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10ME/AU34

Third Semester B.E. Degree Examination, June/July 2015
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. Missing data if any, may be suitably assumed.

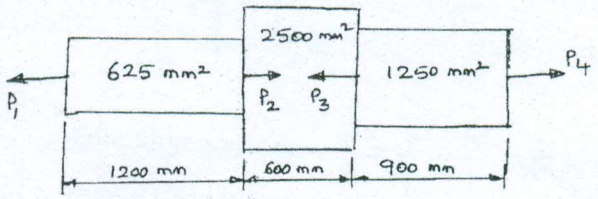
PART - A

1 a. State Hooke's law and define Poisson's ratio. **(03 Marks)**

b. Explain stress – strain diagram for mild steel with salient features. **(07 Marks)**

c. A member ABCD is subjected to point loads P_1, P_2, P_3 & P_4 as shown in fig.Q1(c). Calculate the force P_2 necessary for equilibrium. If P_1 = 45kN. P_3 = 450kN & P_4 = 130kN. Determine stresses in each member also determine the total elongation of the member assuming the E to be $2.1 \times 10^5 N/mm^2$. **(10 Marks)**

Fig.Q1(c)

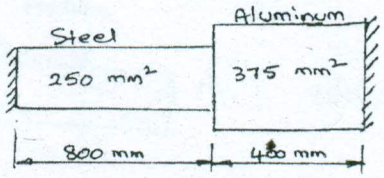


2 a. Derive an expression for volumetric strain of a rectangular bar, subjected to normal stress σ along its axis. **(06 Marks)**

b. Define 3 modulii of elasticity and write the relationship between them . **(04 Marks)**

c. A composite bar consisting of steel and aluminum components shown in fig. Q2(c) is held firmly between two grips at the ends at a temperature of 60^0C. Find the stresses in the two rods, when temperature falls to 20^0C. If i) The ends do not yield ii) The ends yield by 0.25mm. Take $E_S = 2 \times 10^5$ N/mm² $\alpha_S = 1.17 \times 10^{-5}/^0$C
$E_A = 0.7 \times 10^5$ N/mm² $\alpha_A = 2.34 \times 10^{-5}/^0$C **(10 Marks)**

Fig.Q2(c)

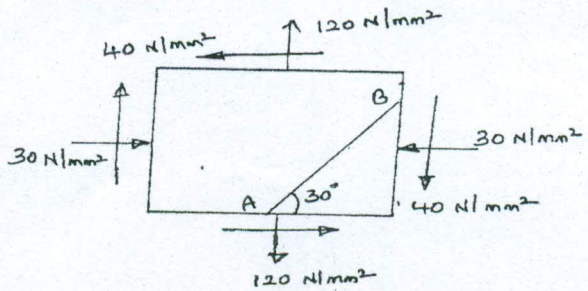


3 a. Define the principal stresses and principal planes. **(03 Marks)**

b. Explain the construction of Mohr's circle and represent principal stress. **(07 Marks)**

c. At a certain point in a strained material the stress condition shown in fig.Q3(c) exists. Find i) The normal and shear stress on the inclined plane AB ii) Principal stresses and principal planes iii) Maximum shear stress. **(10 Marks)**

Fig.Q3(c)



4 a. Derive an expression for strain energy, when a member subjected to impact loads. (06 Marks)

b. Derive an expression for circumferential stress of a thin cylinder. (04 Marks)

c. A C.I pipe has 200mm internal diameter and 50mm metal thickness and carries water under a pressure of 5N/mm^2. Calculate the maximum and minimum intensities of circumferential stress and sketch the distribution of circumferential stress intensity and intensity of radial pressure across the section. (10 Marks)

5

PART - B

5 a. Establish relationship between distributed load, shear force and bending moment at a cross section of a beam. (06 Marks)

b. For the beam shown in fig. Q5(b), draw SFD and BMD and mark the values at the salient points. (14 Marks)

6

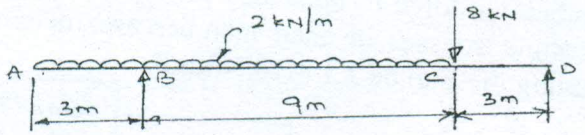


Fig.Q5(b)

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

b. A beam of an I – section consists of 180mm × 15mm flanges and a web of 280mm × 15mm thickness. It is subjected to a shear force of 60kN. Sketch the shear stress distribution along the depth of the section. (10 Marks)

7

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

b. Determine the deflection at points C, D and E in the beam shown in fig. Q7(b). Take E = 200kN/mm^2 and I = 60 × 10^{6}mm^4. (10 Marks)

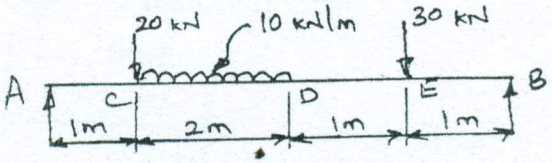


Fig.Q7(b)

8

8 a. A hollow shaft of diameter ratio 3/8 is required to transmit 588KW at 110 rpm, the maximum torque being 120% of the mean. Shear stress is not to exceed 63N/mm^2 and twist in a length of 3m not to exceed 1.4 degrees. Calculate external diameter of shaft which would satisfy these conditions. Take modulus of rigidity = 84 GPa. (12 Marks)

b. Define slenderness ratio and derive Euler's expression for buckling load for column with both ends hinged. (08 Marks)

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