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06ME34

Third Semester B.E. Degree Examination, Dec.09-Jan.10
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each Part.***

PART - A

1 a. Define i) stress ii) principle of super position. **(04 Marks)**

b. A member ABCD is subjected to point loads as shown in fig.Q1(b), calculate i) Force P necessary for equilibrium ii) Total elongation of the bar. Take E = 210 GN/m^2. **(06 Marks)**

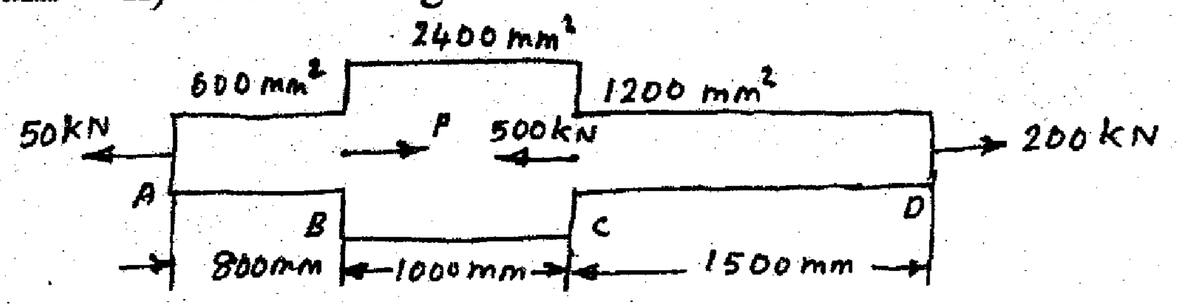

Fig.Q1(b)

c. Two vertical rods one of steel and the other of copper are each rigidly fixed at the top and 500mm apart. Diameters and lengths of each rod are 20mm and 4m respectively. A cross bar fixed to the rods at the lower ends carries a load of 5kN, such that the cross bar remains horizontal even after loading. Find the stress in each rod and the position of the load on the bar. Take $E_s = 2 \times 10^5$ N/mm^2 and $E_c = 1 \times 10^5$ N/mm^2. **(10 Marks)**

2 a. Define Bulk modulus. Derive an expression for Young's modulus in terms of bulk modulus and Poisson's ratio. **(08 Marks)**

b. i) Define Thermal stress. **(02 Marks)**

ii) Calculate the values of the stress and strain in portion AC and CB of the steel bar shown in Fig Q2b (ii). A close fit exists at both the rigid supports at room temperature and the temperature is raised by 75^{0}C. Take E = 200GPa and $\alpha = 12 \times 10^{-6}$ per ^{0}C for steel. Area of cross – sections of AC is 400 mm^2 and of BC is 800 mm^2. **(10 Marks)**

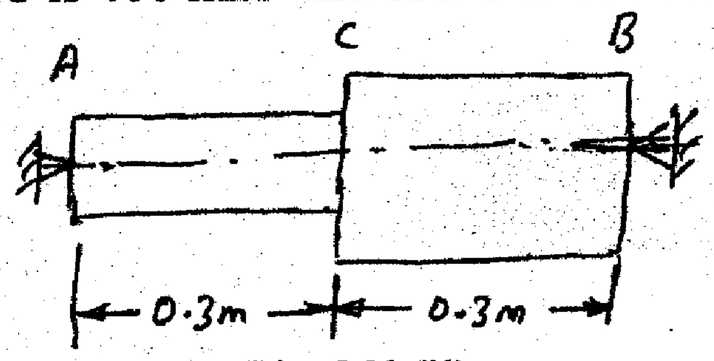

Fig.Q2b(ii)

3 a. Define i) principal stress ii) principal strain. **(04 Marks)**

b. A machine component is subjected to the stresses as shown in Fig. Q3(b). Find the normal and shearing stresses on the section AB inclined at an angle of 60^0 with x – x axis. Also find the resultant stress on the section. Verify the above results by drawing Mohr's circle. **(16 Marks)**

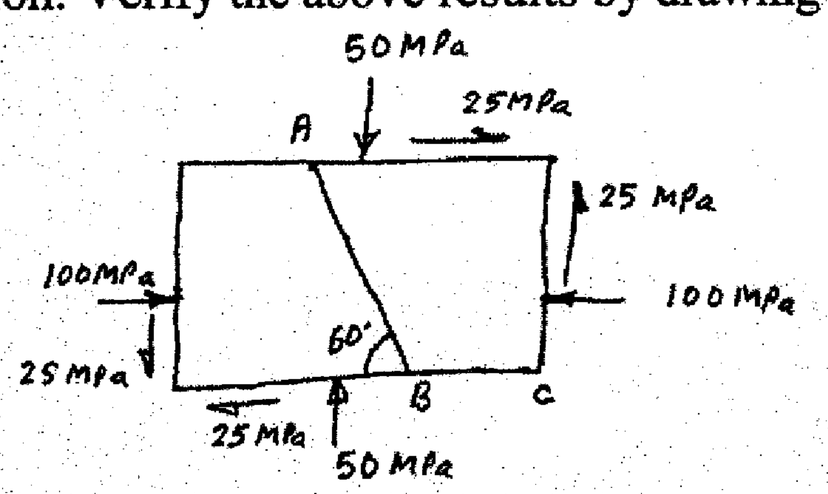

Fig.Q3(b)

