GUJARAT TECHNOLOGICAL UNIVERSITY

BE SEMESTER 4 – OLD PAPER – S22 TO S26 – QUESTION BANK

Subject Name & Code: Structural Analysis-I - 3140603

Chapter 1: Fundamentals of Statically Determinate Structures

Repeated Questions:

1. Principles & Theorems (Theory):

- **Q.** State and explain principle of superposition with its application in this subject. **(WINTER 2022, 4 Marks; SUMMER 2023, 3 Marks; WINTER 2025, 4 Marks)**
- **Q.** Explain Maxwell's theorem of reciprocal deflections. **(SUMMER 2022, 4 Marks; WINTER 2022, 3 Marks; WINTER 2023, 3 Marks; WINTER 2024, 4 Marks; SUMMER 2026, 4 Marks)**

2. Three-Hinged Arches (Theory):

- **Q.** Explain advantages of three hinged arch over beam. **(WINTER 2022, 3 Marks; WINTER 2024, 3 Marks; WINTER 2025, 3 Marks)**

3. Three-Hinged Arches (Numerical):

- **Q.** A three hinged parabolic arch has a span of 20m and central rise 5m. It carries two point loads of 20kN of each at 3m and 6m from the left hinge. Calculate normal thrust, shear and bending moment at a section 5m from left end hinge. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks; SUMMER 2023, 7 Marks; WINTER 2023, 7 Marks; SUMMER 2026, 7 Marks)**

4. Cables (Theory):

- **Q.** Derive the expression for horizontal reaction, tension at the ends for a uniformly loaded cable. **(WINTER 2024, 4 Marks; WINTER 2025, 4 Marks)**

5. Analysis of Frames & Trusses (Numerical):

- **Q.** Draw shear force, bending moment and axial force diagrams for the frame shown in fig. 2. [Diagram required – refer to the original question paper] **(SUMMER 2023, 7 Marks; WINTER 2024, 7 Marks; WINTER 2025, 7 Marks)**
- **Q.** Analyse the truss shown in fig. 3. [Diagram required – refer to the original question paper] **(SUMMER 2023, 7 Marks OR; SUMMER 2026, 7 Marks)**

Other Important Questions:

1. Stability & Determinacy (Theory):

- **Q.** Differentiate between (i) Plane frame and Grid (ii) Conjugate beam and real beam. **(SUMMER 2023, 7 Marks)**
- **Q.** Find SI and KI of structures shown in fig. 1 (a), 1(b). [Diagram required – refer to the original question paper] **(SUMMER 2023, 4 Marks)**
- **Q.** Define statically determinate and indeterminate structures. Also give examples with neat sketch. **(SUMMER 2026, 3 Marks)**
- **Q.** Define statically determinate and indeterminate structures. **(WINTER 2025, 3 Marks)**
- **Q.** Explain the External Stability and internal stability of structure. **(WINTER 2024, 3 Marks)**
- **Q.** Determine degree of redundancy of simply supported beam, cantilever beam and propped cantilever beam. **(SUMMER 2022, 4 Marks)**
- **Q.** Explain in brief about stability of structures. **(SUMMER 2025, 3 Marks)**
- **Q.** Distinguish between Truss and Frame. **(SUMMER 2026, 3 Marks)**

2. Three-Hinged Arches (Theory):

- **Q.** Explain Arch and Cable. **(SUMMER 2022, 3 Marks OR)**
- **Q.** Discuss various types of Arches. **(SUMMER 2026, 3 Marks)**

3. Three-Hinged Arches (Numerical):

- **Q.** A symmetrical three hinged circular arch has span 20m and central rise 4m. It is carrying point load 12kN at 6m from left side hinge. Calculate B.M. at 4 m from left support and also find maximum positive and negative bending moment. **(WINTER 2022, 7 Marks)**
- **Q.** A symmetrical three hinged parabolic arch of span 40m and center rise of 8 m carries UDL of 30kN/m over the left half of the span. Find out support reaction of the arch. **(WINTER 2022, 4 Marks)**

4. Cables (Theory):

- **Q.** Define and explain: Anchor cables. **(SUMMER 2025, 4 Marks)**

5. Cables (Numerical):

- **Q.** A cable loaded with 10kN/m is stretched between two supports in the same horizontal line 200m apart. If the central dip is 15m, find the support reaction. **(SUMMER 2022, 4 Marks OR)**

