Total No. of Questions—**8**] [Total No. of Printed Pages—**7**

Seat No.	

[5057]-2014

S.E. (Mechanical) (First Semester) EXAMINATION, 2016

STRENGTH OF MATERIALS

(Common to Mech./Auto)

(2015 PATTERN)

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

***N.B.* :—** (*i*) Assume suitable data, wherever necessary.

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

(*iii*) Use of electronic pocket calculator is allowed.

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

1. (*a*) Calculate the vertical displacement of point C for the structure shown in Fig. 1. Neglect the weight of the bar and beam. [6]

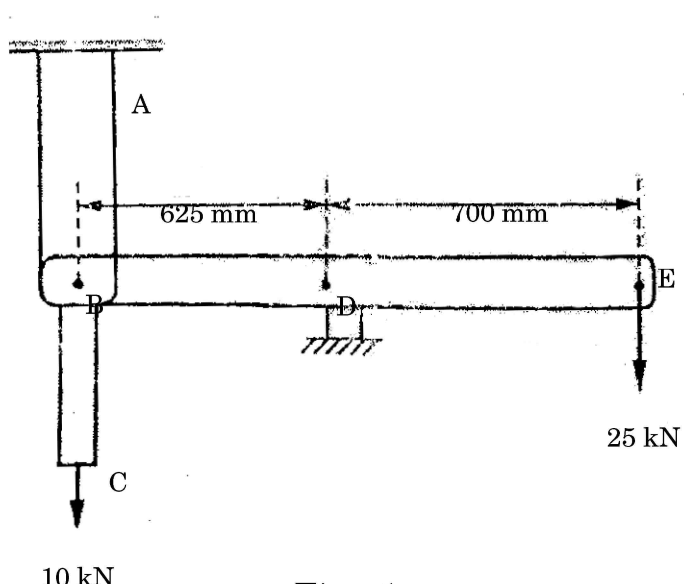

Fig. 1

(*b*) Draw the SFD and BMD for the beam as shown in Fig. 2. Also find the point of contra-flexure if any. [6]

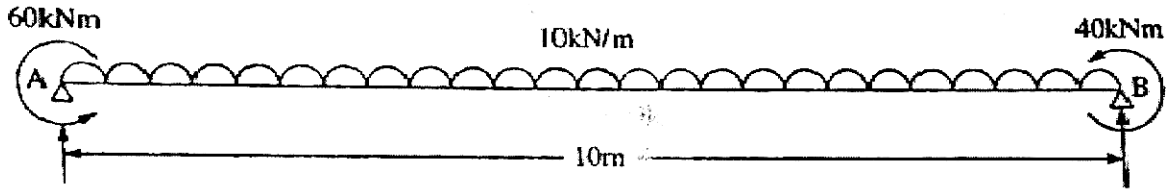

Fig. 2

Or

2. (*a*) The bulk modulus for a material is 50 GPa. A 12 mm diameter rod of the material was subjected to an axial pull of 14 kN and the change in diameter was observed to be 3.6×10^{-3} mm. Calculate the Poisson's ratio and modulus of elasticity for the material. [6]

(*b*) Draw the SFD and BMD for the beam as shown in fig. 3. Also find the point of contra-flexure if any. [6]

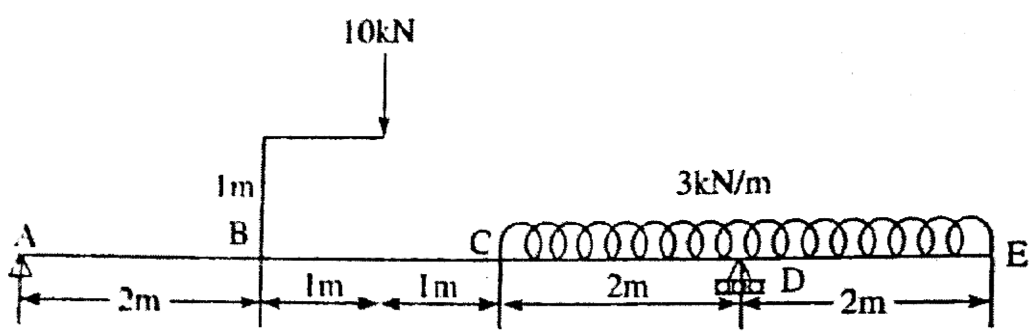

Fig. 3

3. (*a*) A steel channel of C section is used as a simply supported beam on a span of 4 m. The channel is to be designed for a working bending stress of 100 MPa. It has to carry a udl for the whole span. Calculate the permissible load when : [6]

(*i*) The channel stands upright 225 mm high.

