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06CV33

Third Semester B.E. Degree Examination, May/June 2010
Strength of Materials

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain the following: i) Generalised Hook's law ii) Principles of super position. **(06 Marks)**

b. Derive an expression for the elongation of a tapered conical bar subjected to an axial pull. **(06 Marks)**

c. A stepped bar is subjected to forces as shown in figure Q1 (c). Determine the stresses induced in different portions and the net deformation. **(08 Marks)**

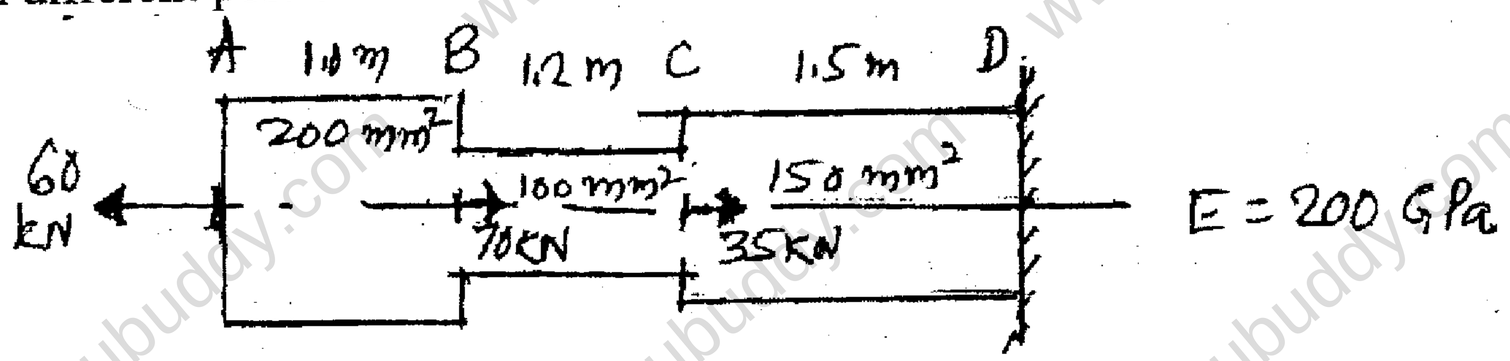

Fig. Q1 (c)

2 a. Define: shear stress, Poisson's ratio, Volumetric strain. **(06 Marks)**

b. Derive the relationship between Young's modulus and bulk modulus. **(06 Marks)**

c. A compound bar shown in figure Q2 (c) is subjected to a temperature raise of 50°C. Determine the stresses induced and the deformation. **(08 Marks)**

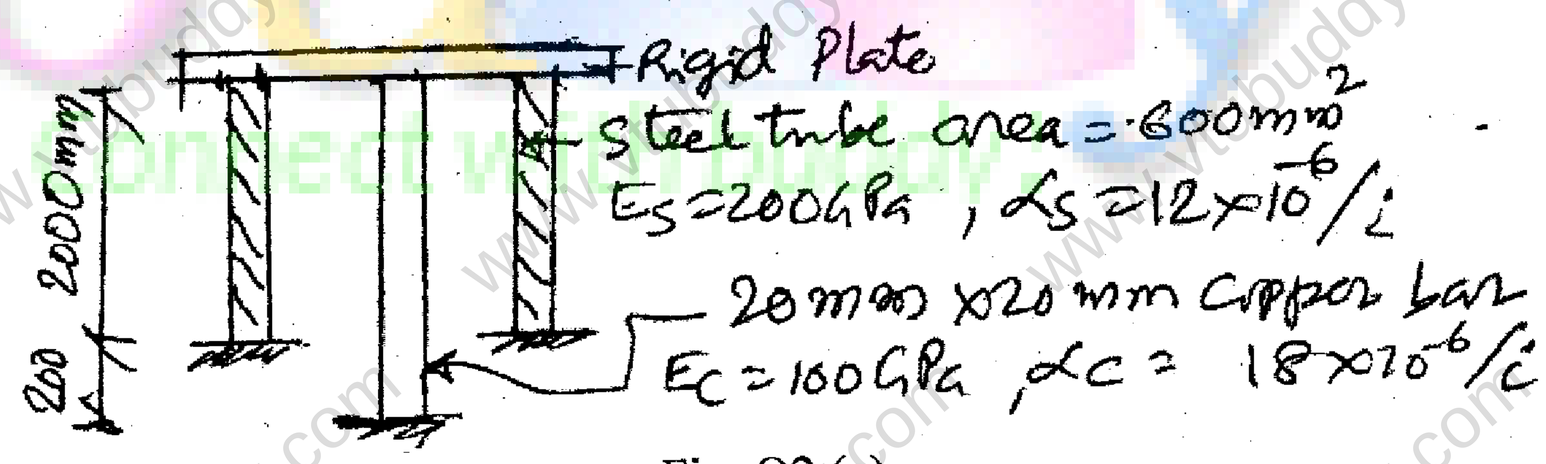

Fig. Q2 (c)

3 a. Derive the relationship between rate of loading, shear force and bending moment. **(06 Marks)**

b. What is pure bending? Explain with example. **(04 Marks)**

c. Draw the shear force and bending moment diagrams for the beam shown in figure Q3 (c), locating the point of contraclexures. **(10 Marks)**

