3rd. 32

Exam.Code:0939
Sub. Code: 7042

1128

B.E. (Mechanical Engineering)
Third Semester
MEC-302: Mechanical of Materials – I

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Part. Use usual notations and symbols for derivations. Assume suitably missing data, if any.

x-x-x

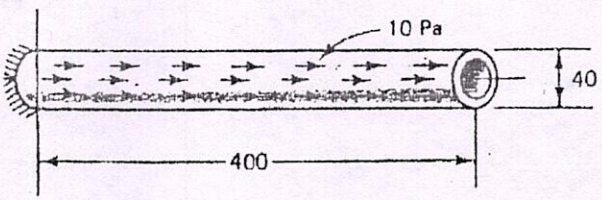
Q1. Provide short and **clear** answers to the following

(a) What is a stress tensor ?
(b) Write down the equilibrium equations for a solid at a point.
(c) How does stress vary on an inlined section in a axially loaded bar.
(d) What is bearing stress?
(e) What is a S-N curve?
(f) How is the Shear modulus related to the Elastic modulus and Poisson's ratio.
(g) What is a strain gauge?
(h) What are Singularity functions?
(i) What is beam curvature?
(j) What is shear center?

Part A

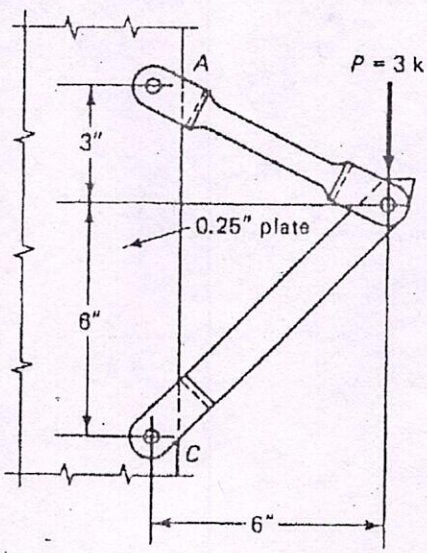
Q2. A 2 mm thick hollow circular tube of 40 mm outside diameter is subjected on the outside surface to a constant shear of 10 Pa in the axial direction. If the tube is 400 mm long, what is the maximum axial stress? Plot the variation of the axial stress along the tube.

Fig. 2



Q3. A bracket of negligible weight is loaded with a vertical force P of 3000 lbf (or 3 kips). For inter-connection the ends of the bars are forked. Determine the deflection of point B by the applied force P. Also determine the stiffness of the bracket at B. Assume that the members are made of 2024-T4 aluminum alloy with E = 10.6×10^6 lbf/in^2 and that they have constant cross-sectional areas, i.e., neglect the enlargements at the connections.

Fig. 3



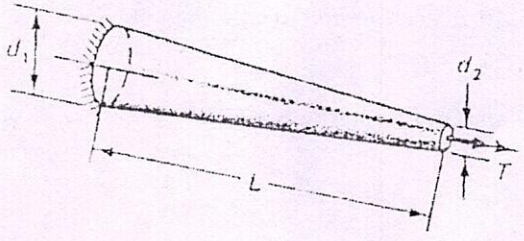
P.T.O.

Q4. A cylindrical vessel is used for storing ammonia at the maximum temperature of 50°C. The vapor pressure of ammonia at 50°C is 20 atm. The thickness of the vessel material is limited to 20 mm with a tensile strength of 400 MPa. If the factor of safety is 5, assuming that all welds are to be inspected with x-rays, what can be the maximum diameter of the vessel. For the selected wall thickness, calculate the change in diameter that would occur with ammonia at 50°C.

Part B

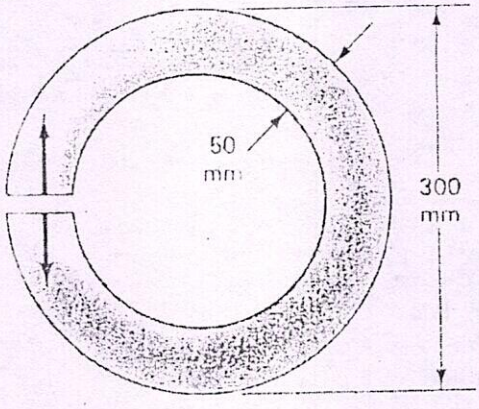
Q5. A solid tapered shaft steel shaft is rigidly fastened to a fixed support at one end and is subjected to a torque T at the other end Find the angular rotation of the free end if d_1=6 in, d_2=2 in, L= 20 in, T=27000 lbf-in. Assume that the usual assumptions of strain in prismatic circular shafts subjected to torque apply, and let G=12×106 lbf/in^2. Also determine the torsional flexibility of the shaft.

Fig. 5



Q6. A steel bar of 50 mm diameter is bent into a nearly complete circular ring of 300 mm outside diameter. Calculate the maximum stress in this ring caused by applying two 10 kN forces at the open end. Also find the ratio of the maximum stress found above to the largest compressive stress acting normal to the same section.

Fig. 6



Q7. Two long wooden planks form a T section of a beam. If this beam transmits a constant vertical shear of 3000 N, find the necessary spacing of the nails between the two planks of make the beam act as a unit. Assume the allowable shear force per nail is 700 N.

Fig. 7