226 : Con. No.-JP

Con. 6461–13. **GS–6267**

(3 Hours) **[Total Marks : 100**

Instructions: 1) Question No. **1** is **COMPULSORY**. Answer any **four** from the remaining.

2) Assume suitable data, if needed & state it clearly.

3) Each full question carries equal marks.

Q. 1) a) State the assumptions of pure bending theory. (04 M)

b) Define: Bulk Modulus & Modulus of Rigidity. (04 M)

c) Draw typical shear stress distribution diagrams for: symmetrical I-section & T-section. (04 M)

d) Define torsional rigidity & polar modulus. (04 M)

e) Derive an expression for the longitudinal stress in thin cylindrical shell. (04 M)

Q. 2) a) The beam (**fig. 1**) carries a concentrated load **W** & a UDL that totals **4 W**. Determine the largest allowable value of **W** if the working stresses are **60 MPa** in tension & **100 MPa** in compression. (14 M)

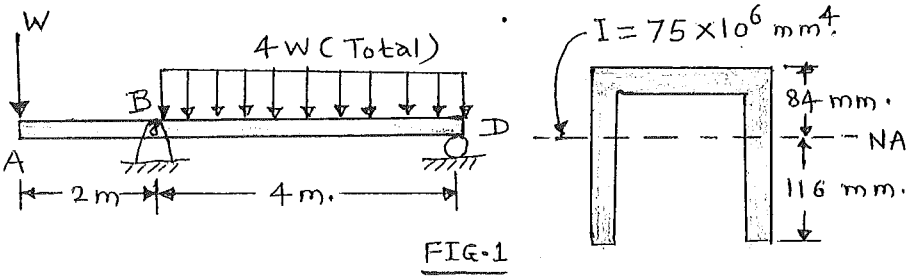


FIG-1

b) A piece of material is subjected to tensile stresses of 60 N/mm^2 & 30 N/mm^2 at right angles to each other. Find fully the stresses on the plane the normal of which makes an angle of 40^0 with the 60 N/mm^2 stress. (06 M)

Q. 3) a) A steel pad supporting heavy machinery rests on four short, hollow, cast iron piers (**Fig. 2**). The ultimate strength of the cast iron in compression is 344.5 MPa. The outer diameter of the piers is d = 112.5 mm & the wall thickness t = 10 mm. Using a factor of safety of 3.5 with respect to the ultimate strength, determine the total load P that may be supported by the pad. (05 M)

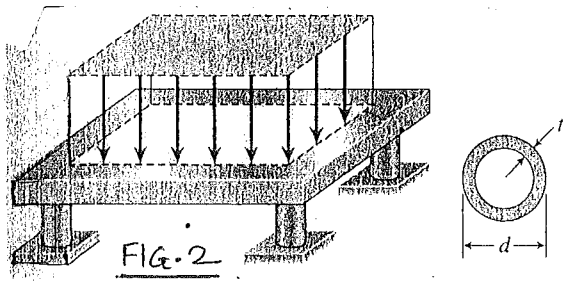


FIG-2

b) A steel pipe having yield stress = 270 MPa is to carry an axial compressive load P = 1200 kN (**Fig. 3**). A factor of safety of 1.8 is to be used against yielding. If the thickness of the pipe is to be one-eighth of its outer diameter, what is the minimum required outer diameter dmin? (04 M)

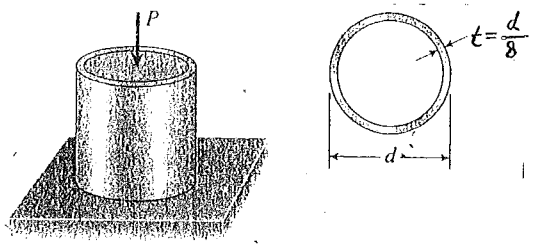


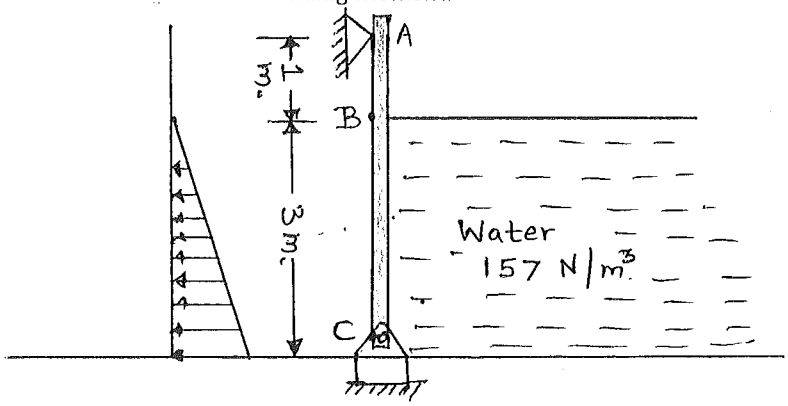
FIG-3

[TURN OVER

c) Derive an expression for the change in length of the bar of uniformly tapering circular section subjected to axial load P. (07 M)

d) A material has E = 1.25 X 10^5 MPa & Poisson's ratio = 0.25. Calculate the shear modulus & bulk modulus. (04 M)