Chapter 1 (Sub-topic): Thin Cylinder

Repeated Questions:

1. Thin Shells – Derivations (Theory):

- **Q.** Derive equation of circumferential and longitudinal stresses in cylindrical shell due to internal pressure. **(SUMMER 2023, 3 Marks; SUMMER 2026, 4 Marks)**

2. Thin Shells (Numerical):

- **Q.** A thin cylindrical shell 900mm diameter, 4m long and 10mm thick is subjected to an internal pressure of 2MPa. Find the circumferential stress if the eccentricity of longitudinal joints is 75%. **(WINTER 2024, 4 Marks; WINTER 2025, 4 Marks)**

Other Important Questions:

1. Thin Shells – Derivations (Theory):

- **Q.** A thin spherical shell of internal diameter 'd' and wall thickness 't', is subjected to internal pressure 'p'. Derive the expression for change in volume of the shell. **(WINTER 2022, 4 Marks OR)**
- **Q.** A thin cylindrical shell of internal diameter d, wall thickness t and length l, is subjected to internal pressure p. Derive the expression for circumferential stress produced if the efficiency of the longitudinal joint is η. **(WINTER 2023, 3 Marks)**
- **Q.** A thin cylindrical shell of internal diameter d, wall thickness t and length L, is subjected to internal pressure p. Derive the expression for change in volume of the cylinder. **(SUMMER 2025, 4 Marks OR)**

2. Thin Shells (Numerical):

- **Q.** A thin cylindrical shell of 600mm diameter is 1500mm long and 10mm thick. It is subjected to an internal pressure of 2N/mm². Calculate the change in diameter, length and volume. Take E = 200GPa and μ = 0.27. **(WINTER 2022, 7 Marks OR)**
- **Q.** A thin cylindrical shell has 100mm internal diameter and wall thickness is 12 mm. It carries a steam pressure of 11N/mm², Find hoop stress and longitudinal stress in the shell material. **(WINTER 2023, 4 Marks)**
- **Q.** A thin cylindrical shell is 3000mm long 1000mm in diameter and thickness of metal 10mm after being filled with water at atmosphere pressure, more water is pumped in until the pressure is 2.4N/mm² on relieving the pressure, what should be amount of additional water let out if the water is assumed to incompressible. Take E for steel = 200kN/m², Poisson's ratio = 0.3. **(WINTER 2023, 7 Marks)**
- **Q.** A cylindrical shell has 3.5m length, 1.2m diameter and 10mm thickness, the shell is subjected to internal pressure of 2N/mm². Calculate the maximum shear and change in dimension of the shell. **(SUMMER 2022, 7 Marks)**
- **Q.** A cylindrical shell 1 meter long, 180 mm internal diameter, thickness of metal 8mm is filled with a fluid at atmospheric pressure. If an additional 20000 mm³ of the fluid is pumped into the cylinder, find the pressure exerted by the fluid on the wall of the cylinder. Find also the hoop stress induced. Take E = 2×10^5 N/mm² and Poisson's ratio as 0.3. **(SUMMER 2026, 7 Marks OR)**

Chapter 2: Strain energy & Displacement of Statically Determinate structures

Repeated Questions:

1. Strain Energy & Resilience (Theory):

- **Q.** Define resilience, proof resilience and modulus of resilience. **(SUMMER 2022, 3 Marks; SUMMER 2023, 3 Marks; WINTER 2023, 3 Marks; SUMMER 2025, 3 Marks; WINTER 2025, 3 Marks; SUMMER 2026, 3 Marks)**
- **Q.** Derive the formula for strain due to sudden loading. **(WINTER 2023, 4 Marks; SUMMER 2025, 4 Marks OR)**
- **Q.** Derive formula for strain energy due to gradually applied loading. **(SUMMER 2022, 4 Marks; SUMMER 2025, 3 Marks OR)**

