GUJARAT TECHNOLOGICAL UNIVERSITY

BE SEMESTER 3 – OLD PAPER – W25 TO S26 – QUESTION BANK

Subject Name & Code: Theory of Structure - BE03006011

Chapter 1: Fundamentals of Statically Determinate Structures

Repeated Questions:

1. Three-Hinged Arches (Theory):

- **Q.** Write the advantages of Three hinge arches over beam. **(WINTER 2025, 3 Marks; SUMMER 2026, 4 Marks)**

2. Reciprocal Theorem (Theory):

- **Q.** State and prove Maxwell's reciprocal theorem. / State Maxwell's reciprocal theorem by all three ways. **(WINTER 2025, 3 Marks OR; SUMMER 2026, 7 Marks)**

3. Portal Frame (Numerical):

- **Q.** Analyze the portal frame shown in figure, and draw shear force and bending moment diagram. [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks; SUMMER 2026, 7 Marks)**

Other Important Questions:

1. Stability, Frames & Determinacy (Theory):

- **Q.** Explain external stability and internal stability of structures. **(SUMMER 2026, 3 Marks)**
- **Q.** Distinguish between plane frame and plane truss. **(SUMMER 2026, 3 Marks)**
- **Q.** Differentiate between statically determinate structures and statically indeterminate structures. **(WINTER 2025, 4 Marks OR)**
- **Q.** Explain about Principle of Superposition. **(SUMMER 2026, 3 Marks OR)**

2. Static & Kinematic Indeterminacy (Numerical):

- **Q.** Find out SI and KI of following Figures. [Diagram required – refer to the original question paper] **(SUMMER 2026, 4 Marks)**
- **Q.** Calculate the static and kinematic indeterminacy for structure shown in figure 3 (a,b). [Diagram required – refer to the original question paper] **(WINTER 2025, 4 Marks)**

3. Three-Hinged Parabolic Arch (Numerical):

- **Q.** A three hinged parabolic arch has a horizontal span of 10m and central rise of 2m. It carries UDL of 1 kN/m over the left-hand half of the span. Calculate the reactions at the end hinges. Also calculate the values of the normal thrust, shear force and bending moment at 2m from the left hinge. **(WINTER 2025, 7 Marks OR)**
- **Q.** A three hinged parabolic arch of 6m rise and 30 m span is loaded by a point load of 100 kN at 10 m from left support and an UDL of 20 kN/m over right half. Calculate the maximum bending moment on right half span. **(SUMMER 2026, 7 Marks)**

4. Thin Cylindrical Shells (Theory & Numerical):

- **Q.** A cylindrical shell 4m long and 1m internal diameter is subjected to an internal pressure of 1.5 N/mm^2. If the thickness of shell is 10mm, find the circumferential & longitudinal stresses. Find also change in diameter, length and volume. Poisson's ratio = 0.3, E = 200×10^3 N/mm^2. **(WINTER 2025, 7 Marks)**
- **Q.** A thin cylindrical shell of internal diameter d, wall thickness is t and length is l, is subjected to internal pressure p. Derive the expression for change in volume of the cylinder. **(SUMMER 2026, 7 Marks OR)**

- **Q.** A thin cylindrical shell 1000mm dia, 5m long and 8mm thick is subjected to an internal pressure of 4MPa, Find the circumferential stress produced if the efficiency of the longitudinal joint is 70%. **(SUMMER 2026, 7 Marks)**

Chapter 2: Statically Determinate Structures (Strain Energy & Displacement of Determinate Beams)

Repeated Questions:

1. Conjugate Beam Method (Theory):

- **Q.** Define conjugate beam. Explain different kinds of a support condition in conjugate beam? **(WINTER 2025, 3 Marks; SUMMER 2026, 3 Marks OR)**

Other Important Questions:

1. Strain Energy (Theory):

- **Q.** Discuss strain energy due to flexure in beam. **(SUMMER 2026, 4 Marks OR)**

2. Strain Energy & Sudden / Impact Loads (Numerical):

- **Q.** A steel bar 150 cm long and rectangular in section 50 mm × 90 mm is subjected to an axial load of 2 kN find maximum stress if, load is applied gradually and the load is applied suddenly. **(WINTER 2025, 3 Marks OR)**
- **Q.** An axial pull of 60 kN is suddenly applied to a steel bar of 2.5m long and 800mm² in cross section. If modulus of elasticity of steel is 200 kN/mm² find maximum instantaneous stress, modulus of resilience, strain energy and maximum instantaneous extension. **(WINTER 2025, 4 Marks)**
- **Q.** A crane chain whose sectional area is 700mm² carries a load of 10kN. It is being lowered at a uniform rate of 40mtr/min, the chain gets jammed suddenly, at that time the length of the chain unwound is 12 meters. calculate the stress induced in the chain due to sudden stoppage. **(SUMMER 2026, 7 Marks)**
- **Q.** A rectangular body 600mm long, 100mm wide and 40mm thick is subjected to a shear stress of 75 MPa. Find out the strain energy stored in it. Take G = 84 GPa. **(SUMMER 2026, 7 Marks)**

3. Deflection by Macaulay's Method (Numerical):

- **Q.** Calculate deflection at point C as shown in figure 1. take EI = 40,000 kN.m². (Using Macaulay's method) [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks)**
- **Q.** Using Macaulay's method determine the slope at end A and Deflection under C. For a simply supported beam of span 5 m and loaded as shown in figure. Take EI = 2×10^3 kN·m². [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks OR)**

