B.E. (Mechanical Engineering) Fourth Semester (C.B.S.)

Mechanics of Materials Paper - V

P. Pages : 4

Time : Three Hours

* 0 7 8 3 *

TKN/KS/16/7375

Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Illustrate your answers whenever necessary with the help of neat sketches.
11. Use of non programmable calculator is permitted.
12. Use of Design Data Book is Permitted.

1. a) Define various elastic constants. And Derive relation between modulus of Elasticity & Modulus of Rigidity. **6**

b) A steel plate having dimensions 360mm x 220mm x 30mm is subjected to bi-axial normal stresses as shown in fig 1(b). Assuming E=200GPa & Poisson ratio = 0.3. Calculate **7**

i) Strain in 3-direction
ii) Volumetric strain
iii) Change in volume
iv) Bulk Modulus

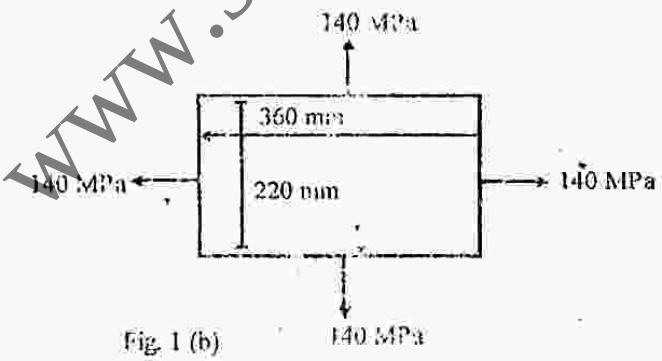

Fig. 1 (b)

OR

2. a) A steel tube of 30mm external diameter and 25mm internal diameter encloses a gun metal rod of 20mm diameter, to which it is rigidly joined at each end. If at a temperature of 30°C there is no longitudinal stress. Calculate the stresses in rod and tube when temperature is raised to 120°C. **7**

$E_{st} = 200GPa$, $E_{GM} = 100GPa$

$\alpha_{st} = 12\times10^{-6}/°C$ $\alpha_{GM} = 20\times10^{-6}/°C$.

b) Member ABCD subjected to point loads as shown in figure 2 (b). Calculate P_2 necessary for equilibrium, if $P_1 = 45kN$, $P_3 = 450kN$ and $P_4 = 130kN$. Determine total elongation Take $E = 2.1\times10^5\ N/mm^2$. 6

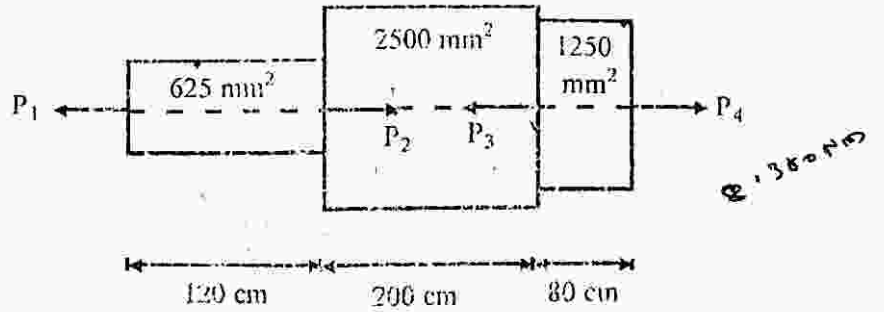

Fig. 2 (b)

3. Draw shear force and Bending Moment diagram for the overhang Beam shown in fig (3). Find the point of contraflexure if any the couple is acting at Pt. 'B'. 13

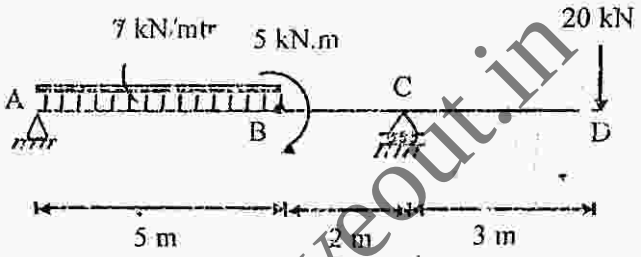

Fig. 3

OR

4. a) For a circular cross section beam. Show that maximum shear stress $T_{max} = \frac{4}{3}$ average. 6

b) A cast iron beam of 25mmx25mm in section and 1 meter long and supported at the ends tails when a centre load of 1000N is applied. What uniformly distributed load will break a cantilever of same material 60mm wide 100mm deep and 1.5 meter long. 8

5. A beam of span 8m is simply supported at the ends. It carries a udl of 30 kN/m over its entire length & a concentrated Load of 60kN at 3m from left support. Determine the maximum deflection in the beam & its Location. 13

$E = 200GPa$ & $I = 80\times10^{-4}\ m^4$.

