USN

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 atleast 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 50mm × 50mm 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 GN/m^2 **(10 Marks)**

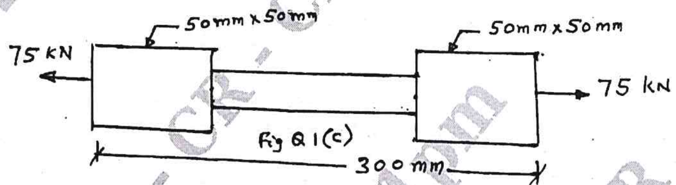

Fig.Q1(c)

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].

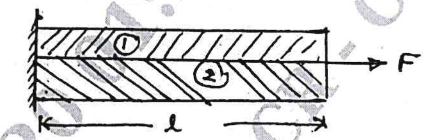

Fig.Q2(a) **(05 Marks)**

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 GPa, E_c = 85 GPa, $\alpha_s = 12\times10^{-6}$/°C, $\alpha_c = 18.5\times10^{-6}$/°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)**

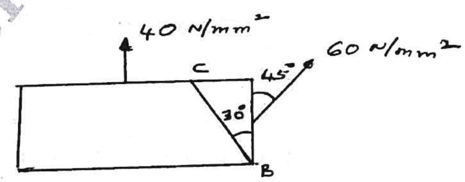

Fig.Q3(a)

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)**

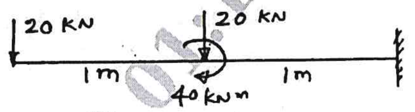

Fig.Q4(a)

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)**

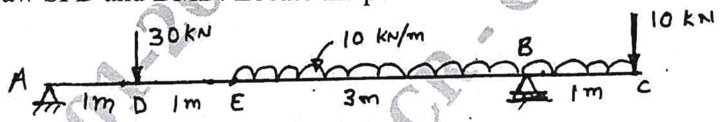

Fig.Q4(b)

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)**

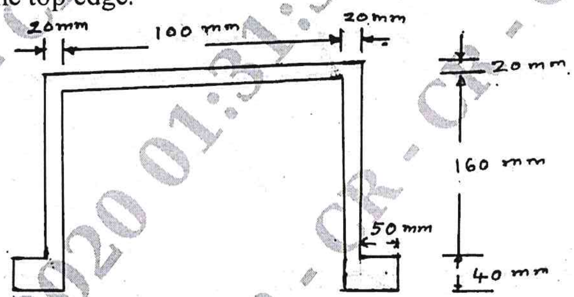

Fig.Q5(b)

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 80mm × 100mm. E = 210 GN/m^2 [Refer Fig.Q6(b)].

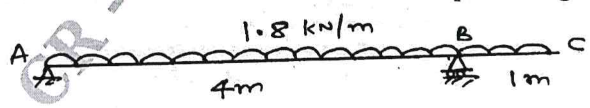

Fig.Q6(b) **(14 Marks)**

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. $G_{AR} = 3\times10^4$ N/mm². $G_{st} = 9\times10^4$ N/mm² [Refer Fig.Q7(b)]. **(15 Marks)**

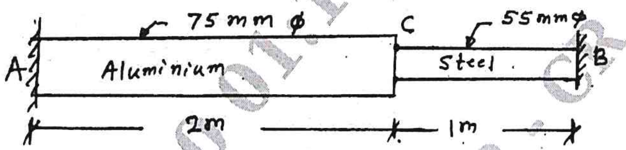

Fig.Q7(b)

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 hallow 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/mm² and 1/1600. For what length of the column would these two formulae give the same crippling load. E = 80 kN/mm². **(12 Marks)**

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