USN | | | | | | | | | |

06ME34

Third Semester B.E. Degree Examination, May/June 2010
Mechanics 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 : i) Poisson's ratio ; ii) Young's modulus. **(04 Marks)**

b. Mention the assumptions made in the theory of simple stress and strain and derive the equation $dl = PL/AE$. **(06 Marks)**

c. A brass bar having a cross sectional area of 1000 mm^2 is subjected to axial forces as shown in Fig.1(c). Determine the total elongation of the bar if $E = 105$ GPa. **(10 Marks)**

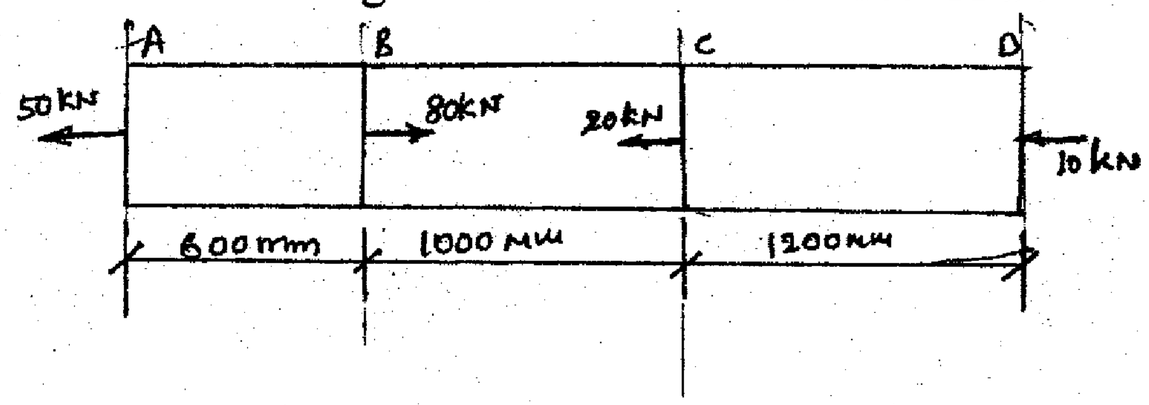

Fig.1(c)

2 a. Define : i) Modulus of rigidity ; ii) Volumetric strain. **(04 Marks)**

b. Explain the reason for development of stress in bars, when their temperature rises or falls. Accordingly calculate the nature and magnitude of stress induced in the rod of 2 m length and 20 mm diameter, when its temperature rises by 70°C, with both ends constrained. Take $E = 1 \times 10^5$ N/mm^2 and $\alpha = 1.2 \times 10^{-5}$/°C. **(06 Marks)**

c. A composite section comprises of a steel tube 10 cm internal diameter and 12 cm external diameter, fitted inside a brass tube of 14 cm internal diameter and 16 cm external diameter. The assembly is subjected to a compressive load of 500 kN. Find the load carried by the tube and the stresses induced in them. The length of tube is 150 cm. Take $E_{steel} = 200$ GPa and $E_{brass} = 100$ GPa. What is the change in length of tubes? **(10 Marks)**

3 a. The longitudinal strain of a cylindrical bar of diameter 3 cm and length 1.5 m is four times the lateral strain during a tensile test. Determine the modulus of elasticity and bulk modulus. Also determine the change in volume when the bar is subjected to a hydrostatic pressure of 100 MPa. Take E = 100 GPa. **(10 Marks)**

b. The state of stress in a two dimensionally stressed body is shown in Fig.3(b). Determine the principal planes, principal stress, maximum shear stress and their planes. Schematically represent these planes on x – y coordinates. **(10 Marks)**

