Total No. of Questions—12] [Total No. of Printed Pages—8+1

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S.E. (Production & Production Sandwich)

(I Sem.) EXAMINATION, 2010

STRENGTH ANALYSIS OF MACHINE ELEMENTS

(2008 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer *one* question from each unit of Section I and Section II.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Figures to the right indicate full marks.

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

(*v*) Use of non-programmable electronic pocket calculator is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

UNIT I

1. (*a*) A hollow cylinder 2 m has an outside diameter of 50 mm and inside diameter of 30 mm. If the cylinder is carrying a load of 25 kN, find the stress in the cylinder. Also find the deformation of the cylinder, if modulus of elasticity for the cylinder material is 100 GPa. [6]

P.T.O.

(*b*) A steel bar 2 m long and 40 mm in diameter is subjected to an axial pull of 80 kN. Find the length of the 20 mm diameter bore, which should be centrally carried out, so that the total elongation should increases by 20% under the same pull. Take E for the bar material as 200 GPa. [10]

Or

2. (*a*) Derive the equation of thermal stress in a simple bar in terms of coefficient of linear expansion and modulus of elasticity. [6]

(*b*) A steel rod 20 mm diameter passes centrally through a copper tube of 25 mm internal diameter and 35 mm external diameter. Copper tube is 800 mm long and is closed by rigid washers of negligible thickness, which are fastened by nut threaded on the rod as shown in Fig. 1. The nuts are tightened till the load on the assembly is 20 kN. Calculate the initial stresses in the copper tube and steel rod. Also calculate increase in the stresses, when one nut is tightened by one-quarter of a turn relative to the other. Take pitch of the thread as 1.6 mm. (E_{steel} = 200 GPa and E_{copper} = 100 GPa) [10]

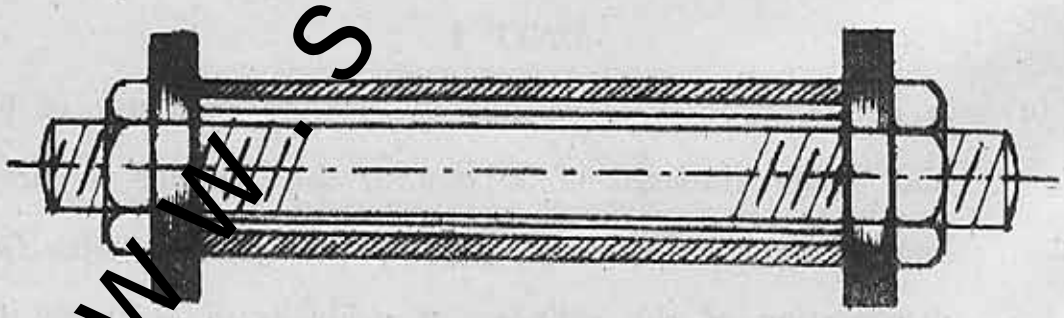

Fig. 1

UNIT II

3. (*a*) A cantilever beam 4 m long carries a gradually varying load, zero at the free end to 3 kN/m at the fixed end. Draw bending moment diagram and shear force diagram for the beam. [6]

(*b*) A simply supported beam AB, 6 m long is loaded as shown in Fig. 2. Construct the shear force and bending moment diagram for the beam and find the position and value of maximum bending moment. [12]