2. Conjugate Beam & Moment-Area Theorems (Theory):

- **Q.** Differentiate conjugate beam and real beam. **(SUMMER 2022, 4 Marks; SUMMER 2023, 3 Marks; WINTER 2025, 4 Marks; SUMMER 2026, 3 Marks OR)**
- **Q.** State moment area theorems I and II. **(SUMMER 2022, 3 Marks; WINTER 2022, 3 Marks; SUMMER 2023, 3 Marks OR; WINTER 2025, 4 Marks OR)**
- **Q.** Define conjugate beam. What are the different kinds of a support condition in conjugate beam? **(SUMMER 2022, 7 Marks OR; WINTER 2023, 3 Marks; SUMMER 2024, 3 Marks)**
- **Q.** Derive the relation between slope, deflection and radius of curvature of the beam. **(SUMMER 2025, 4 Marks; WINTER 2025, 3 Marks; SUMMER 2026, 4 Marks)**
- **Q.** Explain Moment-area theorem I and theorem II. **(WINTER 2025, 4 Marks OR; SUMMER 2026, 4 Marks)**

3. Strain Energy, Impact & Sudden Loads (Numerical):

- **Q.** It is found that a bar 36mm in diameter stretches 2.1mm under a gradual load of 120kN. If a weight of 1500N is dropped on to a collar at the lower end of this bar, through a height of 60mm before commencing to stretch the bar, calculate the maximum instantaneous stress and elongation produced in the bar. **(SUMMER 2025, 7 Marks OR; WINTER 2025, 7 Marks)**

4. Slope & Deflection – Conjugate Beam, Moment-Area & Other Methods (Numerical):

- **Q.** Find out slope at 'A' and deflection at 'C' for the beams shown in fig.4 using Conjugate beam method. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks; SUMMER 2023, 7 Marks OR)**

Other Important Questions:

1. Strain Energy & Resilience (Theory):

- **Q.** Define: (i) Strain energy (ii) Resilience (iii) Modulus of resilience. **(SUMMER 2023, 3 Marks)**
- **Q.** Explain strain energy due to flexure in beam. **(WINTER 2022, 4 Marks OR)**
- **Q.** Derive the expression for strain energy due to impact loading. Explain the key factors influencing the energy absorption and discuss its relevance in engineering applications. **(WINTER 2024, 3 Marks)**
- **Q.** Prove that the maximum strain energy stored in a body is given by, $U = (\sigma^2/2E) \times$ Volume. **(SUMMER 2025, 3 Marks OR)**
- **Q.** Explain gradual load, sudden load and load applied with impact. **(WINTER 2025, 4 Marks)**

2. Conjugate Beam & Moment-Area Theorems (Theory):

- **Q.** What is conjugate beam? Differentiate between real beam and conjugate beam. Justify the support condition in conjugate beam. **(WINTER 2024, 4 Marks OR)**
- **Q.** Justify the support condition in conjugate beam. **(SUMMER 2025, 3 Marks OR)**

3. Strain Energy, Impact & Sudden Loads (Numerical):

- **Q.** Define: Impact factor. A weight of 10kN falls by 30mm on a collar rigidly attached to lower end of a vertical bar 4m long and 1000mm² in section. The upper end of the vertical bar is fixed. Find the instantaneous expansion, stress and energy absorbed by the bar. Find also impact factor. Take E = 210GPa. **(SUMMER 2023, 7 Marks)**
- **Q.** Find the deflection at the free end of cantilever of span 'l' subjected to point load 'P' at free end by equating strain energy to work done. **(SUMMER 2023, 4 Marks)**
- **Q.** An unknown weight falls through 20mm on collar rigidly attached to the lower end of vertical bar 3m long and 25mm in diameter. If the maximum instantaneous extension is known to be 4mm what is the corresponding stress and the value of unknown weight? Take E = 210 kN/mm². **(WINTER 2024, 4 Marks)**
- **Q.** Determine the ratio of strain energy stored in the simply supported beam AB of span 5m carries 25kN load at a central point and the same load distribution over its entire span. **(WINTER 2024, 7 Marks)**
- **Q.** A copper rod 30mm diameter, 2m long is enclosed in a steel tube, 35mm internal diameter 5mm thickness co-axially. The composite member is held vertically. The top end is fixed and rigid collar is provided at the bottom. A body of mass 50kg is to be dropped centrally on the collar through a height h. the maximum instantaneous stress in copper is not to exceed 60MPa Compute the maximum value of 'h' take Es = 200GPa and Ec = 120GPa. **(WINTER 2024, 7 Marks OR)**
- **Q.** A vertical steel rod of uniform diameter, 3.0m long is rigidly secured at its upper end and a weight of 2kN is allowed to slide freely on the rod through a distance of 25mm on to a collar at the lower end of the rod. Calculate the diameter of the rod, if the maximum strain is not to exceed 1/1600. Take E = 2×10^5 N/mm². **(SUMMER 2025, 7 Marks)**
- **Q.** A steel bar 1 meter in length is subjected to a pull such that the maximum stress is equal to 150N/mm². Its cross-section is 200mm² over a length of 950mm and for the middle 50mm length the sectional area is 100mm². If E = 2×10^5 N/mm², calculate strain energy stored in the bar. **(SUMMER 2025, 7 Marks)**
- **Q.** A uniform metal bar has a cross sectional area of 700 mm² and a length of 1.5 meter with an elastic limit of 160 N/mm². Find its proof resilience. Find also the maximum value of an applied load which may be suddenly applied without exceeding the elastic limit. Calculate the value of the gradually applied load which will produce the same extension as that produced by the above suddenly applied load. E = 200 GPa. **(SUMMER 2026, 7 Marks)**
- **Q.** A simply supported beam AB of span 5m carries a uniformly distributed load of 5kN/m over its span. Determine the strain energy stored due to bending in the beam. Take E = 200 GPa, I = 200 cm⁴. **(WINTER 2025, 7 Marks OR)**

