QP Code :4761

(3 Hours) [Total Marks :80]

N.B.: (1) Question No. 1 is **compulsory**. Answer any **three** from remaining **five** questions.
(2) **Illustrate** your answers with neat **sketches** whenever necessary
(3) **Assume** any other data needed suitably, if not given. However, **justify** the same.

1. Attempt any **four** of the following.
   (a) Derive the relationship between shear force, bending moment and intensity of loading. 05
   (b) If two pieces of materials A and B have the same bulk modulus, but the value of modulus of elasticity for B is 1% greater than that for A, find the value of modulus of rigidity for the material B in terms of modulus of elasticity and modulus of rigidity for material A. 05
   (c) Derive an expression for longitudinal stress and circumferential stress for the thin cylinder. 05
   (d) Explain the concept of beam of uniform strength. 05
   (e) State the assumption made in the theory of pure torsion. 05

2. (a) A tensile load of 50 kN is acting on the rod of 50 mm diameter and length of 5 m. Determine the length of a bore of 25 mm that can be made central in the rod, if the total extension is not to exceed by 25 percent under the same tensile load. Take $E = 2.05 \times 10^5$ N/mm^2. 10
   (b) A beam ABCD of span 8 m is supported at A, B and D, has an internal hinge at C. Span AB is of 4 m carries a U.D.L. of 20 kN/m.. Span CD is of 2 m carries a U.D.L. of 20 kN/m Find the support reactions and draw the S.F.D. and B.M.D. 10

3. (a) A solid rod of bronze 20 mm in diameter is surrounded by a fitting steel cylinder of external diameter 28 mm. If the permissible bending stress in bronze and steel are 100 N/mm^2 and 150 N/mm^2, find the moment of resistance of composite section. The Young's modulus for steel may be taken as 1.75 times that of bronze. 10
   (b) What are the principal planes and principal stresses? Explain the Mohr's Circle method for two perpendicular direct stresses with state of simple shear. 06
   (c) A beam of triangular cross-section with base b and height h is used with the base horizontal. Calculate intensity of shear stress at neutral axis and at height h/2. Plot the variation of shear stress intensity over the section. 04

Q. (4) A) A circular shaft has to transmit 550 kW power at 115 RPM. Allowable shear stress = 78 MPa. Find: i) the required diameter of the solid shaft. ii) The diameters of the hollow section, such that internal diameter = 0.75 X External diameter. (10 M)

B) A column of 6 m effective length is to be made from 3 plates (fig. 8). Using E = 210 GPa, find the factor of safety with respect to buckling for an axial load of 17 kN. Use Euler's theory. (06 M)