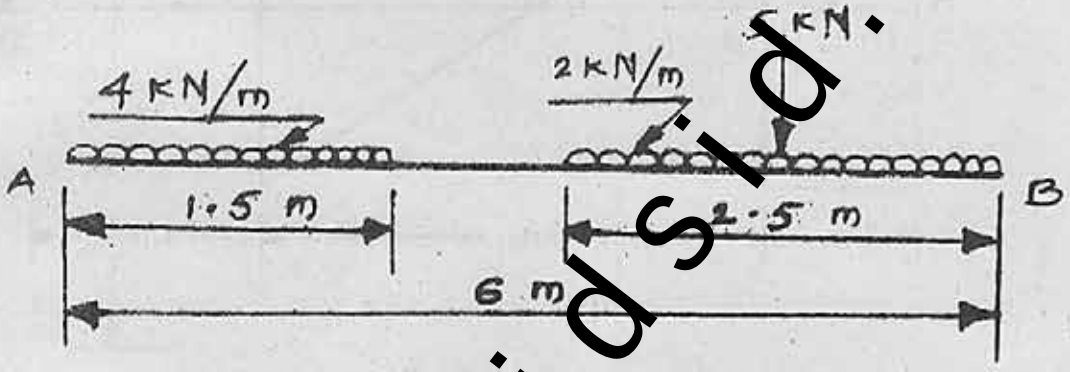

Fig. 2

Or

4. (*a*) A simply supported beam AB of span 2.5 m is carrying two point loads as shown in Fig. 3. Draw shear force diagram and bending moment diagram for the beam. [6]

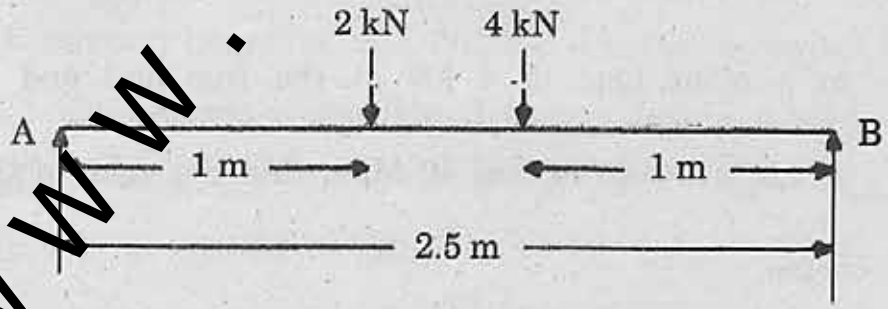

Fig. 3

(*b*) Shear force diagram for a loaded beam is shown in Fig. 4. Determine the loading on the beam and hence draw the bending moment diagram. Locate the point of contraflexure, if any. [12]

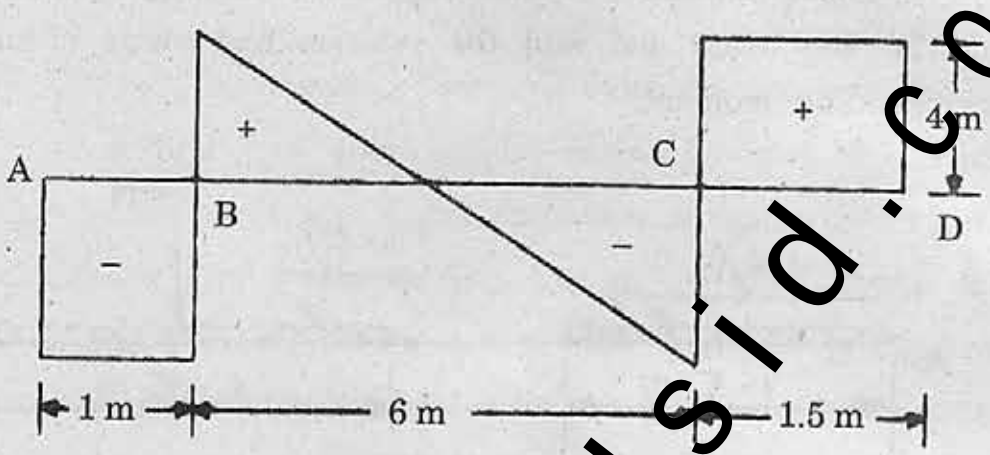

Fig. 4

UNIT III

5. (*a*) A cantilever beam is rectangular in section having 80 mm width and 120 mm depth. If the cantilever is subjected to a point load of 6 kN at the free end and the bending stress is not to exceed 40 MPa, find the span of the cantilever beam. [6]

(*b*) A T-shaped cross-section of a beam shown in Fig. 5, is subjected to a vertical shear force of 100 kN. Draw shear stress distribution diagram. Moment of inertia about the horizontal neutral axis is 113.4×10^6 mm^4. [10]