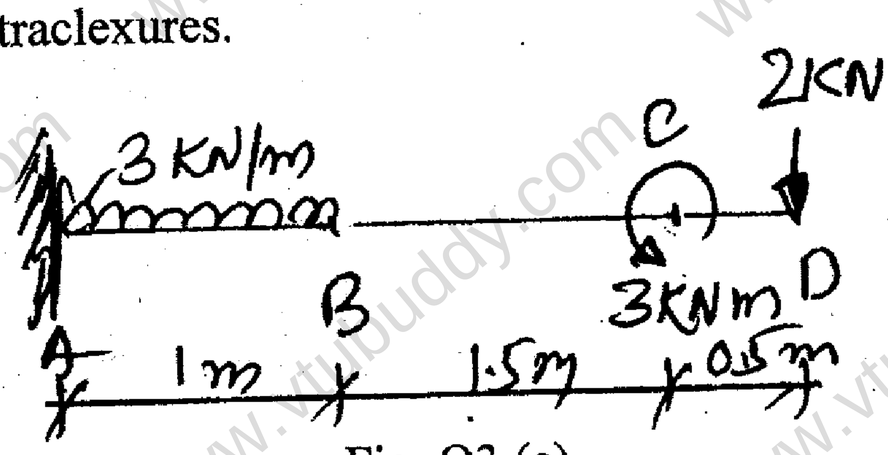

Fig. Q3 (c)

4 a. Show that 'the sum of any two orthogonal components of stresses at a point is constant'. **(06 Marks)**

4 b. An element is subjected to stresses as shown in figure Q4 (b). Determine
i) Stresses acting on the plane 'PP'.
ii) Maximum shear stress and its plane.
iii) Principal stresses and principle planes. **(14 Marks)**

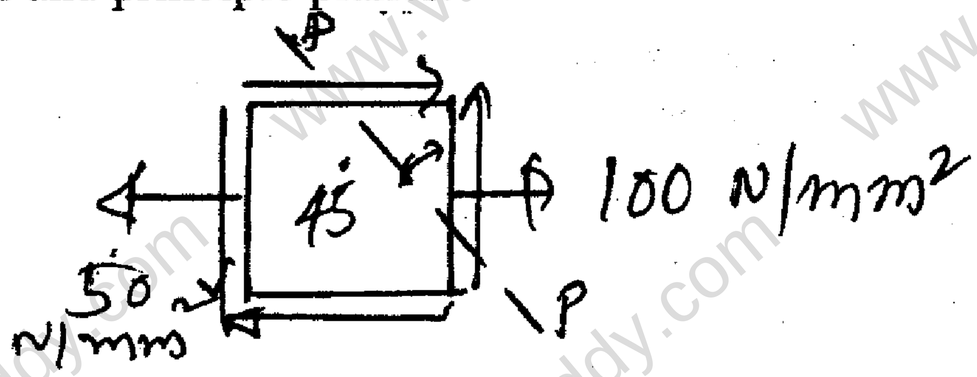

Fig. Q4 (b)

PART – B

5 a. Explain 'Neutral Axis', 'Section modulus' and 'Moment of Resistance' as applied to beams. **(06 Marks)**

b. Derive an equation for the shear stress distribution in rectangular beam. **(06 Marks)**

c. A symmetric I section 10cm×30cm deep with uniform thickness of flanges and web of 10 mm is subjected to a bending moment of 20 kNm and shear force of 60 kN. Sketch the bending stress and shear stress distribution. **(08 Marks)**

6 a. Define 'slope', 'deflection' and 'elastic curve'. **(06 Marks)**

b. State the assumptions made in the moment curvature relationship derivation. **(04 Marks)**

c. A simply supported beam spanning 8 m carries concentrated loads of 60 kN and 30 kN at distances of 2 m and 4 m from the left support. Determine i) The slopes at the ends and ii) the location and magnitude of the maximum deflection. Assume E = 200 GPa and $I = 20\times10^{8}\,mm^{4}$. **(10 Marks)**

7 a. Derive an equation for the ratios of Torsional strengths of hollow and solid circular shafts for a given length, material and mass. **(06 Marks)**

b. Derive the relationship between torque and shear stress. **(06 Marks)**

c. A hollow circular shaft is to transmit a torque of 4.05 kNm.
i) Determine the shaft dimensions for the following data:
Ratio of inside to outside diameter = 0.8
Allowable shear stress = 40 N/mm²
Limiting angle of twist = 1° / 20 dia length
Modulus of rigidity = 80 GPa
ii) For the above dimensions, calculate the maximum shear stress. **(08 Marks)**

8 a. Distinguish between: i) Buckling and crushing ii) Long and short columns. **(06 Marks)**

b. Using Eulers theory, derive an equation for the crippling load of a long column pinned at both ends. **(06 Marks)**

c. A hollow square column of 120 mm outside dimensions and 5 mm thick is 8 m long and is fixed at both ends. Determine the buckling load using Rankine's formula assuming $\sigma = 500$ MPa and $\alpha = \frac{1}{1600}$. What is the equivalent solid square section? **(08 Marks)**

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