This question paper contains 8 printed pages.

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Your Roll No. ....

B.Tech. (C) / II **J**

Paper V— THEORY OF STRUCTURES

(ECE–205)

Time : 3 hours *Maximum Marks* : 70

(Write your Roll No. on the top immediately on receipt of this question paper.)

Question No. 1 is compulsory. Attempt any three questions out of the rest. Any missing data may be suitably assumed.

1. Consider a steel tube surrounding a solid aluminium cylinder, the assembly being compressed between infinitely rigid cover plates by centrally applied load as shown in fig. 1. The aluminium cylinder is 0·0762 m in diameter and the outside diameter of the steel tube is 0·0889 m. If P=213504 N, find the stress in steel and also in aluminium. For steel, E_s=207 GPa and for aluminium E_a=82·7 GPa. 10

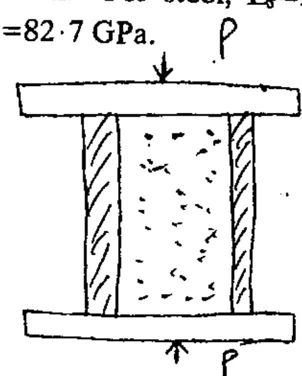

Fig. 1

P. T. O.

2. (*a*) A rigid beam is hinged to a wall at C and supported on two vertical props A and B equal in height. A is 5 metres from the hinge C and B is 2 metres from the hinge. Area of A is 1800 sqmm and area of B is 1200 sqmm. Modulus of elasticity of A is $0 \cdot 100$ MN/mm^2 and of B is $0 \cdot 2$ MN/mm^2. Find the loads on props A and B if a load of 10000 N is placed on beam at 3 metres from hinge. Look fig. 2. 10

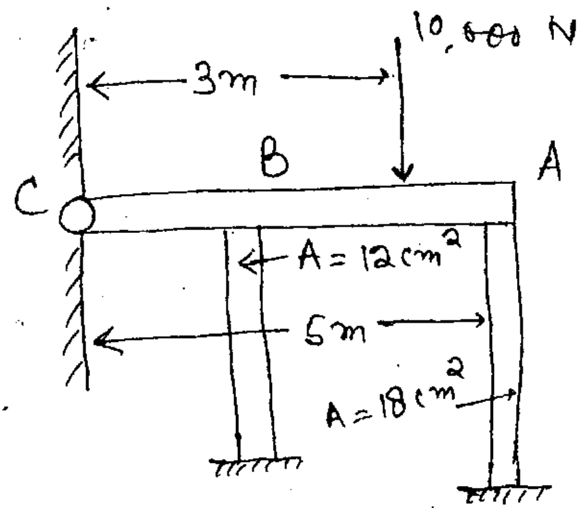

Fig. 2

(*b*) A prismatic bar in compression has a cross-sectional area A=1200 cm^2 and carries a load P=90 kN as shown in fig. 3. Determine the stresses acting on a plane cut through the bar at ϕ=25°. Then show the complete state of stress for $\phi=25°$ by determining the stresses (*i.e.*, normal and tangential) on inclined plane. 10

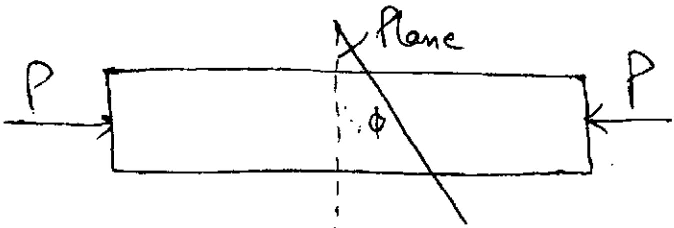

Fig. 3

3. (*a*) (*i*) Write the expressions of principal stresses in a biaxial state of stress. 2

(*ii*) Explain how to determine principal stresses and principal planes from Mohr's circle for a general biaxial loading. 8

(*b*) A plane element is subjected to the stresses shown in fig. 4. Using Mohr's circle, determine (*i*) the principal stresses and their directions and (*ii*) the maximum shearing stresses and the directions of the planes on which they occur. 10

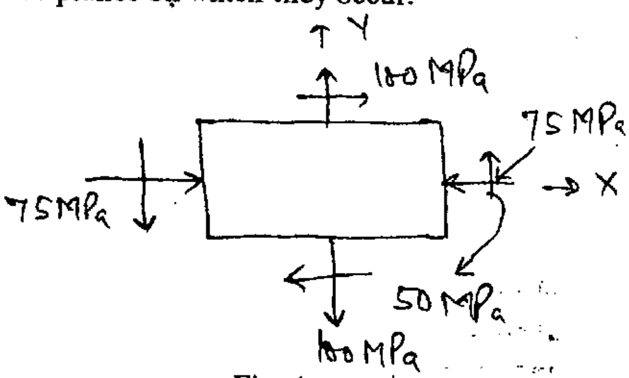

Fig. 4

4. (*a*) Using conjugate beam method or area moment method find deflection at point D for the loaded and supported beam shown in fig. 5. 10

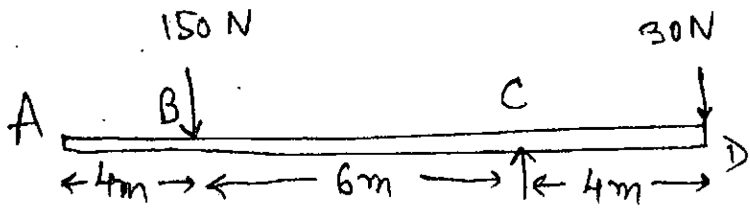

Fig. 5

(*b*) The simple beam supports a concentrated load of 300 N at 2 m from the left support. Compute maximum deflection and its position. EI is constant throughout the beam shown in fig. 6. 10