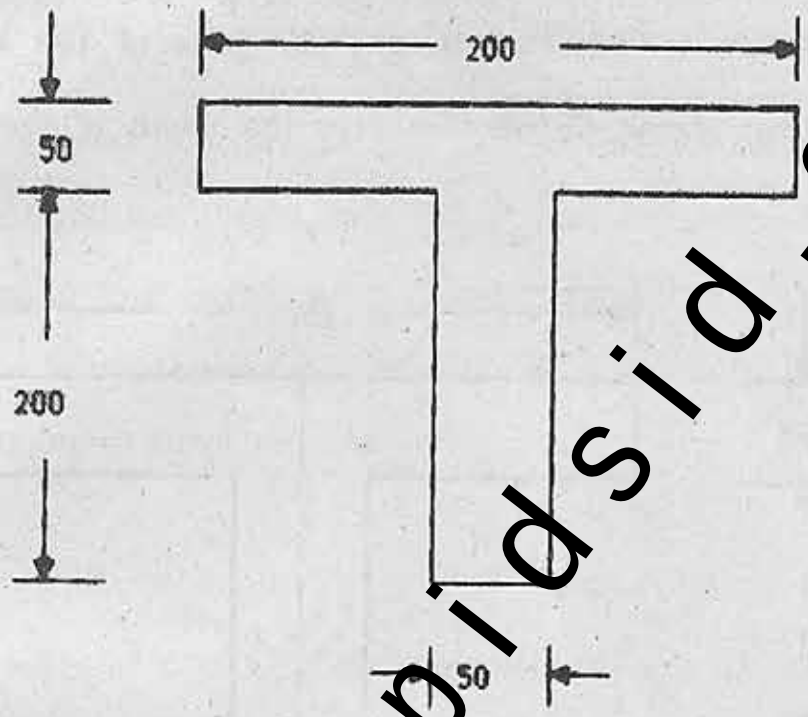

Fig. 5

Or

6. (*a*) A timber beam of rectangular section supports a load of 20 kN uniformly distributed over a span of 3.6 m. If depth of the beam section is twice the width and maximum stress is not to exceed 7 MPa, find the dimensions of the beam section. [6]

(*b*) A cast iron bracket subjected to bending, has a cross-section of I-shape with unequal flanges as shown in Fig. 6. If the compressive stress in top flange is not to exceed 17.5 MPa, what is the bending moment, the section can take ? If the section is subjected to a shear force of 100 kN, draw the shear stress distribution over the depth of the section. [10]

