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Q. P. Code : 555000

Sem III / CBSGS / Auto/mech/som/m-J-17

Time: 3hrs **Marks: 80**

Instructions
1. All questions carry equal marks.
2. Assume suitable data if necessary.
3. Figures to the right indicate full marks.
3. Question No. 1 is compulsory & Attempt any three questions from remaining five questions.

Q.1 Attempt any **FOUR** **20**

a. What do you mean by Core of a section? Obtain the core of a hollow circular section.

b. Draw SFD and BMD for a simply supported beam carrying udl (w) over the full span (L).

c. Derive flexural formula

d. Establish the relationship between Young's modulus, Modulus of rigidity and Bulk modulus.

e. Derive an expression for the elongation of bar having rectangular section due to its self-weight.

f. A rectangular beam 300 mm deep is simply supported over a span of 4 m. What udl the beam can carry if the bending stress is not to exceed 120 MPa. Take $I = 8 \times 10^6$ mm^4.

Q.2 **a.** A beam has a cross section in the form of an isosceles triangle with the base 90 mm and height 150 mm. If the maximum value of permissible shear stress is 0.8 MPa, what is the maximum value of vertical shear force the section can withstand? Also determine shearing stresses at 40 mm from apex and at centroid of the triangle. **8**

b. Write the assumptions made in theory of torsion and derive torsional formula. **6**

c. A rod of 16 mm in diameter is stretched by 4 mm under a steady axial load of 15 kN. What stress would be induced in a bar by a 900 N weight falling through 60 mm, if it is originally unstretched? Take $E = 2 \times 10^5$ MPa. **6**

Q.3 **a.** A cylindrical shell is 3 m long, 1 m in diameter is subjected to an internal pressure of 1 MPa. If the thickness of the shell is 12 mm, find the change in length, diameter, and volume of the shell. Take $1/m = 0.27$ and $E = 2 \times 10^5$ N/mm^2. **10**

b. A high voltage overhead cable 100 m long consists of six strands of 3 mm diameter steel wire, enclosed by 28 strands of 2 mm diameter aluminium wire. If the cable is subjected to a tensile force of 8 kN. Find the stresses in each material and extension of the cable. Take $E_s = 190$ GPa, $E_A = 68$ GPa **10**

[TURN OVER]

Q.4 a. Find slope and deflection at B, C, and D. for the beam shown in Figure 1. **10**

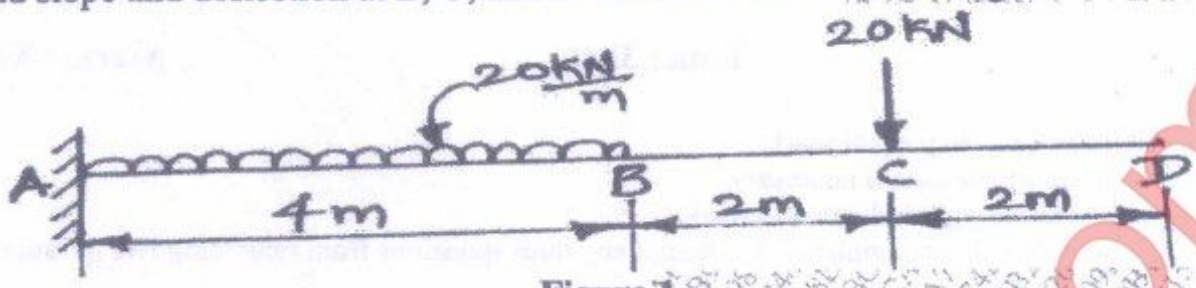

Figure 1

b. A short column has a hollow circular cross section of outside diameter 230 mm and wall thickness 30 mm. An axial compressive load of 400 kN is applied together with a parallel compressive load of 300 kN offset 100 mm from the axis. **10**

i) Calculate the maximum tensile and maximum compressive stresses in the column.

ii) Determine the maximum eccentricity that the 300 kN load can have for no tension condition.

Q.5 a. Determine the crippling load for a T section having dimensions 100 mm x 100 mm x 20 mm and length is 5 m, when it is used as strut with both the ends hinged. Take $E = 2 \times 10^5$ MPa. **10**

b. A bimetallic thermal control shown in Figure 2 is made of brass bar of length 750 mm and cross sectional area 100 mm^2 and magnesium bar of length 1300 mm and cross sectional area 200 mm^2. The two bars are arranged so that the gap between their free ends is 2 mm at room temperature. Calculate **10**

i) The temperature rise at which the two bars come in contact.

ii) The stress in the materials when the temperature increase is 300^0 C.

take $E_b = 150$ GPa, $E_m = 65$ GPa, $\alpha_b = 10 \times 10^{-6}$/ °C, $\alpha_m = 14.5 \times 10^{-6}$/ °C.

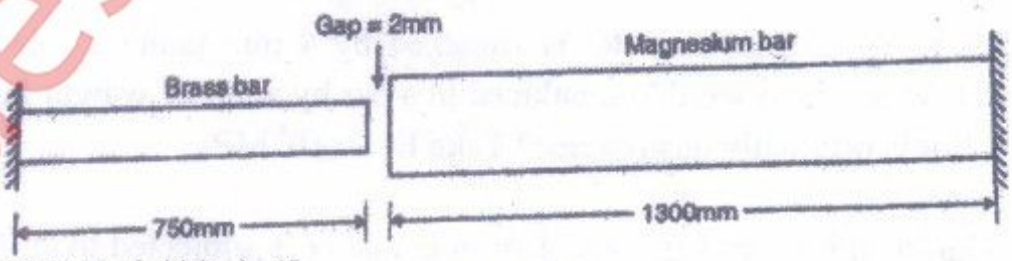

Figure 2

Q.6 a. A beam simply supported at its ends has a span of 6 m. It is loaded with a gradually varying load of zero from left hand support to 1500 N/m to the right hand support. Draw SFD and BMD. 6

b. A beam 8.5 m long rests on the supports 5 m apart, the beam carries load as shown in Figure 3. Draw SFD and BMD showing all the important points. 10

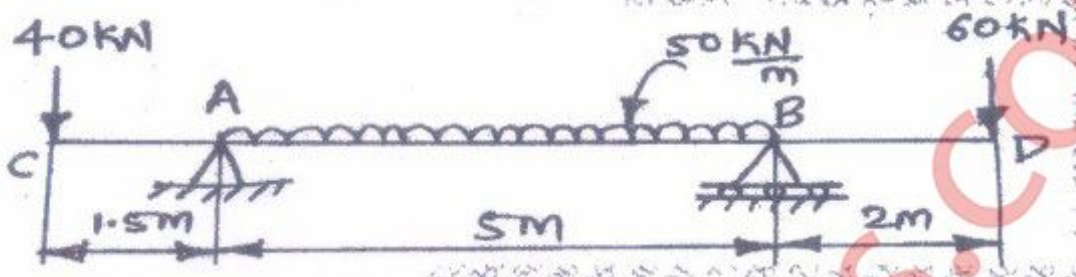

Figure 3

c. Find the maximum power that can be transmitted by a 50 mm diameter shaft at 200 rpm, if the permissible shear stress for the shaft material is 60 MPa. 4