CBCS SCHEME

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15CV/CT32

Third Semester B.E. Degree Examination, July/August 2021
Strength of Materials

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions.***

1 a. Derive an expression for the deformation of the tapering circular cross sectional bar subjected to an axial force P. Use Standard notations. **(06 Marks)**

b. A 18mm diameter steel rod passes centrally through a copper tube of 26mm internal diameter and 38mm external diameter. The rod is 2.6m long and is closed at each end by rigid plate of negligible thickness. The nuts are tightened lightly home on projecting parts of the rod. If the temperature of the assembly is raised by 80^0, calculate the thermal stress induced in copper and steel. Also find final deformation of each material.
Take $\alpha_c = 17.5 \times 10^{-6}/^0C$, $\alpha_s = 12 \times 10^{-6}/^0C$, $E_s = 210$ GPa and $E_c = 105$ GPa. **(10 Marks)**

2 a. Draw the stress strain curve for mild steel specimen in tension. Mark the salient points on it. **(04 Marks)**

b. Derive the relationship between Young's modulus and Bulk modulus of a material **(05 Marks)**

c. A bar of 20mm diameter is tested to destruction. It is observed that when a load of 37.7 kN is applied, the extension is measured over a length of 200mm is 0.12mm and contraction in diameter is 0.0036mm. Find Poisson's ratio and Elastic constants. **(07 Marks)**

3 a. Define Principal Stresses and Principal Planes. **(04 Marks)**

b. Explain the construction of Mohr's circle for compound stress in two dimensional systems. **(05 Marks)**

c. Find the thickness of metal necessary for a cylindrical shell of internal diameter 160mm to withstand an internal fluid pressure of $8N/mm^2$. The maximum hoop stress in the section is not to increase $35N/mm^2$. **(07 Marks)**

4 a. Show that in the case of thin cylindrical shell subjected to internal fluid pressure, the volumetric strain is equal to the sum of twice the hoop strain and the longitudinal strain. **(06 Marks)**

b. The state of stress at a point in a strained material is as shown in Fig. Q4(b). Determine
i) Magnitude of principal stresses ii) Direction of principal planes
iii) Magnitude of maximum shear stress and direction. Sketch these planes. **(10 Marks)**

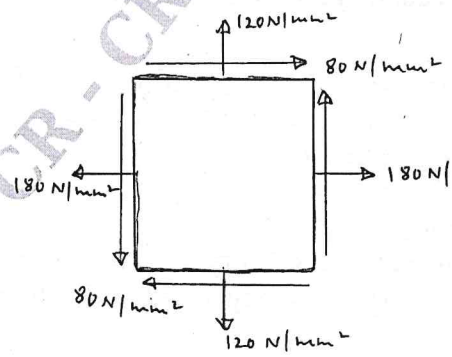
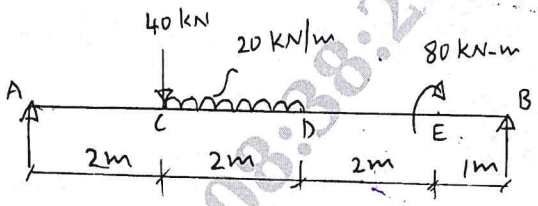


Fig. Q4(b)

5 a. Define : i) Shear force ii) Bending moment with sign conventions. **(04 Marks)**

b. Draw SFD and BMD for a simply supported beam carrying loads as shown in Fig. Q5(b). **(12 Marks)**

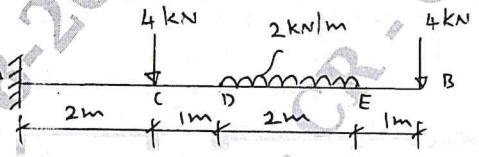
Fig. Q5(b)



6 a. For a simply supported beam of span 'L' carrying a udℓ of W N/m throughout. Obtain equations of SF and BM. Plot SFD and BMD. **(06 Marks)**

b. For the cantilever beam shown in Fig. Q6(b), obtain SFD and BMD. **(10 Marks)**

Fig. Q6(b)



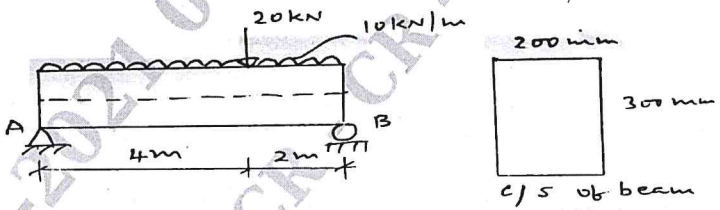
7 a. Draw the shear stress diagram for a rectangular beam section and show that maximum shear stress is 1.5 times average shear stress **(06 Marks)**

b. Compute the ratio of crippling loads by Euler's and Rankine's formula for an axially loaded column 6m high with both ends are fixed. The inner diameter of the tubular section is 50mm and it is 10mm thick. Take yield stress f_s = 415 MPa, E = 200GPa and Rankines constant $a = \frac{1}{7500}$. **(10 Marks)**

8 a. Derive the expression for Euler's Buckling load for column with both ends fixed. **(06 Marks)**

b. A simply supported rectangular beam is loaded as shown in Fig. Q8(b). Determine the maximum flexural stresses and maximum shearing stress at a cross section located 2m from the left support. Sketch the flexural and shearing stress distribution at the specified cross section. **(10 Marks)**

Fig. Q8(b)



9 a. Derive the torsion equation for circular member $\frac{T}{J} = \frac{q_s}{R} = \frac{G\theta}{L}$, with usual notations. **(08 Marks)**

b. A solid shaft has to transmit 150 kw of power at 180 rpm. If allowable shear stress is 70 MPa and allowable angle of twist is 1^0 in a length of 4m. Find the suitable diameter of solid circular shaft. Take G = 84 GPa. **(08 Marks)**

10 a. Write short notes on :
i) Maximum Principal Stress theory ii) Maximum Shear Stress theory. **(06 Marks)**

b. Prove that a hollow shaft is stronger and stiffer than the solid shaft of the same material, length and weight. **(10 Marks)**

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