14/11/2024

SE|civil|sem-III|CBCGS|R-19|C-scheme|MS|SH-24

Duration : 3 Hrs. **[Total Marks: 80]**

QP-10067234

Instructions to the Candidates :

- Question No. 1 is **compulsory.** Answer any **three** out of the remaining five questions.
- Draw neat sketches wherever necessary. **Assume** suitable data, if required & state it clearly.

Q.1 Answer **any four**. **20**

(a) A rectangular block of height 250 mm has a C/S of (50 mm x 40 mm). It has to support an axial compressive load P. Young's modulus of the material is 95000 N/mm^2. Determine the largest load P which can be applied so that the normal stress must not exceed 80 N/mm^2& the decrease in the height of the block should be at the most 0.3 mm. **05**

(b) Derive an expression for the strain energy of an element subjected to a gradually applied axial load. **05**

(c) What do you mean by core or kernel of a section? Locate core of a hollow circular section with an external diameter of 300 mm and a thickness of 25 mm. **05**

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

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

Q.2 (a) For the beam in fig. 1, draw SFD & BMD. A is the fixed end, there is an internal hinge at C & F is a roller support. **08**

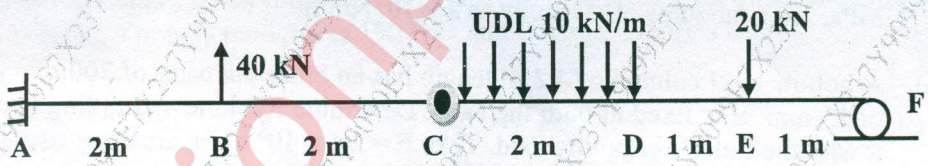

Fig. 1

(b) The C/S of a T-beam is shown in fig. 2. The permissible bending stress is 190 MPa. If the section is simply supported over a span of 4.3 m, how much UDL can it carry safely? Flange is (160 mm x 20 mm) & web is (100 mm x 20 mm). **08**

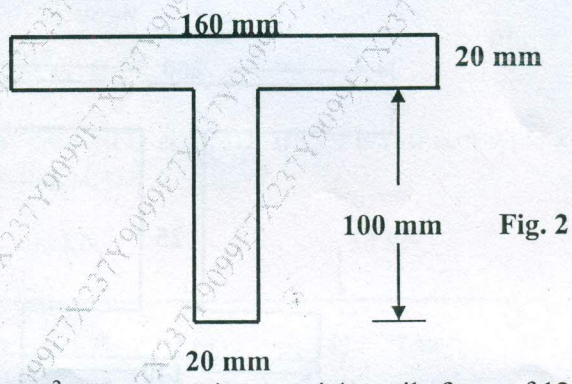

Fig. 2

(c) A metal block of 100 mm^2 C/S area caries an axial tensile force of 12 kN. For a plane inclined at 30^0 with the direction of applied load, calculate normal stress and shear stress. Also calculate maximum shear stress. **04**

Q.3 (a) A hollow circular shaft having internal diameter 0.75 times its external diameter transmits a power of 320 kW at a speed of 230 RPM. The maximum torque is 15% greater than the mean torque. Shear stress is not to exceed 80 MPa and angle of twist in length of 4 m is not to exceed 2.5°. Calculate external and internal diameters. Take modulus of rigidity = 85GPa. **08**

(b) A cylindrical shell of internal diameter 2 m and 3.8 m length is subjected to an internal fluid pressure of 3.5 MPa. If the permissible circumferential stress is 165 MPa, what should be the shell thickness? Also determine longitudinal stress, maximum shear stress and change in volume of the shell. Assume $E = 2 \times 10^5$ MPa & Poisson's ratio = 0.24. **08**

(c) For the cantilever beam of fig. 3, determine slope and deflection at the free end C, using Macaulay's double integration method. EI is constant for the beam. **04**

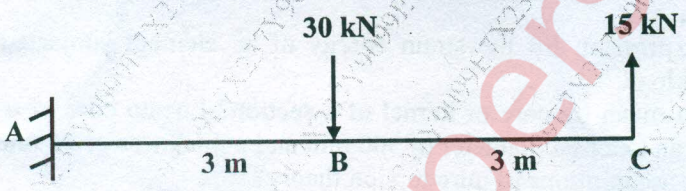

Fig. 3

Q.4 (a) A vertical steel bar 25 mm diameter and 1.8 m. long is provided with a collar at the lower end. Find the maximum weight 'W' that can be dropped through a height of 140 mm over the collar, if the maximum permissible tensile stress in steel bar is 150 MPa. Take modulus of elasticity as 2×10^5 N/mm^2. **08**

