Total No. of Questions—**8**] [Total No. of Printed Pages—**8**

Seat No.	

[4957]-1019

S.E. (Mechanical Sandwich/Automobile) (First Semester)

EXAMINATION, 2016

STRENGTH OF MATERIALS

(2012 PATTERN)

Time : Two Hours **Maximum Marks : 50**

***N.B.* :—** (*i*) Answer *four* questions out of *eight*.

(*ii*) Solve Q. No. **1** *or* Q. No. **2,** Q. No. **3** *or* Q. No. **4,** Q. No. **5** *or* Q. No. **6,** Q. No. **7** *or* Q. No. **8**.

(*iii*) All the *four* questions should be solved in one answer books.

(*iv*) Neat diagrams must be drawn wherever necessary.

(*v*) Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(*vi*) Assume suitable data whenever necessary.

1. (*a*) A reinforced concrete column is 300 mm × 300 mm in section. The column is provided with 8 bars of 20 mm diameter. The column carries a load of 360 kN. Find the stresses in concrete and the steel bars. [6]

P.T.O.

Take E = 2.1 × 10^5 N/mm^2 and E = 0.14 × 10^5 N/mm^2.

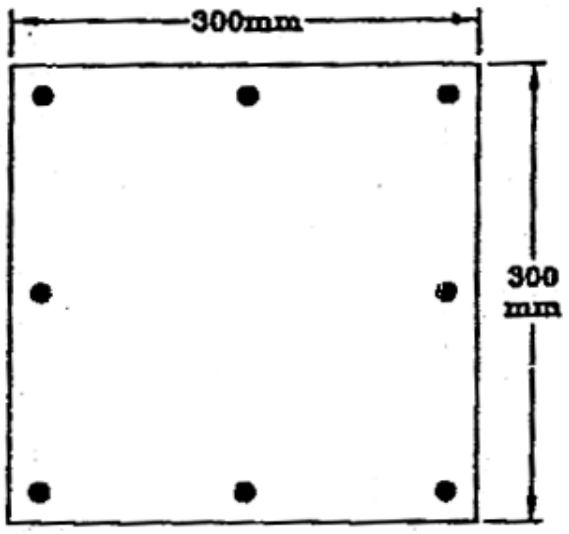

Fig. 1

(*b*) Draw shear force and bending moment diagrams [SFD and BMD] for a single side overhanging beam subjected to loading as shown in the Fig. 2 given below. Locate points of contra flexure, if any. [6]

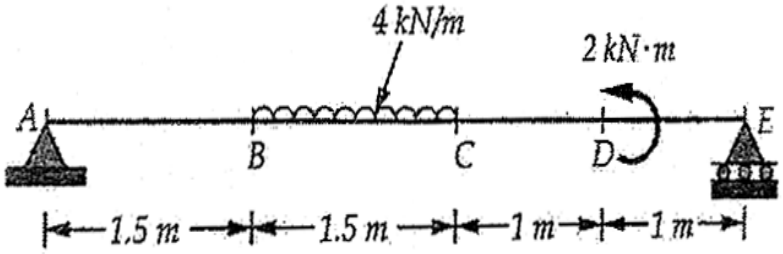

Fig. 2

Or

2. (*a*) A steel rod of 32 mm diameter is enclosed in a brass tube of 48 mm external diameter and 34 mm internal diameter.

Each is 400 mm long and the assembly is rigidly held between two stops 400 mm apart. The temperature of the assembly is then raised by 60°C. Determine : [6]

(*i*) Stresses in the tube and the rod if the distance between the stops remains constant.

(*ii*) Stresses in the tube and the rod, if the stops yields by 0.25 mm.

E_S = 200 GPa; E_b = 90 GPa

$\alpha_s = 12 \times 10^{-6}$ per °C; $\alpha_b = 21 \times 10^{-6}$ per °C.

(*b*) Draw SF and BM diagrams for the beam ABCDE shown in the following figure 3. [6]