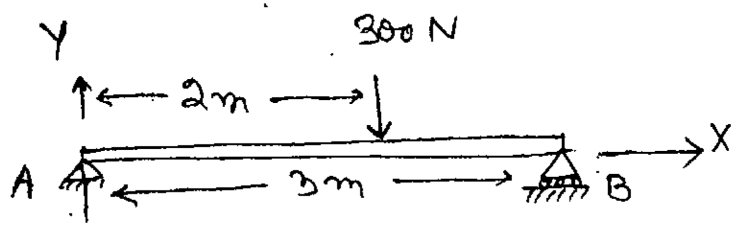

Fig. 6

5. (*a*) The compression flange of a cast iron girder is 10 cm wide and 3 cm deep. The tension flange is 30 cm wide and 5 cm deep and web 25 cm×3·0 cm. Find (*i*) moment of inertia about N.A.; (*ii*) the

load per meter run which may be carried over a 3 metre span by the beam simply supported at its ends if the maximum permissible stresses are 95 N/mm^2 in compression and 25 N/mm^2 in tension. Look fig. 7. 10

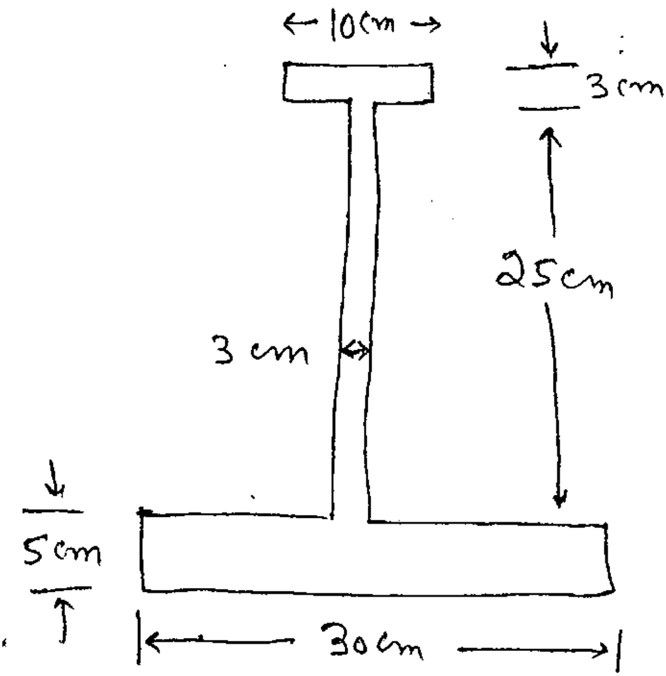

Fig. 7

(*b*) A steel beam of hollow square section with outer side 50 cm and inner side 40 cm is fixed as a cantilever with a length of 3 metres as shown in fig. 8. How much concentrated load can be applied at the free end of cantilever, if the maximum stress in cantilever is not to exceed 60 N/mm^2? 10

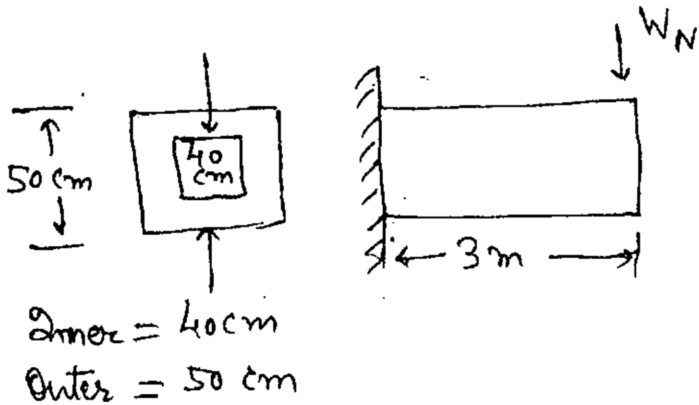

Fig. 8

6. (*a*) A timber beam 150 mm wide and 200 mm deep is to be reinforced by bolting on two steel flitches each 150 mm by 12·5 mm in section. Find the moment of resistance when (*i*) flitches are attached symmetrically at top and bottom, (*ii*) the flitches are attached symmetrically at the sides. Allowable stress in timber is 6 N/mm^2. What is the maximum stress in steel in each case?

Take $E_s = 20\ E_w$. 10

(*b*) Find the minimum value of the slenderness ratio of a mild steel column for which Euler's formula is valid. Take $f_c = 330$ N/mm^2 and $E = 2 \cdot 1 \times 10^5$ N/mm^2. 10

7. (*a*) Definc the following:

   (*i*) Effective length of a column

   (*ii*) Slenderness ratio

   (*iii*) Plane of maximum shear stress

   (*iv*) Polar moment of inertia

   (*v*) Area moment theorems. $1 \times 5 = 5$

   (*b*) A hollow shaft with diameter ratio 3/5 is required to transmit 450 kW at 120 rpm with a uniform twisting moment. The shearing stress in the shaft must not exceed 60 N/mm^2 and the twist in a length of $2 \cdot 5$ m must not exceed 1°. Calculate the minimum external diameter of the shaft satisfying these conditions. Take modulus of rigidity $G = 8 \times 10^4$ N/mm^2. 10

   (*c*) Explain any *five* in short:

   (*i*) Maximum shear stress theory

   (*ii*) Coulomb-Mohr theory

   (*iii*) Maximum principal stress theory

   (*iv*) Rankine theory