(b) A hollow steel column of 4.2 m length has an outer diameter of 200 mm & thickness of 25 mm. It is fixed at both the ends. Determine Rankine's crippling load. Compare it with the Euler's crippling load. Take $E = 2.1 \times 10^5$ MPa, crushing stress = 360 MPa & Rankine's constant = (1/7450). **08**

(c) Explain virtual work principle & Castigliano's theorems. **04**

Q.5 (a) An I-section of fig. 4 is subjected to a shear force of 200 kN. Draw the shear stress distribution diagram. All the dimensions are in mm. **08**

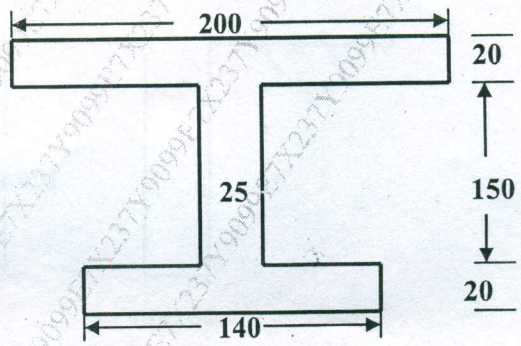

Fig. 4

(b) A masonry pier of fig. 5 is subjected to a vertical load of P = 55 kN. Find the stresses developed at each corner of the pier. The load has an eccentricity of 0.6 m with reference to both the axes X & Y. **08**

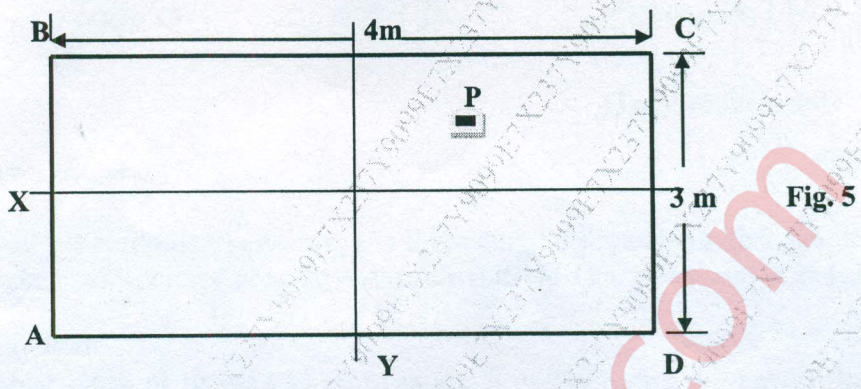

Fig. 5

(c) Three different materials designated as A, B & C are tested in tension in universal testing machine. Each specimen has a diameter of 13 mm & gauge length of 50 mm. At the failure, the distances between gauge marks were 53 mm, 62 mm & 70 mm respectively. At the failure C/S, diameters were 12 mm, 10 mm & 6.5 mm respectively. Determine the percentage elongation & percentage reduction in C/S area of each specimen & then using your own judgment, classify each material as ductile or brittle. **04**

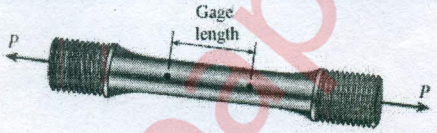

Fig. 6

Q.6 (a) For a rectangular block in fig. 7, Determine the change in each dimension and change in volume. Young's modulus is 190 GPa and Poisson's ratio is 0.27. **08**

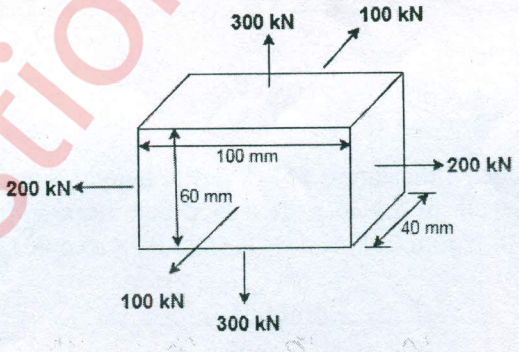

Fig. 7

(b) For the beam in fig. 8, draw SFD & BMD. If C/S is (80 mm wide x 120 mm deep), find the maximum bending stress. **08**

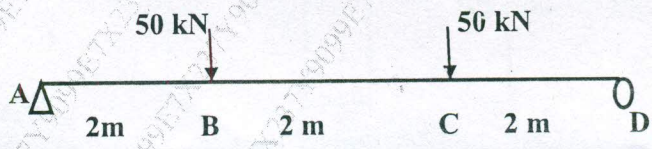

Fig. 8

(c) A 3 m. long cantilever beam carries a UDL of w/unit run on its entire span. The slope at the free end is 1^0. Determine the deflection at the free end. EI is constant for beam. **04**