4. Slope & Deflection – Macaulay's Method (Numerical):

- **Q.** A beam simply supported over a span of 6m is carrying a point load 50kN at mid span. Find slope at supports using Macaulay's method. EI = 20000 kNm². **(SUMMER 2023, 4 Marks)**
- **Q.** Calculate slope at ends and deflection under point load for simply supported beam shown in figure by Macaulay's method. Take EI = 10,000 kN.m². [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks)**
- **Q.** Find a slope at A and deflection at C for the beam shown in Figure 3 using a Macaulay method. Take EI 3000 kN.m². [Diagram required – refer to the original question paper] **(WINTER 2023, 7 Marks)**
- **Q.** Calculate deflections under the loads for a beam loaded as shown in figure. (By Macaulay's Method). [Diagram required – refer to the original question paper] **(SUMMER 2025, 7 Marks)**
- **Q.** A steel beam is simply supported as shown in Fig:(2) at the ends on a span of 8 meters. Determine the location and magnitude of the maximum deflection by Macaulay's Method. Ixx =

4.79×10^{8} mm⁴, E = 200 GPa. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks OR)**

5. Slope & Deflection – Conjugate Beam, Moment-Area & Other Methods (Numerical):

- **Q.** Using conjugate beam method, find slope & deflection at point B and C for the beam shown in figure. Take EI = 2000kN.m². [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks OR)**
- **Q.** Determine maximum slope and deflection for a cantilever beam as shown in figure. Take E = 2×10^{5} N/mm² and I = 2×10^{8} mm⁴. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks)**
- **Q.** Determine slope and deflection at free end of cantilever as shown in Figure 4. Take E = 200GPa and I = 150×10^{6} mm⁴. [Diagram required – refer to the original question paper] **(WINTER 2023, 4 Marks)**
- **Q.** Using a moment area method, determine the slope at B and C and deflection at B of the cantilever beam as shown in Figure 5. [Diagram required – refer to the original question paper] **(WINTER 2023, 7 Marks)**
- **Q.** Using moment area method, find slope & deflection at point C in terms of EI for the beam shown in figure. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks OR)**
- **Q.** Find slope at point A and B & deflection at point C for the beam shown in figure. Take EI = 3000 kN.m². [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks)**
- **Q.** A cantilever 3m long carries a uniformly distributed load the entire length. If the slope at free end is 1° find the deflection at the free end. **(WINTER 2024, 4 Marks)**
- **Q.** Calculate the slope and deflection at point A for a beam loaded as shown Fig. 2 as shown below take E = 200 GPa, I = 3×10^{7} mm⁴. [Diagram required – refer to the original question paper] **(WINTER 2024, 7 Marks)**
- **Q.** A simply Supported beam of span 10m is loaded as shown in Figure 2 determine the position and maximum deflection, Take E = 200 GPa, I = 6.95×10^{8} mm⁴. [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks)**
- **Q.** Determine maximum slope and deflection for a beam by moment area method show Figure 3. Take E = 200 GPa, I = 2×10^{8} mm⁴. [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks OR)**

