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Total No. of Questions : 09

B.Tech.(CE) (Sem.–3) (2011 Batch)

STRENGTH OF MATERIALS

Subject Code : BTCE–303

Paper ID : [A1133]

Time : 3 Hrs. Max. Marks : 60

INSTRUCTION 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 has to attempt any FOUR questions.
3. SECTION-C contains THREE questions carrying TEN marks each and students has to attempt any TWO questions.

SECTION-A

1. **Write briefly :**

   a. A simply supported beam of uniform cross-section is subjected to a maximum bending moment of 30kNm. If its cross-section is a hollow tube with outer diameter 40 mm and inner diameter 30 mm, find the value of maximum bending stress.

   b. Find the ratio of total elongation of a bar of uniform cross-section produced under its own weight to the elongation produced by an external load equal to the weight of the bar.

   c. Find the ratio of the torsional moments of resistance of a solid circular shaft of diameter 'D' and a hollow circular shaft having external diameter 'D' and internal diameter '0.6D'.

   d. A bar 40 mm in diameter is subjected to an axial load of 40kN. The extension of the bar over a gauge length of 200mm is 0.3mm. The decrease in diameter is 0.018mm. Find the Poisson's ratio.

   e. Briefly explain the maximum principal stress theory of failure.

   f. If an element is subjected to pure shearing stress of 30MPa, then find the value of maximum principal stress.

   g. Plot the shear stress *v/s* shear strain curves for brittle and ductile materials.

   h. How are the Young's modulus of elasticity and Modulus of rigidity related?

   i. Briefly explain the difference between 'neutral layer' and 'neutral axis'.

   j. Briefly explain 'Polar Moment of Inertia' and where is it used?

SECTION-B

2. For a shaft in pure torsion, carrying 800N.m of torque, design proposal requires the shaft to have a hollow circular cross-section with 60mm outside diameter. Determine the maximum inside diameter the shaft can have without exceeding the allowable shearing stress of 32.6MPa. Take G = 80GPa.

3. A 5m long hollow tube with outer and inner diameters of 48mm and 30mm, respectively, was found to extend by 6.5mm under and axial tensile load of 90kN. Determine

   (a) the buckling load for the tube when it is used as a strut with hinged ends

   (b) safe compressive load with a factor of safety of 4.5.

4. A main water pipe having external and internal diameters of 1.53m and 1.50 m, respectively, supplying water to city is running full. Determine the maximum span on which the pipe may be freely supported without exceeding a bending stress of 60MPa. The unit weight of steel and water may be taken as 76.0kN/m^3 and 10kN/m^3, respectively.

5. A 40mm square bar of length 160mm is subjected to an axial Compressive load of 20kN. If the lateral strains are prevented by application of a uniform external pressure of suitable intensity on its lateral faces, compute:

   (a) the intensity of pressure and

   (b) the change in the volume. Modulus of elasticity and Poisson's ratio for the material are 200GPa and 0.25, respectively.

6. Determine the reactive forces in the cable supported beam loaded and supported as shown in Fig. 1

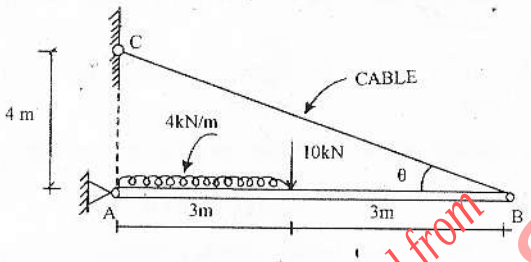

Fig. 1

SECTION-C

7. A vertical pole ACB is rigidly fixed at its base A and carries loads as shown in Fig. 2.

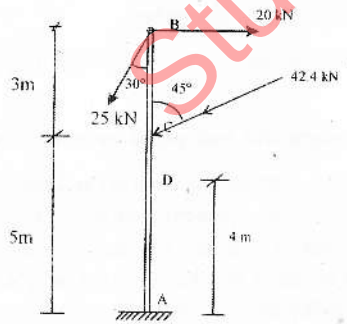

Fig. 2.

(i) Draw the axial force, shear force and bending moment diagrams for the pole.

(ii) Determine the magnitude and direction of the horizontal force applied at D which would be required if the fixing moment at A is to be zero.

8. At a point in a strained body direct tensile stresses of 120MPa and 70MPa act on mutually perpendicular planes. Determine the shearing stress that can be applied so that the major principal stress is limited to 135MPa. Also determine the minor principal stress and the maximum shear stress developed in the material. Also find the orientation of principal planes and maximum shear stress planes. Show these stresses on properly oriented elements as well. Use the Mohr's stress circle approach.

9. A composite bar of size 26mm × 28 mm deep is fabricated by placing a flat bar of aluminium alloy 26mm wide and 8mm thick between two steel bars each 26mm wide and 10mm thick. The three bars are fastened together at their ends when the temperature is 12°C.

(a) Determine the stress in each of the materials when the temperature of the composite bar is raised to 52°C.

(b) At this stage an axial compressive load of 20kN is also applied to the composite bar, compute the final stresses in steel and aluminium. The modulus of elasticity and coefficient of thermal expansion for steel are 200GPa and 12 × 10^{-6}/°C, respectively, and those for aluminium are 65GPa and 22 × 10^{-6}/°C, respectively.