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06ME34

Third Semester B.E. Degree Examination, June 2012
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Differentiate between :
i) Stress and pressure ii) Hardness and toughness. **(04 Marks)**

b. Draw the stress and strain diagram of a M.S. specimen subjected to tension test and explain the salient points. **(06 Marks)**

c. A mild steel circular bar has three segments as shown in Fig.Q1(c). Find
i) The total elongation of the bar
ii) The length of the middle segment to have zero elongation of the bar.
iii) The diameter of the last segment to have zero elongation of the bar. Take E = 205 Gpa. **(10 Marks)**

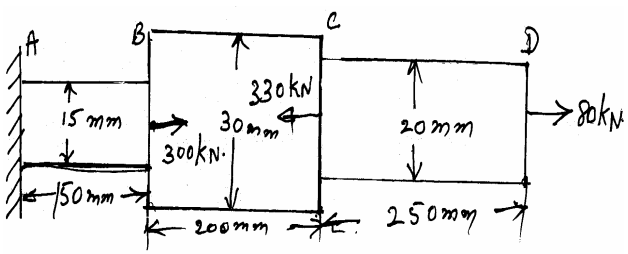

Fig.Q1(c)

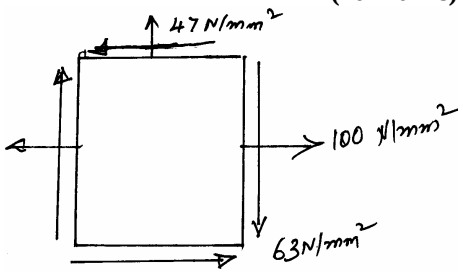

Fig.Q3(c)

2 a. Prove that in case of a composite section, stress in one material is modulator ratio times stress in the other material. **(05 Marks)**

b. A square column of reinforced concrete is compressed by an axial force 'P'. What fraction of load will be carried by the concrete, if the total cross-sectional area of the steel bars is one-tenth of the cross-sectional area of concrete and modulus of elasticity of steel is ten times that of concrete? **(07 Marks)**

c. A compound bar is made up of a central steel plate 60mm wide and 10mm thick to which copper plates 40mm wide and 5mm thick are connected rigidly on each side. The length of the bar at normal temperature is 1 meter. If the temperature is raised by 80°C, determine the stresses in each metal and change in length. Take E_s = 200 GN/m^2 ; E_c = 100 GN/m^2 ; $\alpha_s = 12\times10^{-6}$/°C ; $\alpha_c = 17\times10^{-6}$/°C. **(08 Marks)**

3 a. What are the principal stresses and principal planes? Explain their uses. **(04 Marks)**

b. Explain the procedure for construction of Mohr's circle with tensile, compressive and shear stresses acting in the component. **(06 Marks)**

c. A rectangular block of material is subjected to a tensile stress of 110 N/mm^2 on one plane and tensile stress of 47 N/mm^2 on the plane at right angles to the former as shown in Fig.Q3(c). Each of the above stresses is accompanied by a shear stress of 63 N/mm^2. Determine the direction and magnitude of each principal stress and magnitude of maximum shear stress. Sketch the planes and mark the stresses on the planes. **(10 Marks)**

4 a. Show that the volumetric strain in a thin cylinder is given by

$$\epsilon_V = \frac{pd}{2tE}\left(\frac{5}{2} - \frac{2}{m}\right),$$

where ϵ_V = volumetric strain; 1/m = Poisson's ratio ; E = Young's modulus. **(05 Marks)**

b. A cylindrical shell has an external diameter of 500mm and wall thickness 10mm and length of the cylinder is 1.7 m. Determine the increase in its internal diameter and length when inside pressure is 1 N/mm^2. Take E = 210 GPa ; μ = 0.3. **(05 Marks)**

c. A cast iron pipe of 400mm internal diameter and 100mm wall thickness carries water under pressure of 10 MPa, determine maximum and minimum intensities of hoop stress across the section. Also sketch the radial and hoop stress distribution diagram across the section. **(10 Marks)**

PART – B

5 a. Explain with neat diagram the sagging and hogging bending moment. **(04 Marks)**

b. Draw the BMD and SFD for the loaded beam as shown in the Fig.Q5(b). Mark the salient values on the Figure. **(16 Marks)**

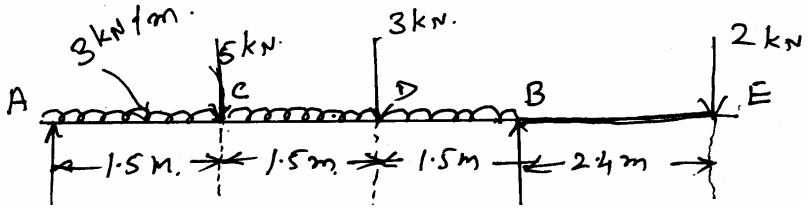

Fig.Q5(b)

6 a. Explain: i) Section modulus ii) Flexural rigidity. **(04 Marks)**

b. Draw shear stress distribution for an I - shaped section of a beam as shown in Fig.Q6(b). The shear force on this section is 200 kN. **(16 Marks)**

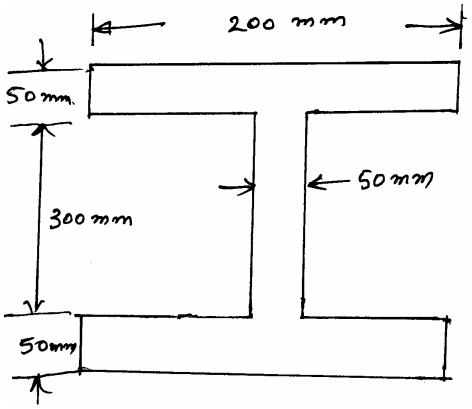

Fig.Q6(b)

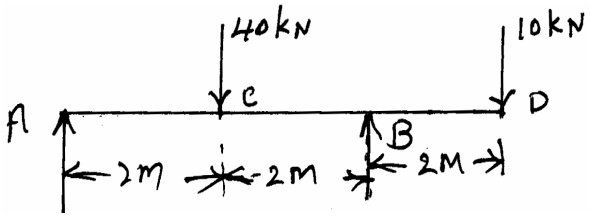

Fig.Q7(b)

7 a. Derive an expression, $E = \frac{d^2y}{2x^2} = M$, with usual notation. **(10 Marks)**

b. Determine the deflection under the loads in the beam as shown in Fig.Q7(b). Take flexural rigidity as EI throughout. **(10 Marks)**

8 a. Derive an expression for the critical load in a column subjected to compressive load, when one end is fixed and other end is free. **(10 Marks)**

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

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