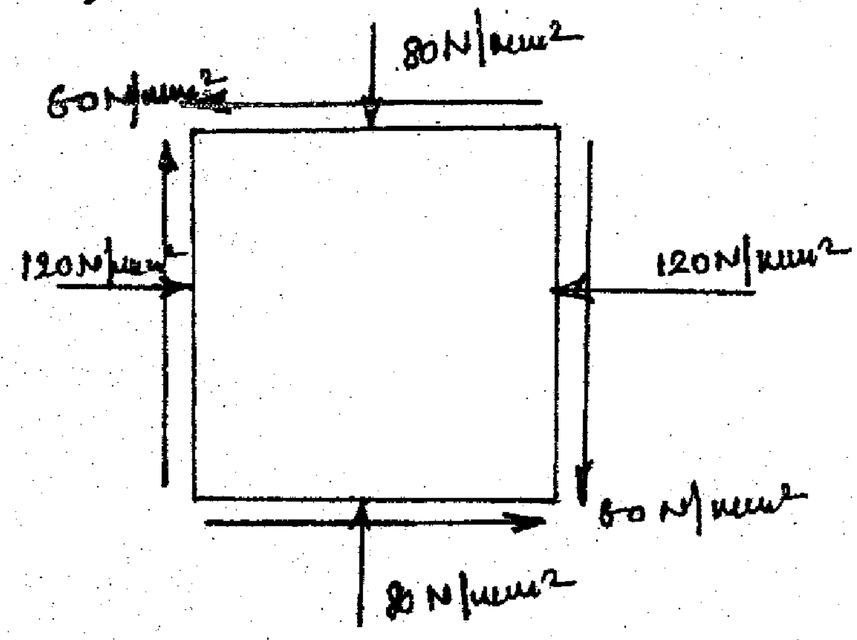

Fig.3(b)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

4 a. Derive an expression for circumferential stress and longitudinal stress for a thin shell subjected to an internal pressure. **(06 Marks)**

b. Derive an expression for the radial pressure and hoop stress for a thick spherical shell. **(06 Marks)**

c. A thick spherical shell of 200mm internal diameter is subjected to an internal fluid pressure of 7 N/mm^2. If the permissible tensile stress in the shell material is $8N/mm^2$, find the thickness of the shell. **(08 Marks)**

PART - B

5 Draw the bending moment and shear force diagrams for the beam loaded as shown in fig. Q5. **(20 Marks)**

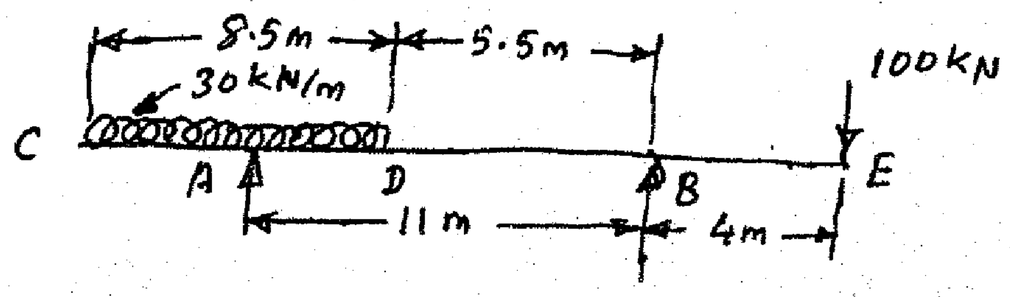

Fig.Q5

6 a. Prove the relations $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$ with usual notations. **(10 Marks)**

b. A T – shaped cross – section of a beam in fig.Q6(b) is subjected to a vertical shear force of 100kN. Calculate the shear stress at the neural axis and at the junction of the web and the flange. M.I. about the horizontal neutral axis is 0.0001134 m^4. **(10 Marks)**

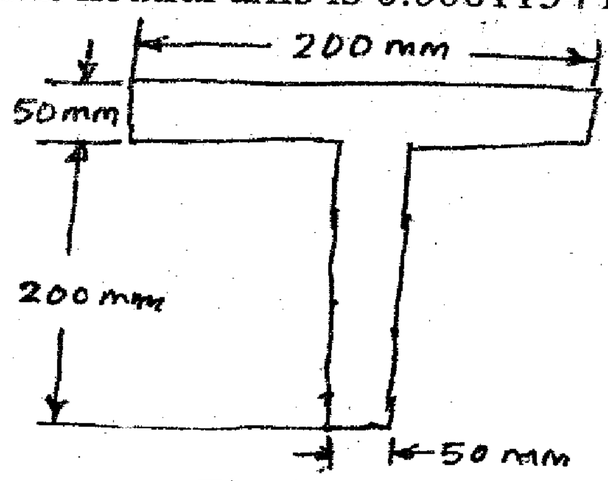

Fig.Q6(b)

7 A beam of length 6m is simply supported at its ends and carries two point loads of 40kN at a distance of 1m and 3m respectively from the left support. By using Macaulay's method, determine : a) deflection under each load b) maximum deflection c) the point at which maximum deflection occurs. Given $E = 2 \times 10^5$ N/mm^2 and $I = 85 \times 10^6 mm^4$. **(20 Marks)**

8 a. Two shafts of the same material and of same lengths are subjected to the same torque, if the first shaft is of a solid circular section and the second shaft is of hollow circular section, whose internal diameter is 2/3 of the outside diameter and the maximum shear stress developed in each shaft is the same, compare the weights of the shafts. **(10 Marks)**

b. A 1.5m long column has a circular cross section of 50mm diameter. One of the ends of the column is fixed in direction and position and other end is free. Take factor of safety as 3, calculate the safe load using :

i) Rankine's formula, take yield stress = $560N/mm^2$ and $a = \frac{1}{1600}$ for pinned ends.

ii) Euler's formula, Young's modulus for C.I. = 1.2×10^5 N/mm^2. **(10 Marks)**

*****