Q.P. Code: 27345

Duration: 3 Hours **Total Marks: 80**

N.B.: (1) Question No. **1 is Compulsory**. Answer any **THREE** from the remaining **FIVE** questions.

(2) **All** questions carry **equal** marks.

(3) Assume suitable data wherever necessary.

(4) Figures to the right indicate max. marks.

1. Attempt Any FOUR [20]

(a) What is Eular's theory for long columns? List out the assumptions made in it.

(b) A uniform steel bar of 2 m length and 20 mm diameter is subjected to a pull of 60 kN. Determine the stress, change in length, strain energy stored and resilience in the bar when the pull is applied gradually. Take E= 210 GPa

(c) Draw Stress- Strain curve for ductile material & explain salient points on it.

(d) A hollow circular shaft transmits 250 kW power at 400 RPM. Find the diameter of shaft necessary if the allowable stress is limited to100 N/mm^2. Take ratio of diameters as 0.6

(e) Write assumptions made in simple bending and derive flexural formula.

2. (a) A thin cylindrical shell, 3 m long and 1 m in diameter is subjected to an internal pressure of 1 N/mm^2. If the thickness of the shell is 12 mm, find the circumferential and longitudinal stresses. Find also the maximum shear stress and change in dimensions of the shell. Take E = 210 GPa and 1/m = 0.3. [08]

(b) A rectangular block of 220 mm x 130 mm x 60 mm dimension along x, y and z directions respectively. Find the axial tensile forces P_x and P_y acting on the block causing an increase of 0.20 mm along x-direction and 0.00625 mm along z-direction. Find also the decrease in dimensions along y-direction. Take, Poisson's Ratio= 0.3, E = 210 GPa. No load acts along y-direction. [12]

3. (a) A uniform rigid block weighing 200 kN is to be supported on three bars as shown in fig. no. 1. There is a gap of 3.5 mm between the block and the top of the steel bar. Find the stresses developed in the bars. Take, $E_S = 200 \times 10^3$ N/mm^2 and $E_A = 200 \times 10^3$ N/mm^2. Two Aluminium rods are of 20 mm x 20 mm and steel rod of 25 mm x 25 mm as cross section. [12]

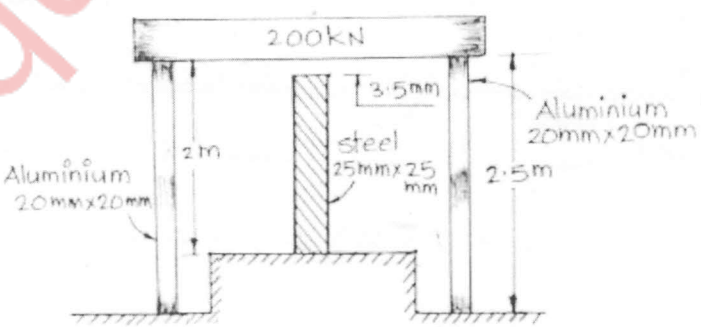

FIG. No. 1 (Q.3a)

(b) Determine the safe load that the hollow cast iron column having outside diameter 200 mm can carry by Rankine's using formula. The column is 5m long and fixed at both the ends. Take metal thickness = 20 mm, σ_c = 500MPa, E = 94 GPa, $1/\alpha$ = 1600 and F.O.S. = 4. [08]

4. (a) Calculate maximum deflection at point D, slope at A and maximum deflection in terms of E and I for the beam shown in fig. no 2. [12]

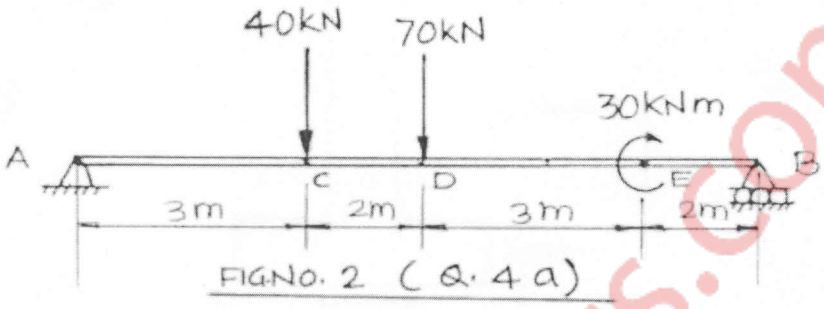

FIG NO. 2 (Q. 4 a)