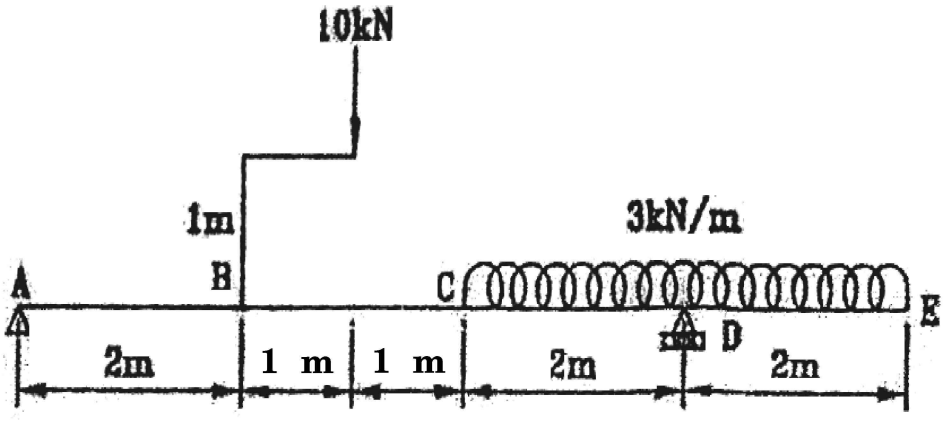

Fig. 3

3. (*a*) A square beam 20 mm × 20 mm in section and 2 m long is supported at the ends. The beam fails when a point load of 400 N is applied at the centre of the beam. What uniformly distributed load per meter length will break a cantilever of the same material 40 mm wide, 60 mm. deep and 3 m long ? [6]

(*b*) A cantilever of length' 'L carries a uniformly distributed load of 'w' N/m for a length of '*a*' from the fixed end, find the deflection at the free end. [6]

Or

4. (*a*) A simply supported beam carries a unifromly distributed load of intensity 30 N/mm over the entire span of 1 m. The cross-section of the beam is a T-section having the dimension as shown in Fig. 4. Calculate the maximum shear stress for the section of the beam. [6]

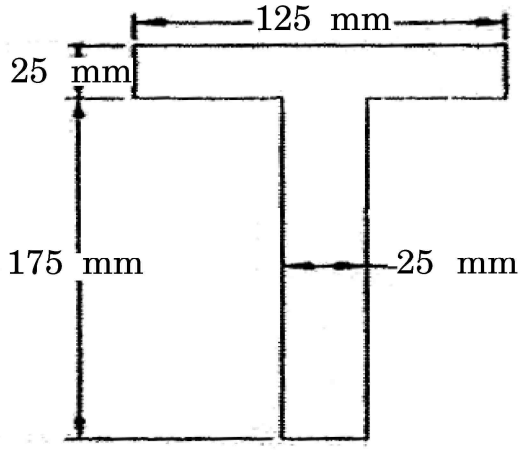

Fig. 4

(*b*) A horizontal cantilever of uniform section of length L carries two point loads W at the free end and 2 W at a distance of '*a*' from the free end. Find the maximum deflection due to this loading. [6]

5. (*a*) A hollow shaft, having an internal diameter 40% of its external diameter, transmits, 562.5 kW power at 100 r.p.m. Determine the external diameter of the shaft if the shear stress is not exceed 60 N/mm^2 and the twist in a length of 2.5 m should not exceed 1.3 degrees. Assume maximum torque = 1.25 mean torque and modulus of rigidity = 9×10^4 N/mm^2. [6]

(*b*) A horizontal beam ABC 1.6 m long is pinned to a support at C and supported by a vertical aluminum tube 2.25 m long as shown in Fig. 5. The upper end of the tube is hinged to the beam while its lower end is firmly fixed. The beam carries a load of 250 kN at A. Find the thickness of the tube if its outer diameter is 120 mm. Allow a factor of safety 2.5 with respect to Euler critical load.

Take E = 7.2×10^4 N/mm^2.

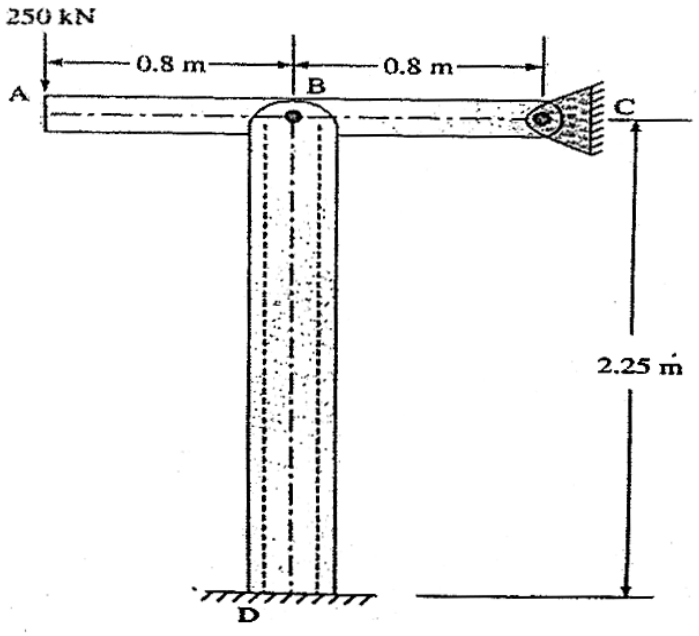

Fig. 5

Or

6. (*a*) The stepped steel shaft shown in figure 6 is 600 mm long and fixed at both ends subjected to a torque 120 kNm at C. Determine the fixing torque at the ends, the maximum shear in the AC and BC and angle of twist of section C. Take G = 80 GPa. [6]

