SE/Sem-III/Civil/R-20/C scheme/04-05-22

Time: (03 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) Draw SFD & BMD for a simply-supported beam shown in fig. 1 **(05 M)**

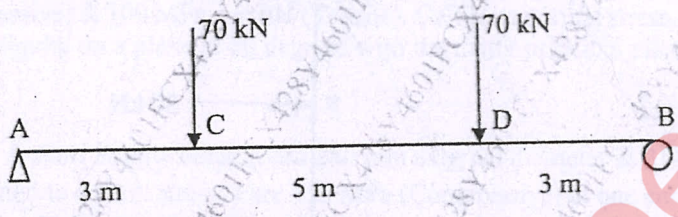

Fig. 1

b) Explain virtual work principle & Castigliano's theorems. **(05 M)**

c) State the assumptions of pure bending theory. **(05 M)**

d) Define core of a section. Locate core of a hollow rectangular section with external dimensions (400 mm width x 700 mm depth) & internal dimensions (370 mm width x 670 mm depth). **(05 M)**

e) Draw stress-strain curve for a mild steel bar under tension. Explain important points. **(05 M)**

f) State the assumptions of pure torsion theory. **(05 M)**

Q. 2) a) The C/S of a T-beam is shown in fig. 2. The permissible bending stress is 195 MPa. If the section is simply supported over a span of 4.4 m, what UDL can it carry safely? **(10 M)**

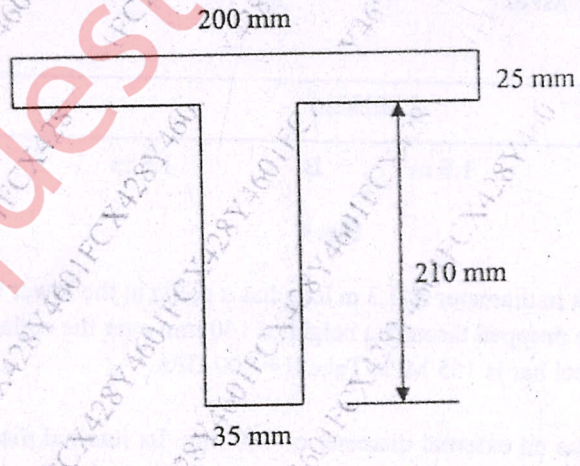

Fig. 2

b) A cylindrical shell of internal diameter 2 m and 3.8 m length is subjected to an internal fluid pressure of 4 MPa. If the permissible circumferential stress is 140 MPa, find out the shell thickness. Also determine longitudinal stress, maximum shear stress, changes in length, diameter and volume of the shell. Assume E = 2.1 x 10^5 MPa & Poisson's ratio = 0.23. **(10 M)**

Q. 3) a) Draw AFD, SFD & BMD for the frame shown in fig. 3. **(10 M)**

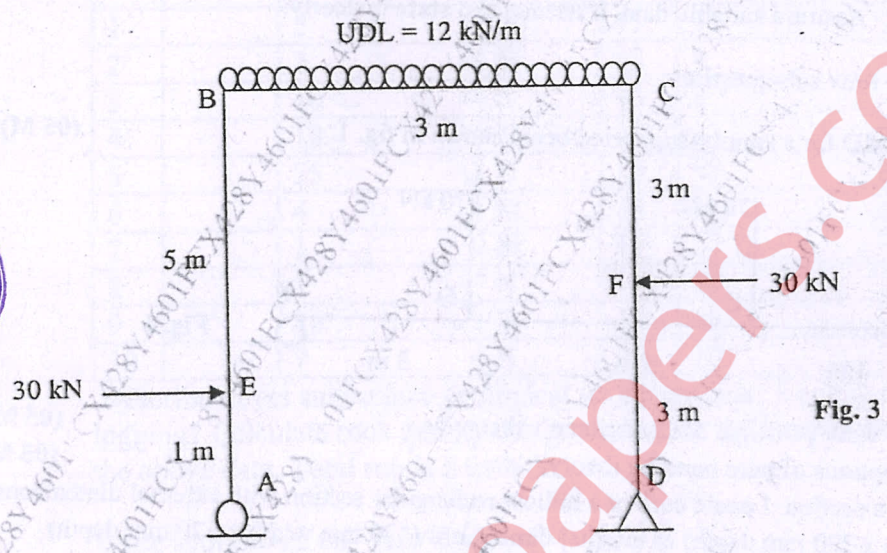

Fig. 3

b) An I-beam section has top flange of (200 mm x 35 mm), web of (25 mm x 130 mm) & bottom flange of (150 mm x 20 mm). It is subjected to a shear force of 170 kN. Draw shear stress distribution diagram across the C/S. **(10 M)**

Q. 4) a) A steel bar shown in fig. 4 has a diameter of 60 mm. Determine change in the length of bar. Young's modulus is 2.1×10^5 MPa. **(05 M)**

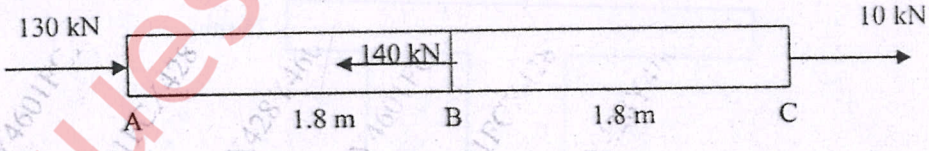

Fig. 4

b) A vertical steel bar 45 mm in diameter & 2.3 m long has a collar at the lower end. Determine the maximum weight that can be dropped through a height of 140 mm over the collar, if maximum allowable tensile stress in steel bar is 155 MPa. Take E = 200 GPa. **(05 M)**

c) A hollow circular shaft has an external diameter of 180 mm. Its internal diameter is 0.7 times the external diameter. Determine the power that can be transmitted if permissible shear stress is 150 MPa & maximum angle of twist is 2.5 degrees for 3.8 m length. Shaft sped is 175 RPM. Maximum torque exceeds average torque by 16%. Take modulus of rigidity as 80 GPa. **(10 M)**

Q. 5) a) For an overhanging beam shown in fig. 5, determine slope at D & deflection at A. Use Macaulay's double integration method. **(10 M)**

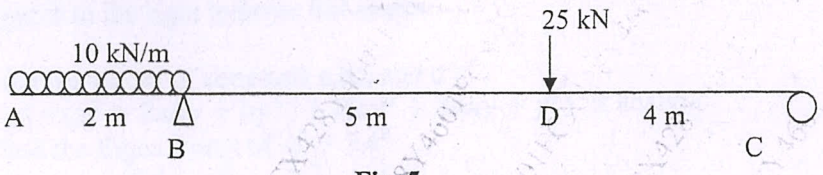

Fig. 5

b) The principal stresses at a point across two perpendicular planes are 165 MPa horizontal (Compressive) & 100 MPa vertical (Tensile). Calculate normal stress, tangential stress & resultant stress & its obliquity on a plane at 30 degrees with the major principal plane. **(10 M)**

Q. 6) a) A short hollow column has 280 mm external diameter & 210 mm internal diameter. When it is subjected to a load, stresses are 155 MPa (Compressive) at one end to zero at the other end. Determine the load value & distance of its line of action from the column axis. **(10 M)**

b) A hollow steel column of 5 m height has an outer diameter of 180 mm & thickness of 25 mm. It is pinned at both the ends. Determine Rankine's crippling load. Compare it with the Euler's crippling load. Take E = 2.1 x 10^5 MPa, crushing stress = 330 MPa & Rankine's constant = (1/7350). **(10 M)**