Q. 4) a) A steel door closes a 2 m wide dam gate as shown in **fig. 4**. Draw SFD & BMD & calculate the position & magnitude of maximum Bending Moment. (12 M)

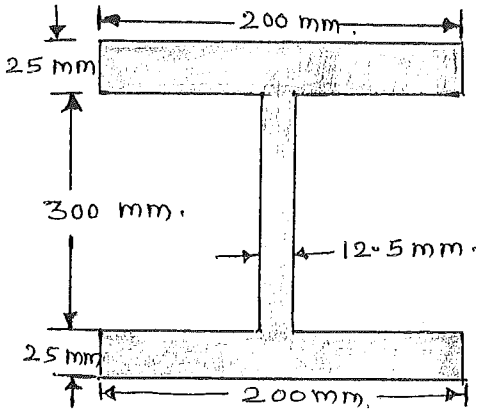


FIG·4

b) A flitched beam consists of a wooden joist 300 mm wide, 400 mm deep strengthened by a steel plate 10 mm thick & 400 mm deep one on either side of the joist. If the maximum stress in the wooden joist is 7.5 MPa, find the corresponding maximum stress attained in steel. Find also the moment of resistance of the beam section. Es = 20 Ew. (08 M)

Q. 5) a) A hollow & a solid shaft of same material have the same weight while the inner diameter of the hollow shaft is half of its outer diameter. What will be the torque carried by the hollow shaft if the solid shaft can carry a torque T for same maximum shearing stress in both the shafts. (10 M)

b) An I-section beam (**Fig. 5**) carries a shearing force of 200 kN at a section. Sketch the shear stress distribution across the section. (10 M)



FIG·5

Q. 6) a) A masonry chimney having the shape of a frustum of a cone is 25 m high. The external diameter at the top & internal diameter at the bottom is 2 m. The chimney is 0.5 m thick at the base. Weight of the chimney is 1800 kN. Find the uniform horizontal wind pressure that may act per unit projected area of the chimney in order to avoid the tension at the base. (10 M)

b) Two planes AB & BC which are at right angles carry shear stresses of intensity 17.5 MPa while these planes also carry a tensile stress of 70 MPa & a compressive stress of 35 MPa respectively. Find the principal planes & the principal stresses. Also find the max. shear stress & the planes on which it acts. (10 M)

Q. 7) a) Calculate the thickness of steel plate to fabricate a spherical pressure vessel of 1.2 m diameter. The max. pressure in the vessel may be 3 MPa. The ultimate tensile strength of steel = 450 MPa & desirable factor of safety is 4. If E = 2.1 X 10^5 MPa, what will be the change in diameter of a sphere? Poisson's ratio= 0.3. (06 M)

b) A 15 mm diameter steel rod passes centrally through a copper tube 50 mm external diameter & 40 mm internal diameter. The tube is closed at each end by rigid plates of negligible thickness. The nuts are tightened lightly home on the projecting parts of the rod. If the assembly temperature is raised by 60^0 C, calculate the stresses developed in copper & steel. Es = 2.1 X 10^5 MPa, Ec = 1.05 X 10^5 MPa, αs = 12 X 10^{-6} per ^{0}C, αc = 17.5 X 10^{-6} per ^{0}C. (07 M)

c) A tie bar 100 mm X 10 mm is connected to another by fillet welds around the end of the bar & also inside a machined slot (**Fig. 6**). Allowing a tensile stress of 155 MPa in the tie bar & a shear stress of 103 MPa in the fillet weld, find the size of the fillet weld. (07 M)

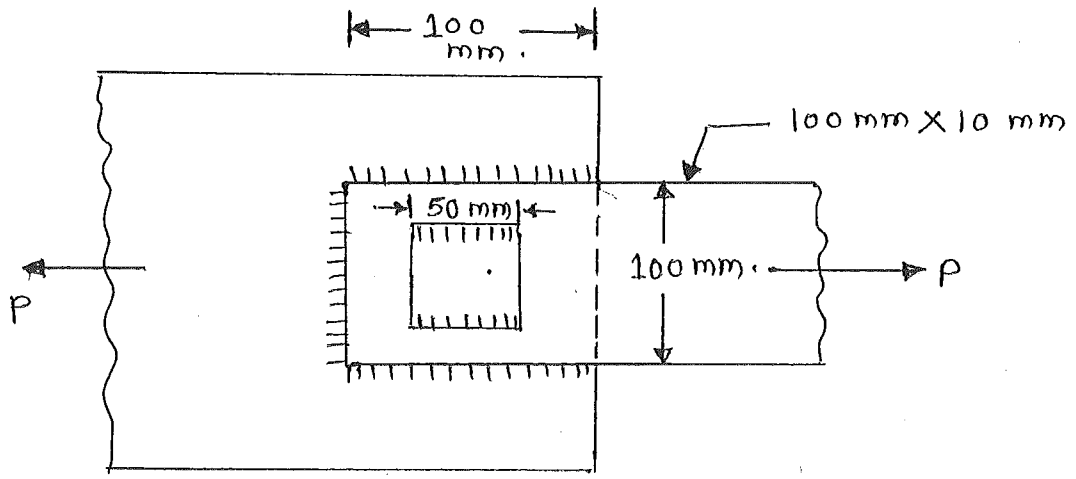


FIG. 6