Chapter 3: Direct and Bending stresses + Column & Struts

Repeated Questions:

1. Direct & Bending Stresses, Core / Kernel (Theory):

- **Q.** Draw a neat sketch for Kernel of section for rectangular 400mm × 300mm. **(SUMMER 2023, 3 Marks; SUMMER 2025, 3 Marks OR; WINTER 2025, 3 Marks; SUMMER 2026, 4 Marks)**
- **Q.** Define Core of the Section. Derive and locate the same for a Circular cross section. **(SUMMER 2022, 3 Marks; WINTER 2022, 3 Marks OR)**
- **Q.** Distinguish between direct stresses and bending stresses. **(WINTER 2023, 4 Marks OR; SUMMER 2025, 3 Marks; SUMMER 2026, 3 Marks OR)**

2. Dams & Retaining Walls (Theory):

- **Q.** Discuss stability checks for a dam. **(SUMMER 2022, 3 Marks OR; SUMMER 2025, 4 Marks)**

3. Columns & Struts (Theory):

- **Q.** Differentiate between long and short column. **(WINTER 2022, 3 Marks; WINTER 2023, 3 Marks OR; SUMMER 2024, 4 Marks; WINTER 2025, 3 Marks OR)**
- **Q.** State assumptions and limitations of Euler's formula. **(SUMMER 2022, 3 Marks; WINTER 2022, 4 Marks; SUMMER 2024, 3 Marks; SUMMER 2026, 4 Marks OR)**
- **Q.** Define: (i) Crippling load (ii) Statically indeterminate structure (iii) Strut. **(SUMMER 2023, 3 Marks OR; WINTER 2024, 3 Marks)**
- **Q.** Derive Euler's formula of critical load for column having both ends hinged. **(SUMMER 2022, 3 Marks; WINTER 2025, 4 Marks OR)**
- **Q.** Write difference between strut and column. **(SUMMER 2022, 4 Marks OR; SUMMER 2026, 3 Marks OR)**
- **Q.** Explain with neat sketch: Effective length of column with different end conditions. **(SUMMER 2025, 3 Marks; SUMMER 2026, 4 Marks OR)**

4. Columns & Struts (Numerical):

- **Q.** The external and internal diameter of a hollow cast iron column are 200mm and 150mm respectively. If column is hinged at both ends having a length of 4m, determine the crippling load using Rankine formula. Take fs = 550 N/mm² and α = 1/1600. **(WINTER 2022, 7 Marks; SUMMER 2025, 7 Marks OR)**

Other Important Questions:

1. Direct & Bending Stresses, Core / Kernel (Theory):

- **Q.** Obtain a relation for the maximum and minimum stresses at the base of a symmetrical column when it is subjected to an eccentric load about two axis. **(WINTER 2022, 4 Marks OR)**
- **Q.** Define "core" or "Kernel" of section. Obtain the "core" or "Kernel" of solid square section. **(WINTER 2023, 3 Marks OR)**
- **Q.** Define and explain: Kernel of rectangular section. **(SUMMER 2022, 4 Marks)**
- **Q.** Define (a) Axial load (b) Eccentricity (c) Core of a section. **(SUMMER 2026, 3 Marks)**
- **Q.** Define and explain: Kernel of Hollow circular section. **(WINTER 2025, 3 Marks)**

2. Eccentric Loading (Numerical):

- **Q.** A rectangular pier of size 300mm × 300mm is subjected to a compressive load of 900kN at one of the corner. Find the stress intensities at all four corners of the pier and draw stress distribution diagram. If the load is acting at the center of the pier, also draw stress distribution diagram. **(WINTER 2022, 7 Marks)**