OR

6. a) A block 100mmx50mmx7.5mm. Thick is subjected to uniformly distributed stress field as shown in fig 6 (A) Compute normal stress and shear stress developed along BD Plane. 6

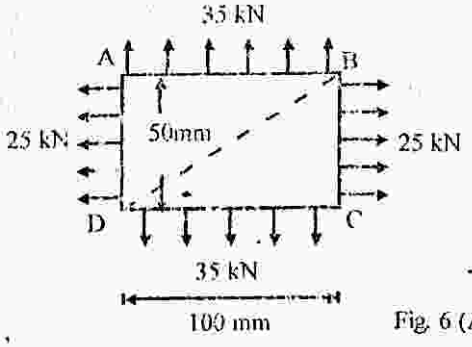

Fig. 6 (A)

b) On a mild steel plate, a circle of 50mm diameter is drawn before the plate is stressed as shown in figure 6 (b). Find the length of major & Minor axes of an ellipse formed as a result of deformation of the circle marked. $E = 200\,GP$ & $\frac{1}{m} = 0.25$. 7

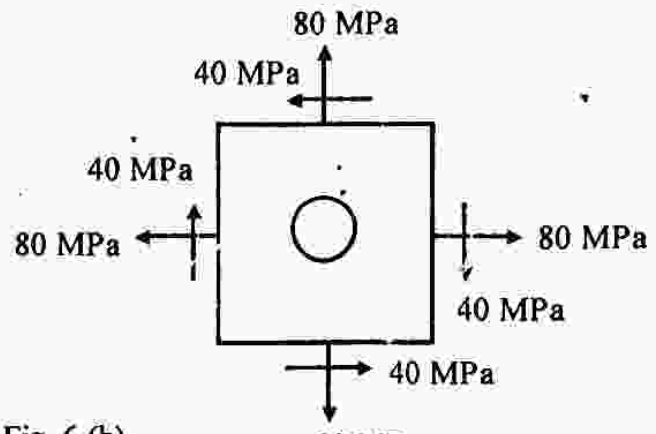

Fig. 6 (b)

7. a) Derive the torsional equation for a solid circular shaft with usual notations. 6

b) A solid shaft is required to transmit 300kW at 110rpm, the maximum torque being 20% greater than mean torque. Determine the diameter 'd' of the shaft so that the torsional shear stress should not exceed 63MPa & angle of twist not exceed 1.5° in a length of 3m. Take G=84 GPa. 7

OR

8. a) Prove that Crippling Load by Euler's formula for column having both ends hinged, is given by, 5

$$F_{cr} = \frac{\pi^2 EI}{L^2}$$

b) A 1.5m long column has circular cross section of 50mm diameter. One end is fixed while other end is free. Calculate Safe Load using F.S=3 by 8

i) Euler's Formula – $E = 1.2 \times 10^5\ N/mm^2$

ii) Rankine's formula, $\delta_c = 560MPa$ & $\alpha = \frac{1}{1600}$.

9. a) Show that strain energy stored in a body when the load is applied gradually is given by, 5

$$U = \frac{\delta^2}{2E} \times V.$$

b) A Wagon Weighing 35KN is attached to a wire rope & moving on level track at a speed of 3.6Km/hr, When the rope Jams & the Wagon is suddenly brought to rest. If the length of the rope is 60m at the time of Sudden Stoppage, Calculate the maximum instantaneous stress & Max. Instantaneous elongation produced. Diameter of rope = 30mm $E = 200\ GN/m^2$. 8

OR

10. a) Explain the Creep Phenomenon. 5

b) A steel bar 25mm diameter and 2.5m length is fixed at the top end and hangs vertically with rigid collar at its lower end. Find the maximum instantaneous stress developed in the rod & deformation if a weight of 200KN falls on collar through 300mm height. Take E = 204 GPa. 8

11. a) Explain in brief the S-N diagram. 4

b) What do you understand by stress concentration? Explain in brief methods of reducing its effect. 5

c) Explain in brief different theories of failure. 5

OR

12. A hot rolled steel shaft is subjected to torsional load that varies from 300N-m C.W. to 100 N-m C.C.W & bending momen: that varies from +400 N-m to -100 N-m. The shaft is of uniform Cross-Section & having no stress raiser present at critical section. Determine the required diameter of shaft. Assume FS=1.5. The material properties are. 14

Sut = 550 MPa; Syt = 410MPa; Seb=290MPa

Surface finish factor = 0.9, Size factor = 0.8, Reliability = 0.9.