CBCS SCHEME

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17CV/CT32

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

Time: 3 hrs. Max. Marks: 100

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

1 a. Draw stress strain diagram for mild steel and explain in brief. **(06 Marks)**

b. Define Poisson's Ratio and Modulus of Rigidity. **(04 Marks)**

c. A bar of uniform cross-section 20mm diameter is subjected to a load as shown in Fig.Q.1(c). Find the total elongation of the bar and maximum stress in the bar. Given E = 200GPa. **(10 Marks)**

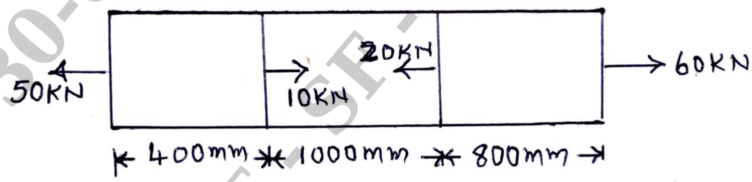

Fig.Q.1(c)

2 a. Derive an expression for the total extension of the tapered bar of circular cross section when it is subjected to an axial tensile load 'P'. **(06 Marks)**

b. Derive the relation between Young's modulus (E) and modulus of rigidity (G) in the form $E = \frac{9KG}{3K + G}$. **(06 Marks)**

c. A compound bar is made of central steel plate 50mm wide and 10mm thick to which copper plate of 50mm wide and 5mm thick are connected rigidly on each sides as shown in Fig.Q.2(c). The length of compound bar is 1000mm at room temperature. If the temperature is raised by 100°C determine stresses in each material and change in length of compound bar. Assume E = 200GPa, E_C = 100GPa, $\alpha_S = 12 \times 10^{-6}$/°C and $\alpha_C = 18 \times 10^{-6}$/°C. **(08 Marks)**

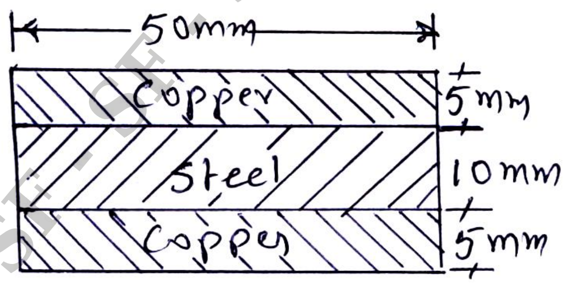

Fig.Q.2(c)

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.

3 a. For thin cylinder subjected to internal pressure 'P' prove that the circumferential stress equal to Pd/2t and longitudinal stress equal to Pd/4t where d = Internal diameter, t = wall thickness. **(06 Marks)**

b. What are principal stresses and principal planes? **(04 Marks)**

c. An element in plane stress is subjected to stresses P_1 = 120N/mm^2 and P_2 = 45N/mm^2 and shear stress 30N/mm^2 as shown in Fig.Q.3(c). Determine the normal stress, shear stress, major principal stress, minor principal stress and maximum shear stress acting on an element rotated through an angle θ = 45°. **(10 Marks)**

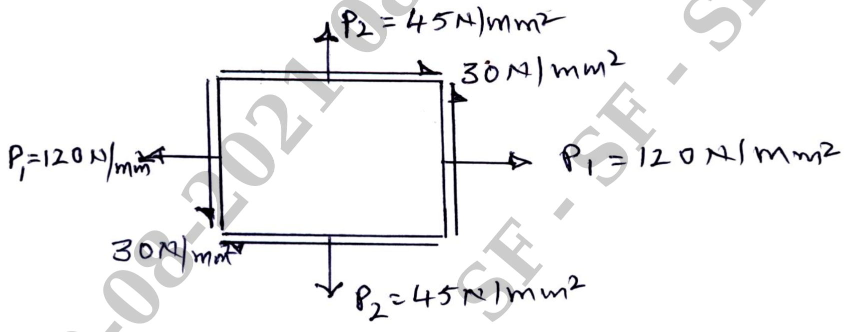

Fig.Q.3(c)