- **Q.** A cast iron column having a 150mm diameter carries an eccentricity load of 50kN. If maximum tensile stress is not exceed 7.5N/mm², find permissible eccentricity of load column. **(WINTER 2023, 4 Marks OR)**
- **Q.** A rectangular column section ABCD having AB = CD = 400mm and BC = AD = 300mm carries a compressive load 300kN at corner B. Find the stress at each corner A, B, C and D and draw stress-distribution diagram for each side. **(WINTER 2023, 7 Marks OR)**
- **Q.** A short column rectangular section 250mm × 200mm is subjected to load of 400kN at a point 50mm from longer side and 100mm from shorter side. Find maximum and minimum stress in the column. **(SUMMER 2022, 7 Marks)**
- **Q.** A cast iron having 160mm diameter carries an eccentric load of 50kN. If maximum tensile stress is not to exceed 7.5N/mm², find possible eccentricity of load on column. **(WINTER 2024, 4 Marks OR)**
- **Q.** A tubular C/S of column as shown in the Fig. 3 is subjected to a PkN vertical load on the centroid of the hole. Determine the maximum value of P, if maximum compressive stress allowed is 50kN/mm². [Diagram required – refer to the original question paper] **(WINTER 2024, 7 Marks OR)**
- **Q.** A masonry pier shown in Fig:(3) supports a vertical load of 600 kN at a point shown in figure. Find the stresses at the corners of the pier. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks)**
- **Q.** A rectangular column of size 30cm × 50cm is acted upon by compressive force of 9000kN at an eccentricity of 'e' cm from C.G. on axis parallel to 50cm side. Find the eccentricity. If maximum tensile stress not to exceed by 4.8N/mm². **(WINTER 2025, 4 Marks)**
- **Q.** A cast iron column of hollow circular section having 200 mm external diameter and 20 mm metal thickness. 5 m length has to carry a load 120 kN at an eccentricity of 20 mm from the geometrical axis. Calculate the maximum and minimum stresses included in the section, if the ends are fixed. Also calculate the maximum permissible eccentricity so that in tension is induced at the base. Take E = 120 GPa. **(WINTER 2025, 7 Marks)**

3. Chimneys & Wind Pressure (Numerical):

- **Q.** A cylindrical chimney, 25m high, of uniform circular section is 5m external diameter and 2m internal diameter. It is subjected to a horizontal wind pressure of 1400N/m². If the coefficient of wind pressure is 0.6 and unit weight of masonry is 22kN/m³, find the maximum and minimum stress at the base of section. **(WINTER 2022, 7 Marks OR)**
- **Q.** A 20m height masonry chimney is 2m square at base and tapers to 1m square at top the tapered central flue is circular in cross-section and 1m diameter at the base. If the total weight of the brick work, about the base is 1300kN. Find for what uniform intensity of wind pressure and one face of chimney the stress distribution the base just ceases to be wholly compressive. **(WINTER 2023, 7 Marks)**
- **Q.** A masonry wall, 6m high, is of solid rectangular section, 3m wide and 1m thick. A horizontal wind pressure of 1.2kN/m² acts on the 3m side. Find the maximum and minimum stress induced on the base, if unit weight of masonry is 24 kN/m³. **(WINTER 2025, 7 Marks)**

4. Dams & Retaining Walls (Theory):

- **Q.** What is middle third rule? What is importance of this rule in stability check for dam section? **(SUMMER 2023, 3 Marks)**
- **Q.** Derive the formula for no tension condition at base for a dam. **(WINTER 2022, 3 Marks OR)**
- **Q.** Explain any two stability conditions for retaining wall. **(SUMMER 2025, 4 Marks OR)**

5. Dams & Retaining Walls (Numerical):

- **Q.** A masonry retaining wall of trapezoidal section is 12m high and retains earth which is level up to the top. The width at the top and bottom are 3m and 6m respectively. Exposed face is vertical. Determine the stresses at base and check the section for its stability. Take density of earth =

16kN/m³ and density of masonry = 24kN/m³ and angle of repose of earth = 30° and μ = 0.5. **(SUMMER 2023, 7 Marks)**

- **Q.** A rectangular retaining wall section is 2m wide. It retains water up to full height. Find the maximum height required for following: (a) when it is just at the point of overturning; (b) when it is just on the point of sliding; (c) there is a no tensile stress is produced at the base of section. The density of wall material and water is 22kN/m³ respectively and take coefficient of friction as 0.5. **(WINTER 2023, 7 Marks OR)**
- **Q.** A small concrete dam, triangular in cross section with one face vertical, is 8m high and 3m wide at base. It has to retain water on one face up to a depth 7m. If unit weight of concrete is 25kN/m³ and that of water 10kN/m³, calculate maximum and minimum stress intensity induced at the base. Sketch also stress distribution diagram under the base of dam. **(SUMMER 2022, 7 Marks OR)**
- **Q.** A masonry dam 6m high, 3m wide at base and 1.2m wide at top, retains water on vertical face for full height. Considering density of masonry as 17kN/m³ and density of water as 10kN/m³ find out maximum and minimum pressure intensities at the base. **(SUMMER 2025, 7 Marks)**
- **Q.** A masonry trapezoidal dam is constructed with following data. Find the width of the dam at base so that 'no tension' is occurred on section. 1. Top width = 1m, 2. Height of dam = 5m, 3. wt. of water = 10kN/m³, 4. Height of water on vertical face of dam = 4.8m, 5. wt. of masonry = 20kN/m³. **(SUMMER 2025, 7 Marks OR)**

