

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
Strength of Materials

Time: 3 hrs.

Max. Marks: 100

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

PART - A

- 1 a. Draw the stress-strain curve for mild steel specimen subjected to axial tension and indicate the salient points. (05 Marks)
- b. With usual notations obtained an expression for elongation of bar of uniform cross-section due to self weight. (05 Marks)
- c. A tie bar has enlarged ends of square cross-section $50\text{mm} \times 50\text{mm}$ as shown in Fig.Q1(c). If the middle portion of the bar is also a square section, find the size and length of the middle portion. The stress in the middle portion has to be limited to 150 MN/m^2 and the total extension of the bar is 0.15mm . $E = 200\text{ GN/m}^2$ (10 Marks)

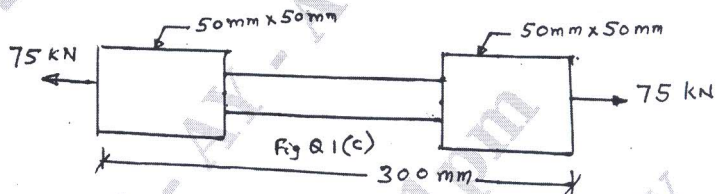


Fig.Q1(c)

- 2 a. Write the equations evolved in the solution of problem of a composite material shown in Fig.Q2(a) subjected to force 'F' with usual notations [① & ② are different materials].

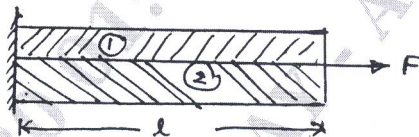


Fig.Q2(a)

- b. Three rods each initially of 300 mm^2 cross-sectional area and 1.5m long support a load of 100 kW . The central rod is made of steel and the outer ones of copper. If the temperature of the rods is increased by 100°C and the rods are so adjusted that they are extended by equal amounts, estimate the load carried by each rod. $E_s = 210\text{ GPa}$, $E_c = 85\text{ GPa}$, $\alpha_s = 12 \times 10^{-6}/^\circ\text{C}$, $\alpha_c = 18.5 \times 10^{-6}/^\circ\text{C}$. (15 Marks)
- 3 a. An element is subjected to stresses as shown in Fig.Q3(a). Determine (i) Principal stresses and their directions analytically (ii) Normal and tangential stress on the plane BC analytically. (10 Marks)

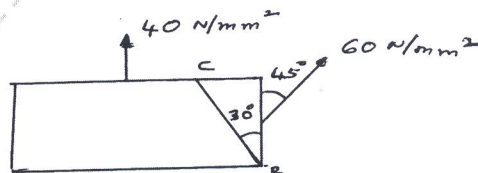


Fig.Q3(a)



- b. Verify the answers obtained in Question No.3(a) by constructing Mohr's circle. (10 Marks)
- 4 a. Draw shear force diagram and bending moment diagram for the cantilever shown in Fig.Q4(a). (06 Marks)

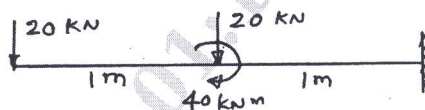


Fig.Q4(a)

- b. For the simply supported overhanging beam loaded as shown in Fig.Q4(b), find the reactions and draw SFD and BMD. Locate the point of contraflexure. (14 Marks)

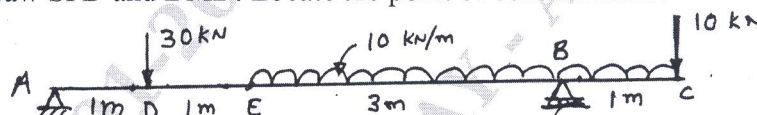


Fig.Q4(b)

PART - B

- 5 a. Show that for a rectangular cross-section, shear stress distribution varies parabolically across the depth. Further show that maximum shear stress is 1.5 times average shear stress. (06 Marks)
- b. A cast iron beam section is shown in Fig.Q5(b). The tensile stress at the bottom edge is 20 N/mm^2 when it is subjected to a bending moment. Determine (i) the value of B.M. and (ii) value of stress at the top edge. (14 Marks)

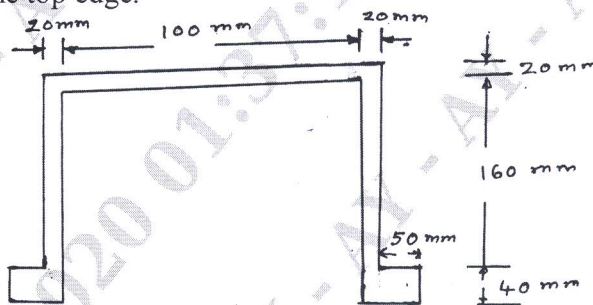


Fig.Q5(b)

- 6 a. Derive $EI \frac{d^2y}{dx^2} = M$ with usual notations. (06 Marks)
- b. Find the deflection of the free end of the overhanging end of a Simply supported beam of rectangular cross-section $80 \text{ mm} \times 100 \text{ mm}$. $E = 210 \text{ GN/m}^2$ [Refer Fig.Q6(b)].

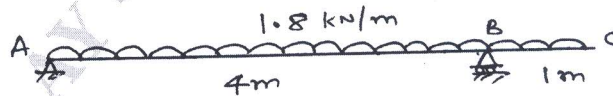


Fig.Q6(b)

- 7 a. State the assumptions made in the theory of Pure Torsion. (05 Marks)

- b. Two solid shafts AC and BC of Aluminium and Steel are rigid supports 'A' and 'B'. A torque of 200 N-m is applied at the Junction 'S'. What is the angle of twist at the Junction? Take modulus of rigidity of the material. $G_{AR} = 3 \times 10^4 \text{ N/mm}^2$. $G_{St} = 9 \times 10^4 \text{ N/mm}^2$ [Refer Fig.Q7(b)]. (15 Marks)

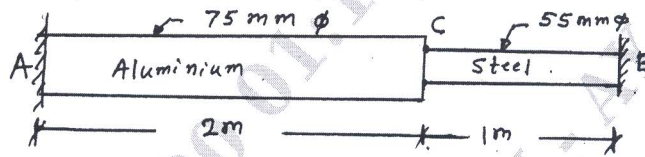


Fig.Q7(b)

- 8 a. Derive Euler's equation for crippling load of a column whose ends are fixed with standard notations. (08 Marks)
- b. Find the Euler's crippling load for a hollow cylindrical cast iron column, 150mm external diameter and 20mm thick it is 6 m long and hinged at both ends. Compare the load with that obtained by the Rankines formula using constants 550 N/mm^2 and $1/1600$. For what length of the column would these two formulae give the same crippling load. $E = 80 \text{ kN/mm}^2$. (12 Marks)