4. Slope & Deflection – Conjugate Beam / Moment Area & Other Methods:

- **Q.** Derive the equation to calculate deflection at free end of cantilever beam of L m span and subjected to UDL of w kN/m (on entire span) using conjugate beam method. **(WINTER 2025, 3 Marks)**
- **Q.** Find slope and deflection at free end of cantilever beam as shown in figure 2 by moment area method or conjugate beam method. E = 2×10^5 N/mm², I = 5×10^8 mm⁴. [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks OR)**
- **Q.** Find slope and Deflection at C for the beam as shown in figure. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks)**

Chapter 3: Combined Stresses + Column & Struts

Repeated Questions:

1. Eccentric Loading (Theory):

- **Q.** Define axial load, Eccentricity and Eccentric load. **(WINTER 2025, 3 Marks; SUMMER 2026, 3 Marks)**

Other Important Questions:

1. Columns & Euler's Theory (Theory):

- **Q.** Write assumptions of Euler's formula. **(WINTER 2025, 3 Marks OR)**
- **Q.** Define slenderness ratio, radius of gyration and effective length for a long column. **(SUMMER 2026, 4 Marks OR)**
- **Q.** Derive Euler's Crippling load formula for the long column fixed at both ends. **(SUMMER 2026, 7 Marks)**

2. Columns – Euler's Load (Numerical):

- **Q.** A rectangular column 500 mm wide by 400 mm deep is hinged at both the ends. Take length of column is 7m, $E = 1.2\times10^5$ N/mm². Find Euler's crippling load. **(WINTER 2025, 4 Marks)**
- **Q.** A T-section as shown in figure. The thickness of flange and web is 10mm. The length of column is 5m and it is hinged at both ends. If $E = 2\times10^5$ N/mm², Find Euler's load. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks OR)**

3. Eccentric Load, Core / Kernel of Section:

- **Q.** Define and explain about Kernel of circular section. **(SUMMER 2026, 4 Marks)**
- **Q.** Find and draw Core or Kernel of hollow rectangular section with outer dimension 400 mm × 600 mm and internal dimensions 300 mm × 500 mm. **(WINTER 2025, 3 Marks)**
- **Q.** A rectangular column of size 500×300 mm carries an eccentric load of 800 kN on the axis bisecting the thickness at 120mm from centroidal axis. Find maximum and minimum resultant stress and draw stress diagram. **(WINTER 2025, 4 Marks)**

4. Dams & Retaining Walls:

- **Q.** Explain various Stability checks for a dam. **(SUMMER 2026, 4 Marks OR)**
- **Q.** A rectangular retaining wall section is 1.5m wide. It retains water up to full height. Find minimum height required when it is just at the point of overturning. The density of wall material is 22 kN/m³ and water 10 kN/m³. Take co-efficient of friction as 0.5. **(WINTER 2025, 4 Marks OR)**
- **Q.** A retaining wall of rectangular section 3m wide and 7m height. it retains earth up to full height. Check the stability for tension in base and for sliding. Take density of soil = 16 kN/m³ density of wall material = 25 kN/m³. angle of repose = 30 degree and Poisson's ratio = 0.5. **(SUMMER 2026, 7 Marks)**

5. Principal Stresses & Mohr's Circle:

- **Q.** Explain Mohr's circle method to find normal stress tangential stress and resultant stress on inclined plane. (for one direct stress and two direct stress) **(WINTER 2025, 7 Marks)**
- **Q.** Two planes AB and BC which are at the right angles as shown in figure 5 carry shear stresses of intensity 17.5 N/mm² while these planes also carry a tensile stress of 70 N/mm² and compressive stress of 35 N/mm² respectively. Determine the principal stresses, positions of the principal planes and maximum shear stress. [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks OR)**
- **Q.** A rectangular block is subjected to a direct tensile stress of 800 N/mm² along with a shear stress. determine the shear stress if major principal stress not to exceed 1200 N/mm². (Tensile). Also find the minor principal stress. **(SUMMER 2026, 7 Marks OR)**

Chapter 4: Statically Determinate Structure Subjected to Moving Loads

Repeated Questions:

None identified.

Other Important Questions:

1. Influence Line Diagrams & Load Positions (Theory):

- **Q.** Define Influence line diagram and write the uses of it. **(SUMMER 2026, 3 Marks OR)**
- **Q.** Explain load position for maximum shear force at section for UDL longer than span and shorter than span. **(WINTER 2025, 4 Marks)**
- **Q.** Explain load position for maximum bending moment at a section for a) UDL longer than span and b) single point load. **(WINTER 2025, 4 Marks OR)**

2. Moving Loads on Girders (Numerical):

- **Q.** An UDL of 15 kN/m and 3m length crosses a simply supported girder of span 12m from left to right. Draw ILD for S.F. and B.M. at section 5m from left and find maximum S.F. and B.M. at this section. **(WINTER 2025, 7 Marks)**
- **Q.** A train of load shown in figure 6 crosses a simply supported girder of span 16m from left to right. Calculate maximum shear force and bending moment at section 6m from left. [Diagram required – refer to the original question paper] **(WINTER 2025, 7 Marks OR)**

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