude but opposite nature
(c) Different in magnitude (d) Always zero
Ans: A) Equal in magnitude and same nature

5 38 For a determinate frame, the number of equilibrium equations available is:
(a) Equal to number of unknowns (b) Less than number of unknowns
(c) More than number of unknowns (d) Not related to unknowns
Ans: A) Equal to number of unknowns

5 39 A truss member that is neither in tension nor compression is said to be:
(a) A redundant member (b) A zero-force member
(c) A deficient member (d) An unstable member
Ans: B) A zero-force member

5 40 In Method of Joints, the analysis begins at a joint with:
(a) Maximum number of unknown forces (b) Minimum number of unknown forces
(c) Exactly 3 unknown forces (d) Exactly 1 unknown force
Ans: B) Minimum number of unknown forces

5 41 A simply supported truss with 12 members and 7 joints is:
(a) Perfect ($m=2j-3$) (b) Deficient ($m<2j-3$)
(c) Redundant ($m>2j-3$) (d) Unstable
Ans: A) Perfect ($m=2j-3$)

5 42 The nature of force in a diagonal member of a cantilever truss with downward load at free end is typically:
(a) Always tensile (b) Always compressive
(c) Depends on position (d) Always zero
Ans: C) Depends on position

5 43 A frame with fewer members than required by $m=2j-3$ is called:
(a) Perfect frame (b) Redundant frame
(c) Deficient frame (d) Determinate frame
Ans: C) Deficient frame

U.NO Q NO QUESTIONS

5 44 In a simply supported truss with UDL converted to nodal loads, the top chord members are generally in:

(a) Tension (b) Compression
(c) Zero force (d) Shear
Ans: B) Compression

5 45 For analysis of a cantilever truss with not more than 8 members, the preferred method is:
(a) Method of Sections only (b) Method of Joints only
(c) Graphical Method (d) Both Methods of Joints and Sections
Ans: B) Method of Joints only

5 46 In a perfect frame, if j=6, then m should be:
(a) 6 (b) 9
(c) 12 (d) 15
Ans: B) 9

5 47 A member that connects two non-adjacent joints in a truss is called a:
(a) Primary member (b) Secondary member
(c) Diagonal member (d) Vertical member
Ans: C) Diagonal member

5 48 The analysis of simply supported perfect frames with vertical nodal loads is done using:
(a) Method of Sections only (b) Method of Joints only
(c) Graphical Method (d) Any method can be used
Ans: B) Method of Joints only

5 49 A cantilever truss with 8 members and 6 joints is:
(a) Perfect (m=2j-3) (b) Deficient (m<2j-3)
(c) Redundant (m>2j-3) (d) Unstable
Ans: A) Perfect (m=2j-3)

5 50 In a simply supported symmetrical truss, the force in the central vertical member when loaded symmetrically is:
(a) Always tensile (b) Always compressive
(c) Zero (d) Variable
Ans: B) Always compressive

SHORT ANSWER QUESTIONS 3 marks

PART B UNIT I

1. A steel bar of length 2 m and diameter 20 mm is subjected to a tensile force of 50 kN. If Young's Modulus is 200 GPa, find the elongation.
2. A bar of length 3 m and cross-sectional area of 200 mm2 elongates by 0.5 mm under a tensile load of 30 kN. What is the Young's Modulus of the material?
3. A shear force of 10 kN is applied to a cubic block with a side length of 100 mm. If the shear modulus of the material is 80 GPa, what is the shear strain?
4. A cube of 100 mm side length is subjected to a pressure of 100 MPa. If the bulk modulus of the material is 150 GPa, what is the change in its volume?
5. A metal bar with a length of 500 mm and a diameter of 20 mm is subjected to a tensile force. The elongation is 0.25 mm and the decrease in diameter is 0.0075 mm. What is the Poisson's Ratio of the material?
6. A material has a Young's Modulus of 100 GPa and a Poisson's Ratio of 0.25. Calculate the Shear Modulus.
7. A cylindrical concrete pillar with a cross-sectional area of 0.25 m2 supports a vertical load of 5000 kN. If the pillar is 5 m tall and the Young's Modulus is 25 GPa, find the total change in length.
8. A 10 m long steel cable with a diameter of 15 mm is used to lift a weight. The maximum allowable stress in the cable is 250 MPa. What is the maximum weight that can be lifted?
9. A block of material with a cross-sectional area of 1000 mm2 is subjected to a tensile force. The original length is 500 mm and the elongation is 0.5 mm. If the stress is 100 MPa, what is the force applied?
10. A cubic block with a side of 50 mm is subjected to a volumetric strain of 0.0002. If the Bulk Modulus of the material is 120 GPa, what is the volumetric stress?