4 a. Explain the construction of Mohr's circle for compound stresses in two dimensional systems. **(10 Marks)**

b. The external and internal radius of a thick cylinder is 300mm and 200mm respectively. The maximum stress permitted is 15.5N/mm^2. The external pressure is 4N/mm^2. Find the internal pressure. Plot the curves showing the hoop and radial stresses across the thickness. **(10 Marks)**

5 a. Explain:
   i) Sagging Bending moment
   ii) Hogging Bending moment
   iii) Point of contra flexure. **(06 Marks)**

b. For the beam shown in Fig.Q.5(b) draw SFD and BMD, show the salient values on the figure. Locate the point of contra flexure if any. **(14 Marks)**

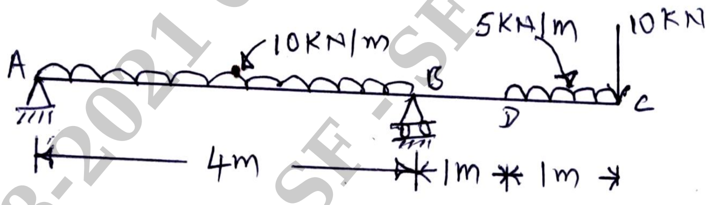

Fig.Q.5(b)

6 a. Derive the relation between load intensity shear force and bending moment. **(06 Marks)**

b. Draw the shear force and bending moment diagram indicating principal values for an overhanging beam shown in Fig.Q.6(b). **(14 Marks)**

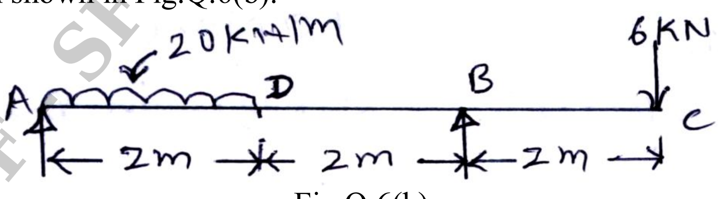

Fig.Q.6(b)

7 a. Explain maximum principal stress theory and maximum shear stress theory. **(10 Marks)**

b. Design a shaft to transmit 1M Watt of power at 300rpm. The stress in the shaft should not exceed 60MPa and angle of twist should not be more than 1° in the length of 10 times diameter. Assume C = 80MPa for the material. **(10 Marks)**

8 a. Derive the torque equation $\frac{T}{J} = \frac{C\theta}{L} = \frac{q}{R}$. **(10 Marks)**

b. State the assumptions made in the theory of pure torsion. **(05 Marks)**

c. Explain maximum principal strain theory. **(05 Marks)**

9 a. Derive expression for buckling load on column with both ends hinged. **(06 Marks)**

b. Define the terms:

i) Neutral axis

ii) Section modulus

iii) Modulus of rupture. **(06 Marks)**

c. A T-section shown below in Fig.Q.9(c) is used as simply supported beam over a span of 4m. It carries a udl of 8kN/m over its entire span. Calculate maximum tensile and compressive stresses in the beam. **(08 Marks)**

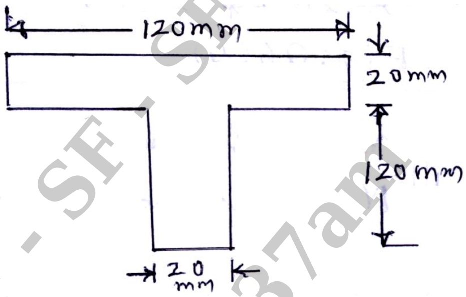

Fig.Q.9(c)

10 a. A 1.5m long column has a circular cross-section of 5cm diameter. One end of the column is fixed in direction and position and the other end is free. Take factor of safety as 3. Calculate safe load using.

i) Rankines formula, taking yield stress 560N/mm^2 and $a = \frac{1}{1600}$.

ii) Eulers formula taking $E = 1.2 \times 10^5$N/mm^2. **(08 Marks)**

b. A beam with an I-section consists of 180mm × 15mm flange and web of 280mm depth and 15mm thick. It is subjected to a moment of 80kN-m and shear force of 60kN. Sketch the bending and shear stresses distribution along the depth of the section. **(12 Marks)**

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