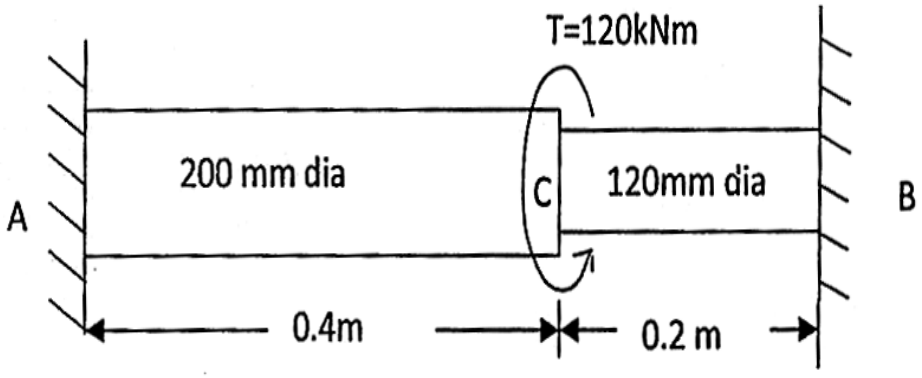

Fig. 6

(*b*) A hollow cylindrical cast iron column is 4 m long, both end fixed. Design the column to carry an axial load of 250 kN. Use Rankine's formula and adopt a factor of safety of 5. The internal diameter may be taken as 0.8 times the external diameter. Take F_c = 550 N/mm^2 and α = 1/1600. [7]

7. (*a*) At a point in a strained material the normal stresses acting are +50 MPa and –30MPa at a plane right angle to each other, with a shear stress of 20 MPa. Determine :

(*i*) Principal stresses and their nature

(*ii*) Normal and tangential stress on a plane inclined at an angle of 25° with the plane of 50 MPa. [7]

(*b*) A bolt is subjected to an axial pull of 40 kN and a transverse shear force of 15 kN. Determine the diameter of the bolt required based on :

(*i*) Maximum principal stress theory

(*ii*) Maximum shear stress theory

(*iii*) Maximum strain energy theory.

Take elastic limit in simple tension is equal to 350 MPa and Poisson's ratio = 0.3. Assume FOS = 2.5. [6]

Or

8. (*a*) A 100 mm diameter bar with a built in bracket is fixed to the wall and loaded as shown in Fig. 7. Determine the principal stresses at the top extremity of the vertical diameter for the section marked A. [7]

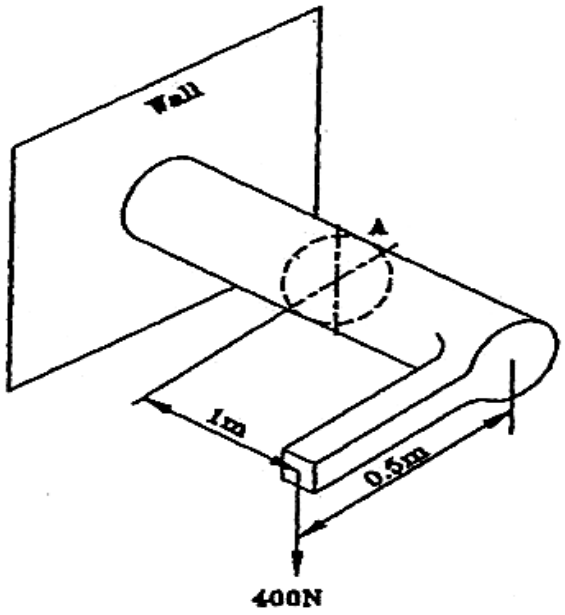

Fig. 7

(*b*) According to the theory of maximum shear stress, determine the diameter of a bolt which is subjected to an axial pull of 9 kN together with a transverse shear force of 4.5 kN. Elastic limit in tension is 225 N/mm^2,

factor of safety = 3 and

Poisson's ratio = 0.3. [6]