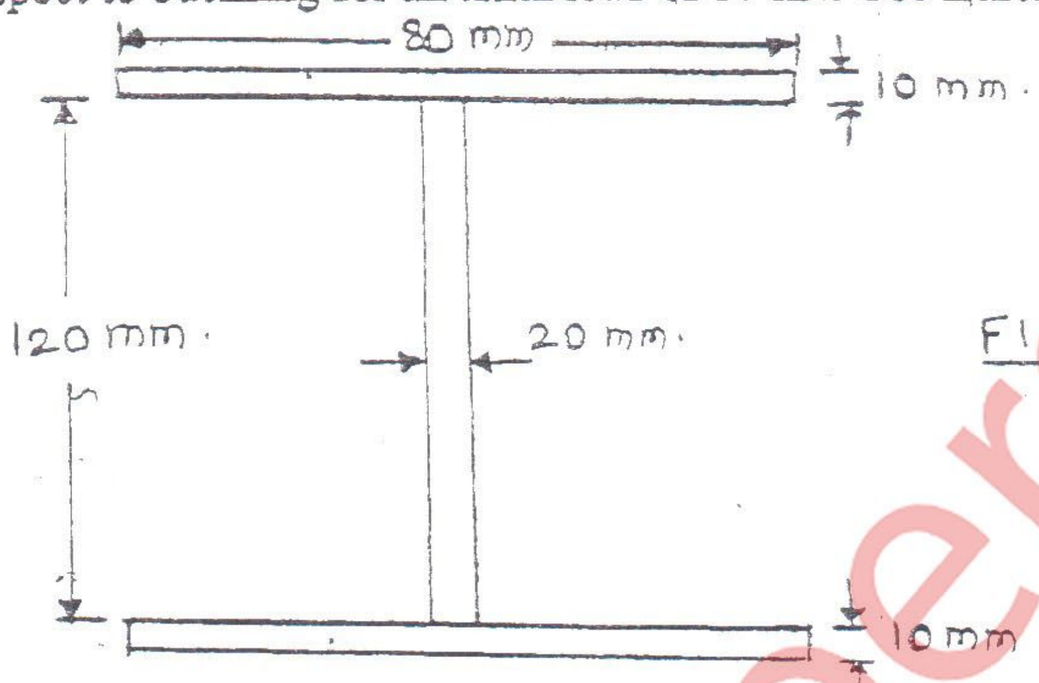

FIG. 8

C) Write a note on temperature stresses. (04 M)

Q. (5) A) A bar is subjected to a tensile load of 50 kN. Bar diameter = 30 mm, Gauge length = 300 mm, extension = 0.114 mm, change in diameter = 0.00366 mm. Find: Poisson's ratio, Young's modulus, *bulk* modulus & modulus of rigidity (06 M)

B) Write a short note on flitched beams. (04 M)

C) An element in a stressed body is subjected to normal stresses on mutually perpendicular directions (fig. 9). Determine the normal, tangential & resultant stresses on a plane P-P inclined as shown. Either use analytical method or graphical method. (10 M)

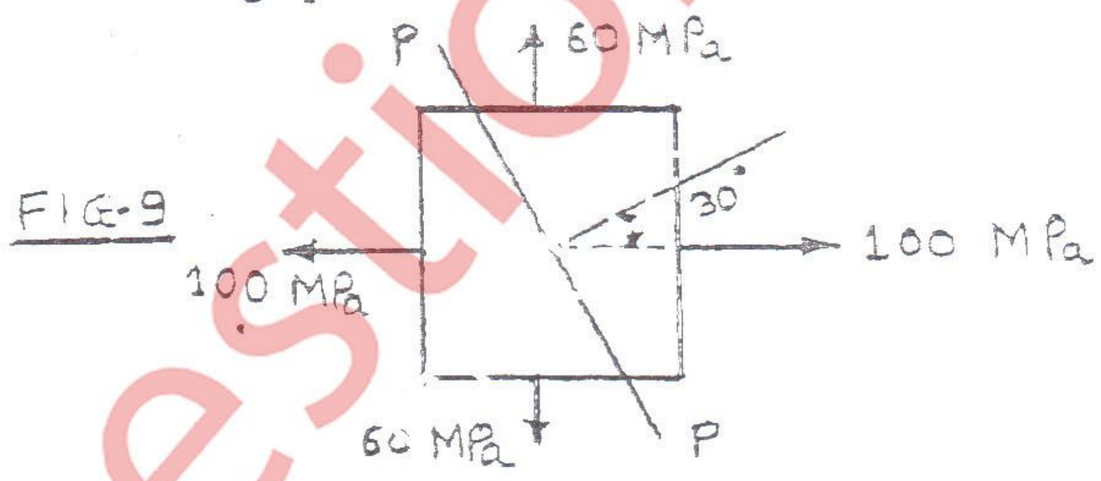

FIG-9

Q. (6) A) The steel pipe, 500 mm long is filled with concrete & subjected to an axial compressive load of 90 kN. Determine the stress in the concrete & the steel due to this loading. The pipe has an outer diameter = 80 mm & an inner diameter = 70 mm. E_{steel} = 200 GPa, $E_{concrete}$ = 24 GPa. (06M)

B) Determine the maximum torque that can be applied safely to a solid shaft of diameter 260 mm. The permissible angle of twist = 1.3 degrees in a length of 6 m & the shear stress is not to exceed 61 MPa. Take modulus of rigidity G = 90 MPa. (06 M)

C) Locate the core or kernel of I-section with the properties: top & bottom flange: (150 mm X 10 mm), Web: 280 mm X 10 mm. Overall depth = 300 mm. (08 M)