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

Mechanics of Materials

P. Pages : 3 **NKT/KS/17/7287**

Time : Three Hours 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) A circular steel bar is subjected to various forces as shown in fig. Q. 1 a. Determine the total elongation in the bar. $E = 2\times10^5\ N/mm^2$. **6**

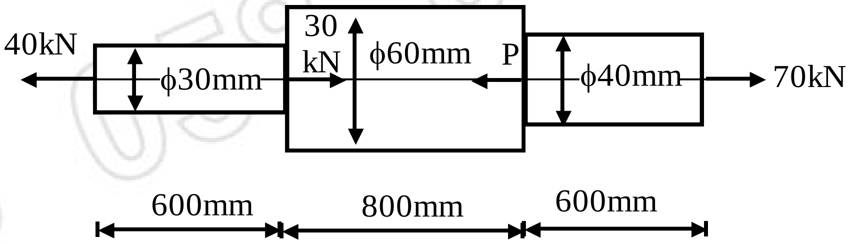

Fig. Q.1(a)

b) A steel rod of 30 mm diameter and 200mm long is rigidly held between supports. Determine the stress induced in the bar when temp. is raised by 70°C if. **7**

i) Supports are rigid.

ii) Supports yield by 0.6 mm

$E = 2\times10^5\ N/mm^2,\ \alpha = 12\times10^{-6}/°C$.

OR

2. a) A metallic block of dimensions 300 mm x 200 mm x 100 mm is loaded with 80 kN (T), 100 kN (C), 90 kN (T) along x, y and z direction resp. Determine the volumetric strain and change in volume $\mu = 0.3,\ E = 2\times10^5\ N/mm^2$. **7**

b) Define Elastic constant [E] and modulus of rigidity [G] and Poisson's ratio (μ) & Derive the relation between E, G and μ. **6**

3. Draw the shear force and bending moment diagram for the beam shown in fig. Q. 3. **14**

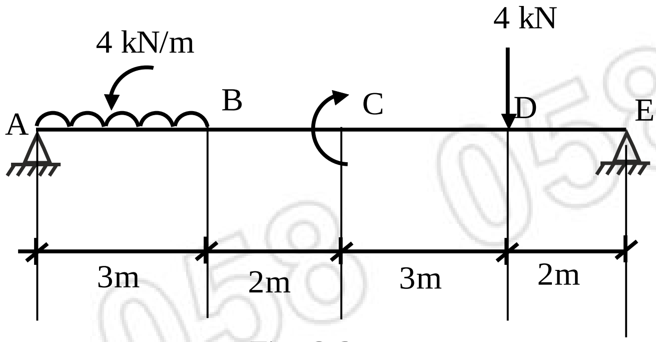

Fig. Q.3

OR

4. a) Prove the relation **7**

$$\frac{\sigma}{y} = \frac{M}{I} = \frac{E}{R}$$

for simple and pure bending.

b) A test beam has square cross-section 30 mm x 30 mm. It is simply supported over a span of 1.2 meter and loaded with a point load at mid span. Failure takes place at load of 800 N. Using the factor of safety 7.5. Calculate the safe rate of UDL over a simply supported span of 5 meter if the cross section is 120 mm x 300 mm deep. **7**

5. A simply supported beam as shown in fig. Q. 5 carries point loads. Find : **13**

i) Slope and deflection under each load.

ii) Maximum deflection

iii) Point at which maximum deflection occurs.

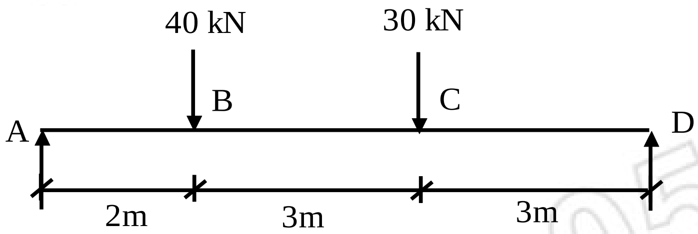

Fig. Q.5

OR

6. a) Define the terms principle planes and principle stresses. **2**

b) At a point in a strained material, the intensities of tensile stresses on two planes at right angle to each other are 40 N/mm^2 and 20 N/mm^2, accompanied by a shear stress of 30 N/mm^2. Find the magnitude and direction of principal stresses analytically and verify it graphically using Mohr's circle. **11**

7. a) Deduce the torsion equation **7**

$$\frac{T}{J} = \frac{\tau}{R} = \frac{C\theta}{L}$$

b) A solid shaft transmits 300 kw at 200 rpm. Determine the diameter of the shaft if the shear stress is not to exceed 50 N/mm^2 and twist in a length of 3 m not exceeding 2°, if the maximum torque is 1.25 times the mean torque $C = 1 \times 10^5$ N/mm^2. **7**

OR

8. a) Prove that the crippling load by Euler's formula for a column having one end fixed and other end free is given by $F = \frac{\pi^2 EI}{4\ell^2}$ **7**

b) A round column of length 3m has both ends fixed. Determine the minimum diameter of column if it has to carry a permissible load of 300 kN with a factor of safety of 3. Take $\sigma_e = 400 \ N/mm^2$, $\alpha = \frac{1}{1600}$ in Rankine's formula. **7**

9. a) What do you mean by creeping ? Discuss the conditions responsible for crack propagation. **6**

b) Prove that the strain energy stored in a body due to shear stress is given by $U = \frac{\tau^2}{2C} V$ **7**

OR

10. a) A load of 5 kN falls by 100 mm on a collar rigidly attached to a vertical rod of diameter 20 mm and length 3m. Find the instantaneous expansion of the bar. $E = 2 \times 10^5 \ N/mm^2$. **6**

b) A 2m long bar of 30 mm diameter is subjected to an axial load of 2 kN. Determine the maximum stress and strain energy developed in a bar if load is applied - **7**
i) Gradual
ii) Sudden
$E = 2 \times 10^5 \ N/mm^2$

11. a) Determine the suitable size of a bolt subjected to direct tensile load of 45 kN and a shear force of 25 kN by using two theories of failure. Material of bolt is SAE 1035. The factor of safety is 3 & Poisson Ratio = 0.3. **8**

b) What do you mean by stress concentration suggest suitable remedies to overcome them. **5**

12. A pulley is keyed to a shaft midway between two bearings. The shaft is made of SAE 1030. The bending moment at pulley varies from - 100 N.m. to 250 N.m. & the torque on shaft varies from - 75 N.m. to +150 N.m. Obtain the diameter of shaft for infinite life. Assume factor of safety of 2 size factor 0.85 and surface finish factor of 0.90. **13**

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