4 a. Derive an expression for circumferential and longitudinal stress for thin cylinder. **(10 Marks)**

b. A pipe of 400mm internal diameter and 100mm thickness contains a fluid at a pressure of $80N/mm^2$. Find the maximum and minimum hoop stresses across the section. Also sketch radial and hoop stresses distribution across the section. **(10 Marks)**

PART – B

5 a. What are the different types of beams? Explain briefly. **(05 Marks)**

b. For the beam shown in fig.5(b), draw shear force and Bending moment diagram. Locate the point of contra flexure if any. **(15 Marks)**

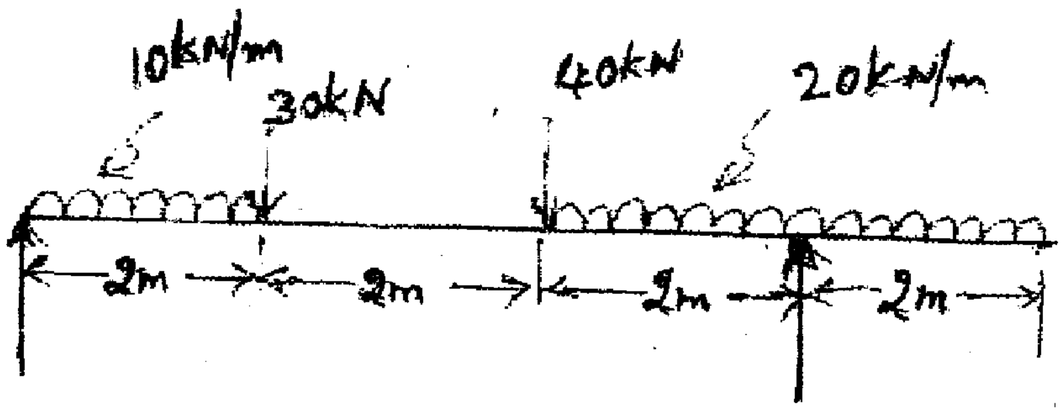

Fig.5(b)

6 a. Derive an expression $E = \frac{d^2y}{dx^2} = M$ with usual notations. **(10 Marks)**

b. Determine the deflection under the loads in the beam shown in fig.6(b). Take flexural rigidity as EI through out. **(10 Marks)**

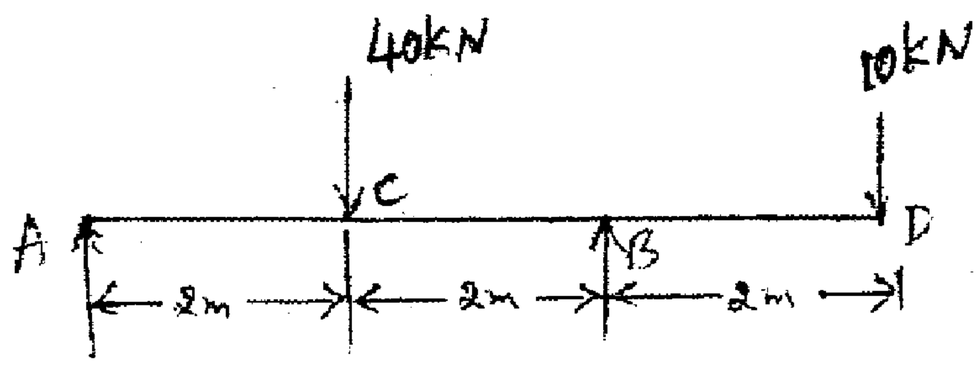

Fig.6(b)

7 a. What are the assumptions made in simple theory of bending? **(04 Marks)**

b. Derive an expression for relationship between Bending stress and Radius of curvature. **(06 Marks)**

c. A Cantilever of square section 200mm × 200mm, 2 meter long just fails in flexure when a load of 12kN is placed at its free end. A beam of same material and having a rectangular cross section 150mm wide and 300mm deep is simply supported over a span of 3m. Calculate the minimum central concentrated load required to break the beam. **(10 Marks)**

8 a. Define Slenderness Ratio and derive Euler's expression for buckling load for column with both ends hinged. **(10 Marks)**

b. A solid shaft rotating at 500 rpm transmits 30kW. Maximum torque is 20% more than mean torque. Allowable shear stress 65 MPa and modulus of rigidity 81GPa, angle of twist in the shaft should not exceed 1^0 in 1 meter length. Determine suitable diameter. **(10 Marks)**

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