6. Columns & Struts (Theory):

- **Q.** Discuss Euler's formula for column buckling. What are its key assumptions, and how is it used in column design? **(WINTER 2023, 3 Marks)**
- **Q.** Describe the behavior of columns with initial curvature. How does this initial curvature affect their stability, and what considerations are needed in their design? **(WINTER 2023, 4 Marks)**

7. Columns & Struts (Numerical):

- **Q.** A strut 2m long is 50mm in diameter. One end of the strut is fixed while its other end is hinged. Find the compressive load for the member using Euler's formula, allowing a factor of safety of 3.5. Take E = 2.1×10^5 N/mm². **(SUMMER 2023, 4 Marks)**
- **Q.** A column of size 250mm b × 350mm d 4.2m in length with its both ends are fixed. Find load carrying capacity of the column by Rankine's formula. Take fc = 320N/mm², E = 2.1×10^5 N/mm², α = 1/6400. **(SUMMER 2023, 4 Marks)**
- **Q.** A hollow cast iron column of 300 mm diameter and 25 mm thickness is used as 5m long column with both ends fixed. Find the safe crippling load by (a) Euler's formula (b) Rankine's formula Take factor of safety as 3.5 and maximum compressive stress as 500 N/mm² take value of α as 1/1600 and E = 0.14×10^5 N/mm². **(SUMMER 2024, 7 Marks)**
- **Q.** A hollow cast iron column 6m. long is fixed at both ends, and has an external diameter of 400mm. find the internal diameter of column if it supports an axial load of 1000kN. Factor of safety = 5; α = 1/1600, fc = 550N/mm². **(WINTER 2023, 7 Marks)**
- **Q.** A column has one end fixed and other end hinged with length of 6.0m. It is made up of a tube having external diameter of 100mm and wall thickness of 10mm. If yield strength of the material is 410N/mm² and Rankine constant is 1/4800, calculate Euler's critical load and Rankine's critical load. **(SUMMER 2022, 3 Marks OR)**
- **Q.** A solid cast iron circular column of 4m height is to be erected such that its one end remains fixed and other end remain hinged. Find the size if the section. If column has to carry a safe axial load of 300kN. Take factor of safety of 5, Fc = 500N/mm², Rankine's Constant α = 1/1500. **(WINTER 2024, 7 Marks)**
- **Q.** A hollow cylindrical cast iron column is 4 meter long, both ends being fixed. Design the column to carry an axial load of 250kN. Use Rankine's formula and adopt a factor of safety 5. The internal diameter is 0.8 times the external diameter. Crushing stress for the column material is 550N/mm², and α = 1/1600. **(SUMMER 2026, 7 Marks)**

Chapter 4: Statically Indeterminate beams

Repeated Questions:

1. Moment Distribution Terms (Theory):

- **Q.** Define & explain the following terms Relative stiffness, Carry-over factor, Distribution factor. **(SUMMER 2023, 3 Marks; WINTER 2024, 3 Marks OR)**

2. Fixed Beams – Theory & Derivations:

- **Q.** Find out fixed end moment for a fixed beam carrying uniformly distributed load for the whole span. **(WINTER 2022, 3 Marks; SUMMER 2024, 4 Marks; SUMMER 2025, 3 Marks)**
- **Q.** What are the advantages and disadvantages of fixed beam? **(SUMMER 2024, 4 Marks OR; WINTER 2024, 3 Marks OR; WINTER 2025, 3 Marks OR)**
- **Q.** State advantages of fixed beam over simply supported beam. **(SUMMER 2022, 3 Marks OR; WINTER 2024, 3 Marks; SUMMER 2025, 4 Marks; WINTER 2025, 3 Marks OR)**