(b) Find the maximum u.d.l. the simply supported T-beam of span 6 m, as shown in fig. no 3, can carry if the maximum permissible stress is not to exceed 200 MPa. [08]

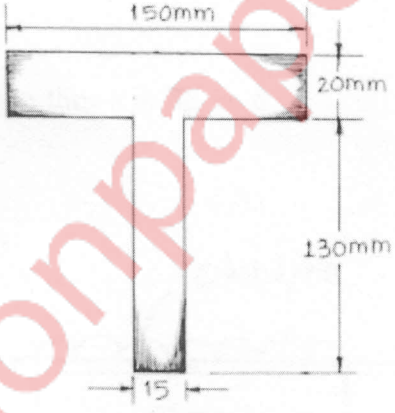

FIG. NO. 3 (Q. NO. 4b)

5. (a) Draw SFD, BMD and axial force diagram for the beam shown in fig. no 4. Also show the point of contraflexure if any. [12]

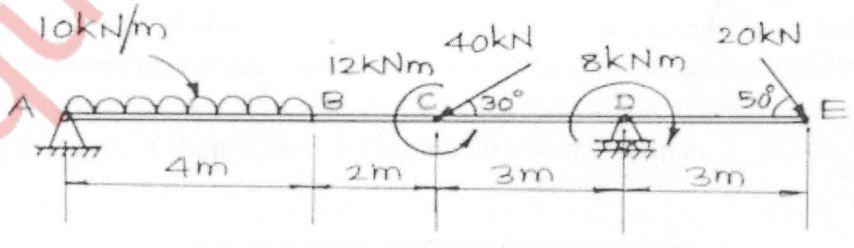

FIG. NO. 4 (Q. NO. 5a)

(b) A simply supported cast iron beam of inverted T section carries u.d.l. of 1500N/m, as shown in fig. no 5. Draw shear stress distribution across the cross section for maximum shear force for the beam. [08]

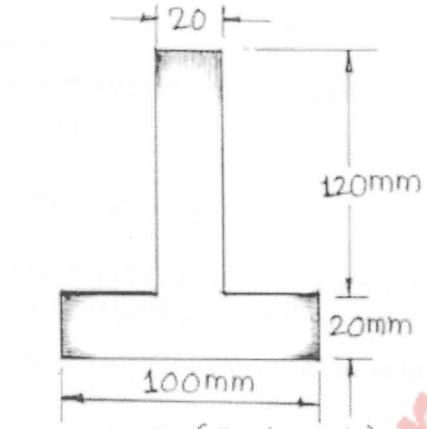

FIG. NO. 5 (Q. NO. 5 b)

6. (a) Draw SFD and BMD for the beam shown in fig. no 6. [10]

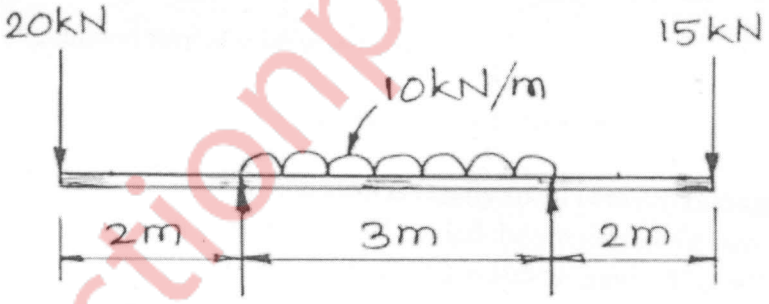

FIG. NO. 6 (Q. NO. 6 a)

(b) Calculate the diameter of shaft if the angle of twist is not to exceed 1^0 in a length of 20 times the diameter of shaft and maximum permissible shear stress is not to exceed 100 N/mm^2. Take, G = 84 GPa. If the shaft is replaced by hollow shaft with the ratio of diameters as 2, find inside and outside diameter of the shaft. A shaft is used to transmit 50 kW at 150 r.p.m [10]