UNIT II

1. A cantilever beam of length 4m carries three concentrated loads of 10kN, 15kN, and 20kN at 1m, 2m, and 4m from the fixed end respectively. What is the maximum bending moment?
2. A simply supported beam of 6 m span cariies a UDL of 5 kN/m over its entire span. Draw the bending moment diagram.
3. A cantilever beam of length 8 m has a UDL of 2 kN/m for the first half of its length from the fixed end. What is the bending moment at the fixed end?
4. A cantilever beam of 6 m length carries a concentrated load of 20 kN at 4 m from the fixed end and a UDL of 5 kN/m over the entire span. Calculate the bending moment at the fixed end.
5. A cantilever beam of 5 m length is loaded with a UDL of 10 kN/m over its half-length from the fixed end. What is the maximum bending moment?
6. A simply supported beam of 5 m length has a UDL of 10 kN/m over its entire span. What is the bending moment at the midpoint?
7. A cantilever beam of 5 m length is subjected to a UDL of 10 kN/m. The bending moment at the fixed end is:
8. A cantilever beam of 6 m length carries a UDL of 10 kN/m. The bending moment at a section 2 m from the fixed end is:
9. A simply supported beam of 4 m length carries a central point load of 10 kN and a UDL of 5 kN/m over its entire span. What is the maximum bending moment?
10. A cantilever beam of length 6 m carries a UDL of 5 kN/m over the first 3 m from the fixed end. The maximum bending moment is:

UNIT III

1 A T-section has a flange of 120x20 mm and a web of 20x150 mm. Find the centroid of the section from the bottom of the web.

2 A solid circular section has a diameter of 150 mm. Calculate the radius of gyration.

3 A solid rectangular section of 100 mm x 200 mm is placed such that its 100 mm side is vertical. Its moment of inertia about the centroidal horizontal axis is:

4 A solid circular section has a diameter of 200 mm. Find its section modulus.

5 A soild circular section has diameter 120 mm. Find its polar moment of inertia.

6 A solid rectangular section of 100 mm x 200 mm is placed with the 200 mm side vertical. What is the section modulus about the horizontal centroidal axis?

7 A T-section with a flange of 150x20 mm and a web of 20x100 mm has a centroid at 40.5 mm from the bottom of the web. Total height of the section is 120 mm. Find the moment of inertia about the horizontal centroidal axis.

8 An doubly symmetric I-section with flanges of 100x10 mm, a web of 10x150 mm. Total height of the section is 170mm. Find the moment of inertia about the horizontal centroidal axis.

9 A solid circular section has a diameter of 200 mm. Find its section modulus.

10 A square section has a side of 80 mm. Find its radius of gyration.

UNIT IV

1 A simply supported beam with a UDL of 10 kN/m over a 6 m span has a rectangular cross-section of 100 mm x 200 mm. What is the maximum bending moment and maximum bending stress?

2 A simply supported beam of 4 m span is subjected to a UDL of 12 kN/m. The cross-section is a rectangle with a width of 100 mm. If the maximum bending stress is 25 MPa, what is the required depth of the beam?

3 A simply supported beam of 8 m length has two equal point loads of 15 kN at 2 m from each support. If the beam has a rectangular section of 120 mm wide, and the maximum allowable bending stress is 10 MPa, what is the minimum required depth?

4 A simply supported beam of 10 m length has a central point load of 50 kN. If the beam has a solid square cross-section, and the maximum allowable bending stress is 100 MPa, what is the required side length of the square?

5 A simply supported beam of 8 m span is loaded with a UDL of 10 kN/m and a central point load of 40 kN. If the maximum bending stress is 15 MPa, what is the required section modulus?

6 A simply supported beam of 6 m span has a central point load of 20 kN. The beam has a rectangular cross-section with a width of 150 mm. If the maximum bending stress is 10 MPa, what is the minimum required depth?

7 A simply supported beam of size 150 mm x 200 mm and 3 m span is loaded with uniformly distributed load(UDL). The allowable bending stress 10 MPa. Calculate the magnitude of maximum UDL allowed on the beam.