3. Propped Cantilever Beams (Numerical):

- **Q.** Analyse the propped cantilever beam AB, fixed at 'A' and simply supported at 'B' subjected to UDL of 20kN/m² throughout span using consistent deformation method. Draw shear force and bending moment diagrams. **(WINTER 2022, 7 Marks; SUMMER 2023, 7 Marks; WINTER 2024, 7 Marks OR; WINTER 2025, 7 Marks)**

Other Important Questions:

1. Moment Distribution Terms (Theory):

- **Q.** Define (a) Carry over moment (b) Stiffness (c) Distribution factor. **(SUMMER 2024, 3 Marks OR)**

2. Fixed Beams – Theory & Derivations:

- **Q.** Draw S.F. and B.M. diagram for fixed beam carrying central point load 'W' using basic principle. **(SUMMER 2023, 4 Marks OR)**
- **Q.** Find fixed end moments due to rotation of support B by Θ in clockwise direction for fixed beam AB. **(SUMMER 2023, 4 Marks OR)**
- **Q.** Give advantages of fixed beam. **(WINTER 2022, 4 Marks)**
- **Q.** What are the fundamental principles to consider when analyzing a fixed beam in structural engineering? **(WINTER 2023, 3 Marks)**
- **Q.** State basic difference between fixed and simply supported beams. State advantages of fixed beam over simply supported beam. **(SUMMER 2025, 4 Marks)**
- **Q.** Derive the equation of fixed end moment in a fixed beam of span 'L' having one of the support sink by δ. **(SUMMER 2026, 4 Marks OR)**

3. Propped Cantilever Beams (Numerical):

- **Q.** A propped cantilever beam of span 'l' is subjected to a point load 'w' at the center of the span. Determine all and draw shear force and bending moment diagram. **(WINTER 2023, 4 Marks)**
- **Q.** Using method of consistent deformation, analyse the propped cantilever beam shown in Figure. Draw shear force and bending moment diagrams also. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks)**
- **Q.** Using method of consistent deformation, analyse the propped cantilever beam shown in Figure, and draw shear force and bending moment diagrams. Choose V_B as a redundant. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks)**
- **Q.** A propped cantilever beam of span 'L' is subjected to a point load 'P' at mid span. Determine the reactions at the supports. **(WINTER 2025, 7 Marks OR)**

4. Fixed Beams (Numerical):

- **Q.** A fixed beam of 10m span carries U.D.L. of 10kN/m on its entire span. Find fixed end moment equation using area moment method. **(WINTER 2022, 4 Marks)**
- **Q.** Analyze the fixed beam shown in the figure 2. [Diagram required – refer to the original question paper] **(SUMMER 2024, 7 Marks)**
- **Q.** A fixed beam of 5m span carries central uniformly distributed load of 10kN/m on entire span. Find fixed end moment equation using area moment method. **(SUMMER 2022, 4 Marks OR)**
- **Q.** A beam AB span 5m fixed at both ends carries a uniformly distributed load of 20kN/m over the whole span. The left end 'A' rotates clockwise by 0.8° and right end 'B' sinks by 10mm. determine the fixed end moments and reactions at the supports. Draw also shear force and bending moment diagram. Take E=200kN/mm² and I = 10×10^3 mm⁴. **(WINTER 2024, 7 Marks OR)**
- **Q.** A fixed beam AB of span 6m carries two point loads of 20kN each at distance 1.5m from each end. Draw S.F. and B.M diagrams for the beam. **(SUMMER 2025, 7 Marks)**
- **Q.** Determine the support reactions for the fixed beam shown in Fig:(4) Draw shear force and bending moment diagrams. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks)**

5. Moment Distribution Method (Numerical):

- **Q.** Determine end moments for the beam ABC loaded as shown in fig.5 using moment distribution method. [Diagram required – refer to the original question paper] **(SUMMER 2023, 7 Marks OR)**
- **Q.** Analyze the beam shown in the figure 3 using moment distribution method and draw bending moment diagram. [Diagram required – refer to the original question paper] **(SUMMER 2024, 7 Marks OR)**
- **Q.** Determine the support movement for a continuous beam as shown in Fig. 5 by moment distribution method. Also draw bending moment diagram. [Diagram required – refer to the original question paper] **(WINTER 2024, 7 Marks)**
- **Q.** Analyze the continuous beam shown in Fig:(5) by moment distribution method. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks OR)**

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