Roll No. | | | | | | | | | | | | | Total No. of Pages : 03

Total No. of Questions : 09

B.Tech. (CE) (2011 Onwards) (Sem.–3)

STRENGTH OF MATERIALS

Subject Code : BTCE-303

Paper ID : [A1133]

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

1) Write briefly :

1. A 1.5 m long circular rod tapers uniformly from 40 mm diameter at one end to 20 mm diameter at the other end. Find the axial strain in the bar if it is subjected to an axial load of 200 kN. Take E = 200 GPa.
2. If, for a two dimensional element, one the principal stresses is zero, find out the relationship between the other principal stress and maximum shear stress.
3. Find the second moment of area about an axis passing through the base of a right triangle, if its base length is 300 mm and its hypotenuse is 500 mm.
4. What do you understand by the term '*section modulus*'?
5. What do you understand by the terms '*point of contraflexure*' and '*point of maximum bending moment*'?
6. What is the difference between a strut and a column?
7. What would be the ratio of the maximum shear stress developed in a hollow and a solid shaft, both subjected to same torque, made of same material, and having same length and weight. Given the ratio of outer to inner diameter of hollow shaft as 2.
8. What are flitched beams? Explain briefly.
9. Briefly explain the maximum shear strain energy or distortion energy theory.
10. Briefly explain the concept of strain hardening as applicable to ductile materials.

SECTION-B

2. A pin-ended square cross-section column of length 3m is subjected to a compressive stress of 10 MPa. Using a factor of safety of 2.5, find the cross-section if the column is to safely support a 200 kN load. Take E for the material of the column to be 15 GPa.

3. A hollow steel shaft transmits 6000 kW at 110 r.p.m. If the allowable shear stress is 60 N/mm^2 and the inner diameter is two-thirds of the outer diameter, find the dimensions of the shaft. Also find the angle of twist for the shaft over a 3 m length. Given that the modulus of rigidity of material of the shaft is 80 GPa.

4. A thin spherical shell of diameter 500 mm is subjected to an internal pressure of 2 MPa. Find the thickness of the shell, if the maximum stress in the shell is limited to 60 MPa. Consider the joint efficiency to be equal to 80%.

5. A 750 N man stands on the middle rung of a 300 N ladder as shown in **Fig. 1.** Assuming that the floor and the wall are perfectly smooth and that slipping is prevented by string DE, find the tension in the string and also the reactions at A and B.

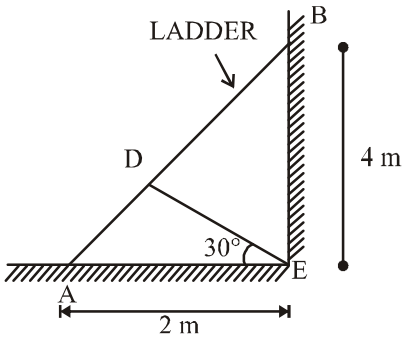

Fig. 1

6. A composite bar made of two steel sections is rigidly fixed at the top. The gap between its lower end and the rigid support is 0.2 mm (**Fig. 2**). Estimate the stresses in the two sections if the bar is heated through 80°C. Take E_s = 200 GPa and coefficient of thermal expansion $\alpha = 12\times10^{-6/0}$C.

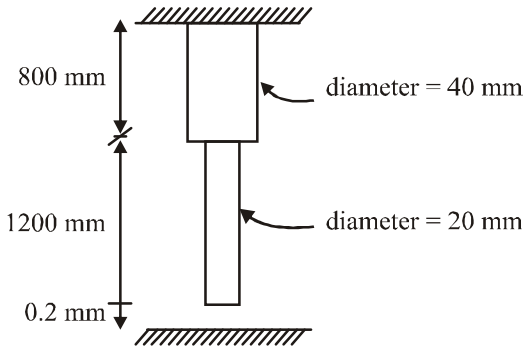

Fig. 2

SECTION-C

7. The measured strains in three directions inclined at 60° to one another as shown in **Fig. 3** are 550×10^{-6}, -100×10^{-6} and 150×10^{-6}. Calculate the magnitude and direction of the principal strains in this plane. If there are no stresses perpendicular to the given plane, determine the principal stresses at the point. Take E = 200,000 N/mm^2 and poisson's ratio = 0.30. Show the states of principal stresses and principal strains on properly oriented elements as well.

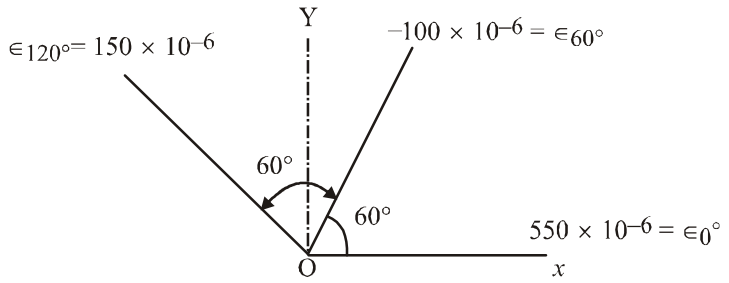

Fig. 3

8. A beam ABCD is 24m long and is simply supported at B and D, 18 m apart. Point C is located at the center of the beam. A concentrated load of 20kN at A and a total distributed load of 120 kN, which varies linearly from p kN/m at the center C to q kN/m at D, is spread from C to D. Find the values of p and q for the reactions at B and D to be equal. Plot the shear force and bending moment diagrams as well. Also locate the position of points of contraflexure, if any, and also find the position and magnitude of maximum bending moment.

9. A rectangular wooden beam 50 mm wide and 150 mm deep is reinforced by screwing a steel plate 6mm thick and 50 mm wide on to the bottom. The screws are 6mm diameter and are pitched 75 mm apart. They are a close fit in the plate. The beam is simply supported at the ends over a span of 3m and is loaded at the center by a load of 1000 N. Calculate the maximum stresses in the steel plate and timber, and the maximum shearing stresses in the screws. Neglect the weight of the beam itself and any weakening of the plate due to screw holes. Take E_{steel} = 210 GPa and E_{timber} = 14 GPa.