8 A simply supported beam of size 100 mm x 300 mm and 5 m span is loaded with central point load. The allowable bending stress 5 MPa. Calculate the magnitude of maximum load allowed on the beam.

9 A simply supported beam of 10 m span is subjected to a UDL of 10 kN/m. If the beam has a rectangular cross-section of 150 mm x 300 mm, what is the maximum bending stress?

10 A rectangular beam of 100 mm x 200 mm is subjected to a bending moment of 15 kNm. The Young's Modulus is 200 GPa. Find the radius of curvature.

UNIT V

1 A perfect truss is specified as follows: Pin at A(0,0), roller at E(8,0), joints B(0,4), C(4,4), D(8,4), F(4,0). The dimensions are in meters. The members are AB, BC, CD, DE, EF, AF, AC, CE and CF. The truss is loaded with 100 kN downward at C. Find the magnitude and nature of forces in the member AC.

2 A cantilever truss specifications are as follows: supported at A(0,0) and supported joint B(4,0), free joint C(4,3). The dimensions are in meters.The members are AB, BC, AC. The truss is loaded with 8 kN downward at C. Find force in all members.

3 Bridge truss specifications are as follows: Hinge at A(0,0), roller at D(8,0), joint B(2,3), joint C(6,3). The dimensions are in meters. The members are AB, BC, CD, AD, AC. The truss is loaded with 20 kN downward at B. Find the magnitude and nature of force in the member AC.

4 A perfect truss is specified as follows:. Pin at A(0,0), roller at F(12,0), top joints B(3,4), C(6,4), D(9,4), bottom joint E(6,0). The members are AB, BC, CD, DF, EF, AE, BE, CE and DE. The truss is loaded with 25 kN downward at C. Find the magnitude and nature of forces in the member CE.

5 A perfect truss is specified as follows:. Pin at A(0,0), roller at F(12,0), top joints B(3,4), C(6,4), D(9,4), bottom joint E(6,0). The members are AB, BC, CD, DF, EF, AE, BE, CE and DE. The truss is loaded with 50 kN downward at C. Find the magnitude and nature of forces in the member EF.

6 A perfect truss is specified as follows: Pin at A(0,0), roller at D(4,0), joints B(0,4), C(4,4). The dimensions are in meters. The members are AB, BC, CD, AD, AC. The truss is loaded with 20 kN downward at C. Find the magnitude and nature of force in the member AC.

7 A perfect truss is specified as follows: Pin at A(0,0), roller at E(8,0), joints B(0,3), C(4,5), D(8,3). The dimensions are in meters. The members are AB, BC, CD, DE, AE, AC, CE. The truss is loaded with 18 kN downward at C. Find the magnitude and nature of forces in the members AB and BC.

8 A roof truss is made as follows: Pin at A(0,0), roller at G(14,0), top joints B(2,4), C(5,6), D(9,6), E(12,4), bottom joint F(7,0). The dimensions are in meters. The members are AB, BC, CD, DE, EG, FG, AF,EF, BF, CF, DF. Loads: 20 kN downward at A, B, C, D, E and G. Find the magnitude and nature of force in the member AF.

9 A perfect truss is specified as follows: Pin at A(0,0), roller at E(8,0), joints B(0,4), C(4,4), D(8,4), F(4,0). The dimensions are in meters. The members are AB, BC, CD, DE, EF, AF, AC, CE and CF. The truss is loaded with 100 kN downward at F. Find the magnitude and nature of forces in the member CF.

10 A perfect truss is specified as follows:. Pin at A(0,0), roller at F(12,0), top joints B(3,4), C(6,4), D(9,4), bottom joint E(6,0). The members are AB, BC, CD, DF, EF, AE, BE, CE and DE. The truss is loaded with 200 kN downward at E. Find the magnitude and nature of forces in the member AB.

PART C DETAILED ANSWER QUESTIONS 10 MARKS

UNIT I

1 Steel bar 150 mm wide and 12 mm thick is 1.0 m long. It is subjected to an axial tension of 180 kN. Determine the elongation of the flat, contraction in width and thickness. Take $E = 2 \times 10^5$ N/mm² and Poisson's ratio = 0.33.

2 A rectangular wooden column of length 3 m and size 300 mm × 200 mm carries an axial load of 300 kN. The column is found to be shortened by 1.5 mm under the load.