(*ii*) The channel lies flat with the 225 mm horizontal.

Take : A = 3053 mm^2, l_{xx} = 2547.9 × $10^4 mm^4$, l_{yy} = 209.5 × 10^4 mm^4, Position of N.A. for horizontal case is 24.6 mm from the web outermost fibre, overall depth of the channel 225 mm and flange width 90 mm.

(*b*) Find the deflection at C for the beam loaded as shown in Fig. 4. Take EI = 40,000 kNm^2. [6]

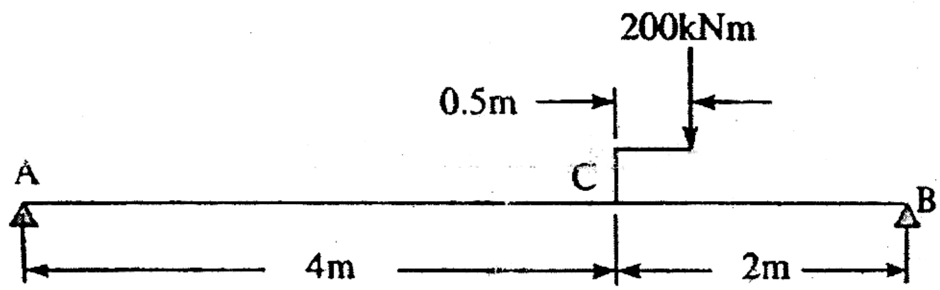

Fig. 4

Or

4. (*a*) Calculate the shear stress at the salient positions and also draw the shear stress distribution diagram for the beam section shown in Fig. 5. [6]

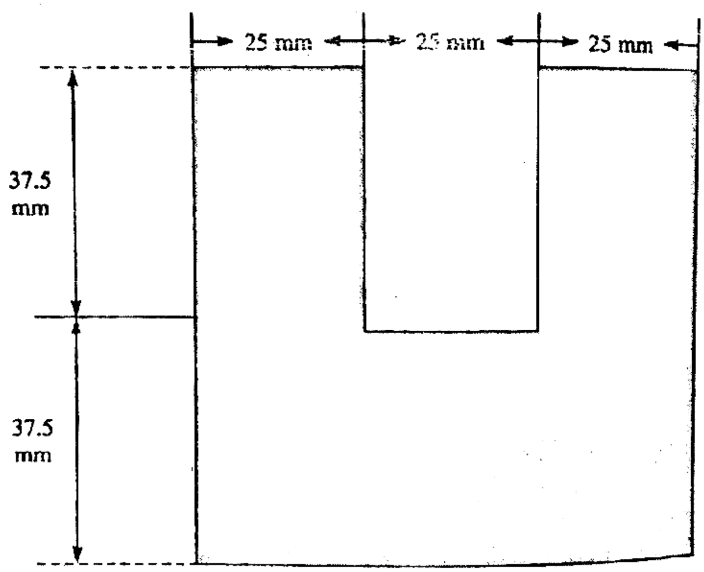

Fig. 5

(*b*) A uniform rod AB has σ_y = 250 MPa and E = 200 GPa. Collar D moves along the rod and has a speed of 3 m/s. It strikes a small plate attached to the end B of the rod as shown in Fig. 6. Using FOS = 4, determine the largest allowable mass of the collar if the rod is not to be permanently deformed. [6]

5. (*a*) A hollow marine propeller shaft turning at 110 rpm is required to propel a vessel at 12 m/s for the expenditure of 6337.5 kW of shaft power, the efficiency of the propeller being 68 %. The diameter ratio of the shaft is to be 2/3 and the direct stress due to the thrust is not to exceed 8 MPa.