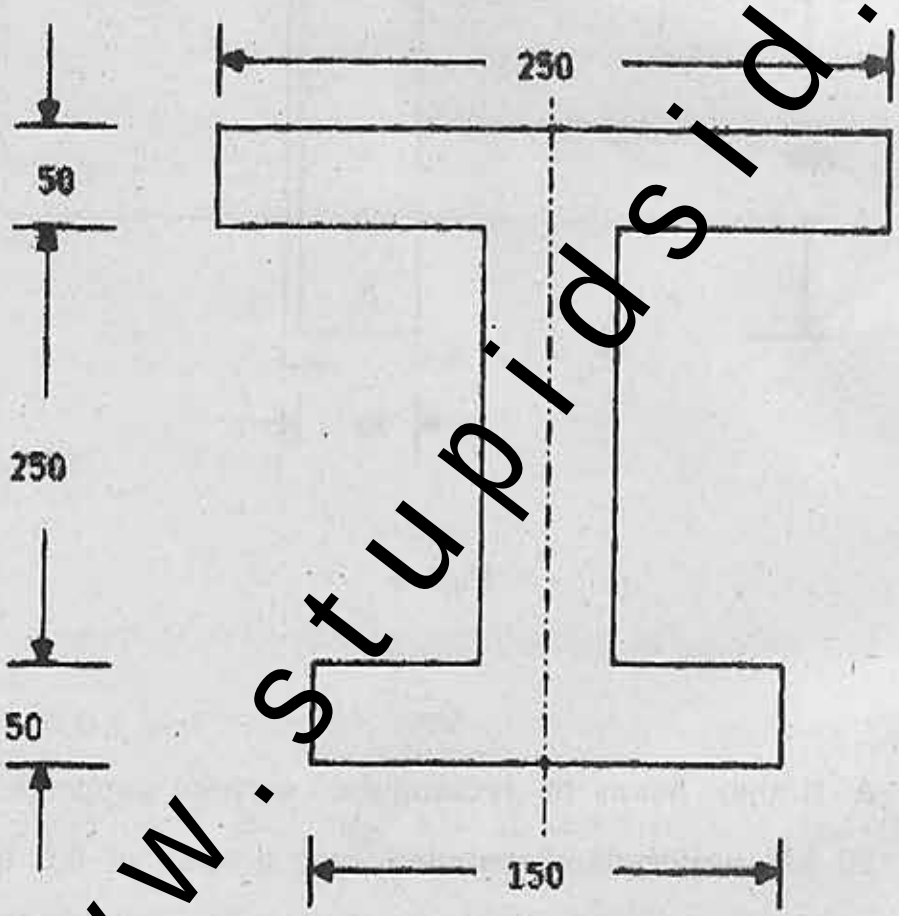

Fig. 6

SECTION II

UNIT IV

7. (*a*) Two timber pieces of section 60 mm × 100 mm are joined with epoxy along a plane inclined at 30° to the X-axis. Find the maximum force the member can sustain if the strength of the joint is 5 MPa in tension and 3 MPa in shear. [8]

(*b*) At a point in a bracket the normal stresses on two mutually perpendicular planes are 120 N/mm^2 tensile and 60 N/mm^2 tensile. The shear stress across these planes is 30 N/mm^2. Find using the Mohr's stress circle, the principal stresses and maximum stress at the point. [8]

Or

8. (*a*) A mass of 200 kg falls through a height of 500 mm on a concrete column of 300 mm × 400 mm section. Determine the maximum stress and deformation in the 4 m long column, if Young's modulus of concrete is 20 GPa. [8]

(*b*) A 10 mm diameter mild steel bar of length 1.5 m is stresses by a weight of 120 dropping freely through 20 mm before commencing to stretch the bar. Find the maximum instantaneous stress and the elongation produced in the bar, E = 200 GPa. [8]

UNIT V

9. (*a*) Determine the maximum stress and deformation of a shaft of 100 mm diameter and 2.7 m length subjected to a torque of 30 kNm. Assume G = 75 GPa for the material. [8]

(*b*) A hollow steel shaft 3 m long transmits a torque of 24 kNm. The total angle of twist is not to exceed 2.5° and the allowable shear stress is 90 MPa. Determine inside and outside diameter of shaft. G = 85 GPa. [10]

Or

10. (*a*) A solid shaft of 200 mm diameter has the same cross-sectional area as that of a hollow shaft of the same material with inside diameter 150 mm. Find the ratio of power transmitted by the two shafts at the same speed. [10]

(*b*) Find the diameter of the shaft to transmit 60 kW at 150 r.p.m. if the maximum torque is likely to exceed the mean torque by 25% for a maximum permissible shear stress of 40 N/mm^2. Find also the angle of twist for a length of 2.5 m. [8]

UNIT VI

11. (*a*) A cantilever of length 2 m carries a uniformly distributed load of 2500 N/m for a length of 1.25 m from the fixed end and a point load of 1000 N at the free end. If the section is rectangular 120 mm wide and 240 mm deep, find the deflection at the free end. Take E = 10000 N/mm^2. [10]

(*b*) A cast iron beam 40 mm wide and 80 mm deep is simply supported on a span of 1.2 m. The beam carries a point load of 15 kN at the center. Find the deflection at the center. Take E = 108000 N/mm^2. [6]

Or

12. (*a*) What is meant by equivalent length of columns ? What are its values for different end conditions of columns ? [6]

(*b*) A column has a height of 7 m. It is hinged at both ends and cross-section is rectangular 80 mm × 120 mm. Calculate buckling load by Euler's formula. E = 180 GPa. [10]