34 +11   (55)

SE Civil III 'C'   23.11.23

Duration:3 Hours   **Marks: 80**

Instructions:

1. **Question No. 1 is Compulsory.**
2. **Answer any three questions from the remaining.**
3. **Each full question carries 20 marks.**
4. **Assume suitable data, if needed and state it clearly.**

Q. 1) Answer any **four** sub-questions.

a) A cantilever beam AB of 2 m length is fixed at left end A & free at right end B. It carries a UDL of 10 kN/m on its entire span. A point load of 10 kN acts at free end in upward direction. Draw shear force & bending moment diagrams.   **(05)**

b) What is core or kernel of a section? Locate the core of a hollow circular section having external diameter of 200 mm and thickness of 20 mm.   **(05)**

c) Write a note on virtual work principle & Castigliano's theorems.   **(05)**

d) What are the assumptions made in theory of pure torsion?   **(05)**

e) Derive the relationships between modulus of rigidity, bulk modulus and modulus of elasticity for a material.   **(05)**

f) Derive expression for strain energy due to gradually applied axial load to an element.   **(05)**

Q. 2) a) A cylindrical shell of internal diameter 1.8 m and 4.2 m length is subjected to an internal fluid pressure of 3.2 MPa. If the hoop stress is limited to 160 MPa, find the shell thickness. Also calculate longitudinal stress, maximum shear stress, changes in length, diameter and volume of the shell. Assume $E = 2 \times 10^5$ MPa & Poisson's ratio = 0.24.   **(10)**

b) A T-beam has a flange (165 mm x 25 mm) and a web (30 mm x 180 mm). The bending stress is limited to 160 MPa. If it is simply supported over a span of 4.5 m, calculate the maximum UDL it can carry safely.   **(10)**

Q. 3) a) An I-beam section has top flange of (170 mm x 20 mm), web of (25 mm x 100 mm) & bottom flange of (150 mm x 20 mm). If it is subjected to a shear force of 200 kN, draw shear stress distribution diagram across the C/S.   **(10)**

b) A S/S beam ABCD is 12 m long. Left end A is roller supported & right end D is hinged. AB = BC = CD = 4 m. each. Part AB carries a UDL of 10 kN/m. At C, there is an anticlockwise couple of 15 kNm. Draw SFD & BMD.   **(10)**

Q. 4) a) A hollow circular shaft has an external diameter of 170 mm. Its internal diameter is 0.8 times the external diameter. Determine the power that can be transmitted if shear stress is limited to 130 MPa & maximum angle of twist is 3.5 degrees for 3.8 m length. Shaft sped is 200 RPM. Maximum torque exceeds average torque by 20%. Take modulus of rigidity as 80 GPa.   **(10)**
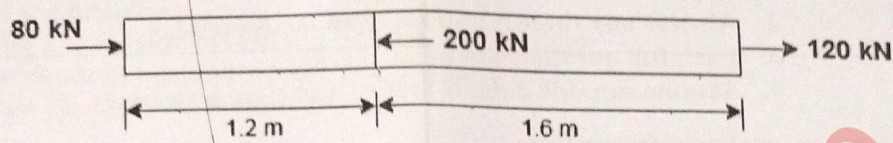
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b) A steel bar has a C/S of (40 mm x 40 mm). Determine change in the length of bar. Young's modulus is 2×10^5 MPa. (05)

c) A vertical steel bar 25 mm in diameter & 1.8 m long is provided with a collar at the lower end. Determine the maximum weight 'W' that can be dropped through a height of 110 mm over the collar, if maximum permissible tensile stress in steel bar is 155 MPa. Take E = 200 GPa. (05)

Q. 5) a) The principal stresses at a point across two perpendicular planes are 135MPa horizontal (Tensile) & 85 MPa vertical (Compressive). Determine the normal stress, tangential stress & resultant stress & its obliquity on a plane at 35 degrees with the major principal plane. (10)

b) An overhanging beam ABCD is 10 m long. Left end A is hinged & right end D is free. Part AC is 8 m long. At C, there is a roller support. A point load of 25 kN acts at B, at the centre of part AC. Right overhanging part CD of length 2 m carries a UDL of 5 kN/m on its entire span. Using Macaulay's double integration method, determine slope at C & deflection at B in terms of EI. (10)

Q. 6) a) A hollow steel column of 5.5 m length has an outer diameter of 130 mm & thickness of 15 mm. It is fixed at one end & pinned at the other end. Determine Rankine's crippling load. Compare it with the Euler's crippling load. Take E = 2×10^5 MPa, crushing stress = 330 MPa & Rankine's constant = (1/7500). (10)

b) A short column of 200 mm external diameter & 150 mm internal diameter, when subjected to a load, the stresses are 150 MPa (Compressive) at one end to 25 MPa (Tensile) on the other end. Determine the value of the load & distance of its line of action from the axis of the column. (10)

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