(i) Find stress and strain of the wooden column.

(ii) Find the Young's modulus and rigidity modulus of the column, if Poisson's ratio is 0.25.

3 Explain various types of stresses with required sketches.

4 A bar of 30 mm diameter is subjected to a pull of 60 kN. The measured extension on a gauge length of 200 mm is 0.1 mm and change in diameter is 0.004 mm. Calculate Young's modulus, Poisson's ratio, bulk modulus and change in volume of the bar.

5 Determine the value of Young's modulus and Poisson's ratio of a metallic bar of length 35 cm, breadth 4 cm and depth 4 cm subjected to an axial compressive load of 30 kN. The decrease in length is 0.75 cm and increase in breadth is 0.003 cm

UNIT II

1 (i) Distinguish between cantilever beam and simply supported beam. (6 marks)

(ii) Describe any two types of beams based on support conditions. (4 marks)

2 A cantilever beam 3 m long carries a UDL of 2 kN/m over a length of 2 m from the fixed end. Draw the shear force diagram and bending moment diagram.

3 Sketch the shear force and bending moment diagram for a simply supported beam of span 6 m carrying two point loads of 20 kN each at middle third points.

4 A simply supported beam of 4 m length carries a point load of 5 kN at centre and UDL of 2 kN/m over the entire length. Draw the SFD and BMD.

5 Define shear force and bending moment. Explain the sign convention for shear force and bending moment with example.

UNIT III

1 Find the centroid of the T-section with top flange 160 mm × 10 mm and web 130 mm × 18 mm. Overall depth is 140 mm.

2 Find the centroid of an I-section with top flange 120 mm × 10 mm, bottom flange 120 mm × 10 mm, and web 100 mm × 10 mm.

3 Find the centroid of a T section with top flange 100 mm × 20 mm, stem 200 mm × 10 mm.

4 Find the moment of inertia of a symmetrical I-section with top flange 120 mm × 10 mm, bottom flange 120 mm × 10 mm and web 100 mm × 10 mm.

5 Find the moment of inertia about XX and YY axis, radius of gyration and section modulus for a square hollow section whose outer dimension is 25 mm × 25 mm and thickness is 2 mm.

UNIT IV

1 Write the moment of inertia and section modulus for:

(i) Rectangle of breadth 'b' and depth 'd'

(ii) Circle of diameter 'd'

(iii) Hollow square of side 'a' and thickness 't'

2 A rectangular beam of size 60 mm × 100 mm is subjected to a central point load of 4 kN on a simply supported span of 4 m. Find the maximum bending stress.

3 (i) Write the bending equation and expand all terms. (3 marks)

(ii) A steel wire of 6 mm diameter is bent into a circular shape of radius 6 m. Determine the maximum stress induced. Take $E = 2 \times 10^5$ N/mm². (7 marks)

4 (i) Define neutral axis with a sketch. (3 marks)

(ii) A rectangular beam of size 60 mm × 100 mm is subjected to a central point load of 4 kN on a simply supported span of 4 m. Find the maximum bending stress. (7 marks)

5 A beam of symmetrical section is 350 mm deep and has a Moment of Inertia of 131.6 x 10^6 mm^4 about its principal axis. To what radius may it be bent? If the maximum stress is not to exceed 126 N/mm^2. Take E = 2x10^5 N/mm^2. What would be the moment of resistance at this stress?

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UNIT V

1 Explain perfect frames and imperfect frames including deficient and redundant frames with required sketches and examples.

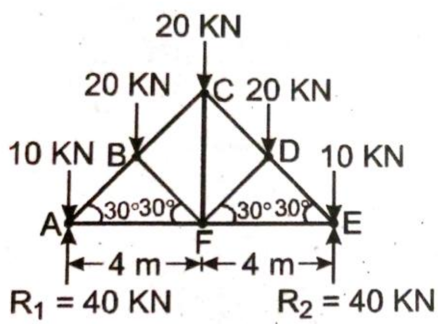
2 (i) Explain the support conditions of truss with sketches. (6 marks)

(ii) Define rafters and ties. (4 marks)

3

Explain the steps involved in the analysis of a truss using method of joints and method of sections.

4 Determine the forces in the members of the truss shown in figure.



5 Analyse the cantilever frame shown in figure by the method of joints and determine the nature and magnitude of forces in the members.