Calculate : [7]

(*i*) the shaft diameter,

(*ii*) the maximum shearing stress due to the torque.

(*b*) Find the Euler's critical load for a hollow cylindrical cast iron column with 200 mm O.D. and 25 mm thickness, if it is 6 m long and hinged at both ends.

Take E = 8×10^4 MPa.

Compare Euler's critical load with Rankine's critical load taking σ_c = 550 MPa and a = 1/1600. [6]

Or

6. (*a*) Fig. 6 shows a horizontal shaft ABCD fixed to a rigid base at D and subjected to torques. A hole 60 mm in diameter has been drilled into the part CD of the shaft. Determine the angle of twist at the end A. Take G = 7.7×10^4 MPa. [6]

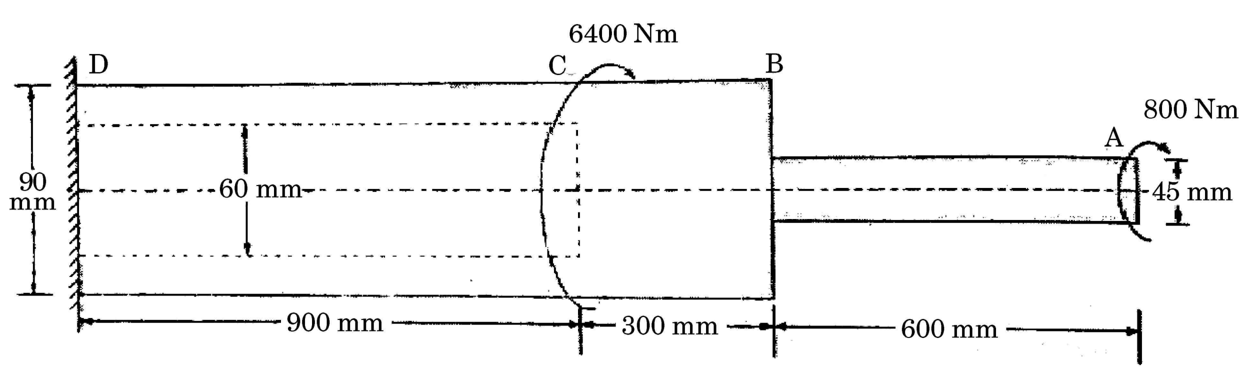

Fig. 6

(*b*) The following particulars refer to an engine cylinder,

Diameter of the cylinder = 400 mm.

Steam pressure in cylinder = 0.6 MPa.

Distance between the piston and cross head = 1.25 m. Find the diameter of the piston rod allowing a F.O.S. of 4. Assume that the piston rod is firmly fixed to the piston and the cross head. Take σ_c = 330 MPa and a = 1/7500. Use Rankine's method. [7]

7. (*a*) At a certain point on a strained material the principal stresses are 100 MPa and 40 MPa, both tensile. Find the normal, tangential and resultant stresses across a plane through the point at 48 degrees to the major principal plane, using Mohr's circle. [7]

(*b*) The stresses induced at a critical point in a machine component made of steel are σ_x = 100 MPa, σ_y = 40 MPa, T_{xy} = 80 MPa. Calculate the F.O.S. by maximum shear stress theory and maximum distortion energy theory. Assume S_{yt} = 380 MPa. [6]

Or

8. (*a*) The principal tensile stresses at a point across two mutual perpendicular planes are 80 MPa and 40 MPa. Find the normal, tangential, resultant stresses and its obliquity on a plane at 20 degrees to the major principal plane. Find also the intensity of the stress which acting alone can produce the same maximum strain. Take Poisson's ratio as 0.25. Use analytical method only. [7]

(*b*) A solid circular shaft is subjected to a bending moment of 40 kN-m and a torque of 10 kN-m. Design the diameter of the shaft according to : [6]

(*i*) Max. principal stress theory,

(*ii*) Max. shear stress theory.

Take μ = 0.25, Stress at elastic limit = 200 MPa, F.O.S. = 2.