Indian Institute of Technology, Guwahati

ME 101 – Engineering Mechanics

Mid-Semester Examination

26th February 2014

Duration: 2 hours Total Marks: 70

Class notes and books are not allowed

Q. No. 1 Derive the expression for moment of inertia with respect to x-axis for the area shown in Fig. 1 10

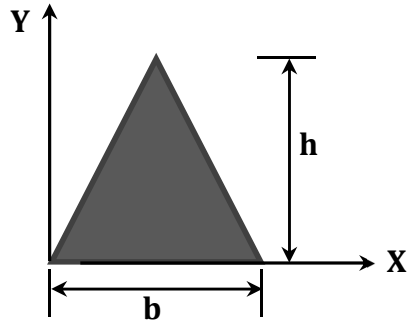


Fig. 1

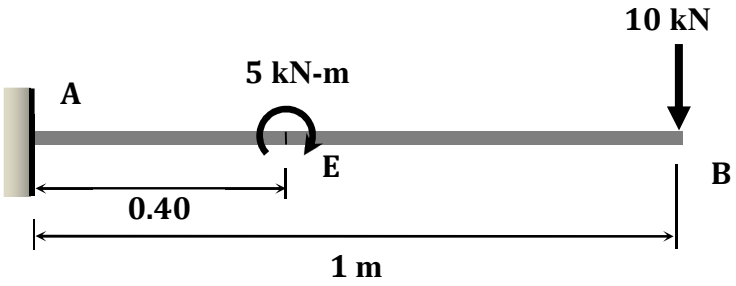


Fig. 2

Q. No. 2 Draw the shear force and bending moment diagram of the beam AB shown in Fig. 2 5+5=10

Q. No. 3 a) For the given loading, determine the zero force members in the truss shown in Fig. 3(a). 5

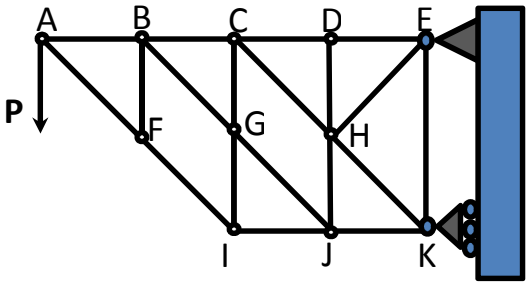


Fig. 3 (a)

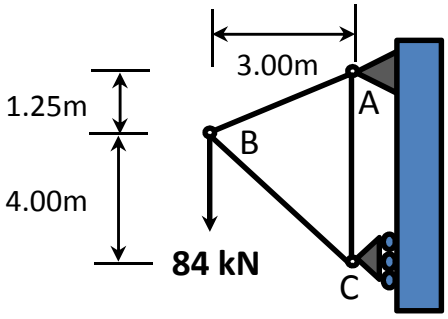
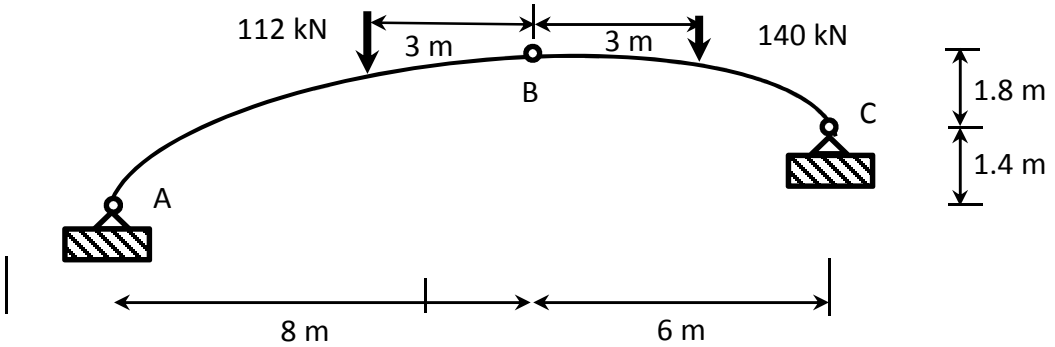


Fig. 3 (b)

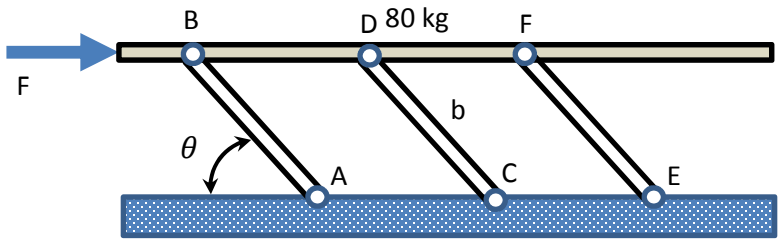
b) Determine the forces in each member of the truss shown in Fig. 3(b). State whether the members are in tension or in compression. 3+2=5

Q. No. 4 The axis of the three hinge arch (Fig. 5) is a parabola with vertex at B. For the loading shown in the Fig. (a) Draw the free body diagram AB and AC, (b) Find the components of reaction at A, (c) Find the components of the forces exerted at B on the segment AB. 3+4+3=10



Q. No. 5 It is known that for a given area $\bar{I}_y = 1.25 \times 10^{-4}$ m^4 and $\bar{I}_{xy} = -5.20 \times 10^{-5}$ m^4, where the x- and y- axes are rectangular centroidal axes. If the axis corresponding to the maximum product of inertia is obtained by rotating the x axis 67.5° counterclockwise about C, (a) Draw the Mohr's circle, (b) Determine the moment of inertia $\bar{I}_x$ of the area, and (c) the principal centroidal moments of inertia. 5+2+3=10

Q. No. 6 Consider the structure given in Fig. 6 below. (a) Find out the virtual work done by the fore F due to virtual displacement of $\delta\theta$. (b) Find out virtual work done by all the limbs (AB, CE, EF and BF) of the structure due to the virtual displacement $\delta\theta$. (c) Find out the horizontal force F necessary to maintain equilibrium of the 80 kg plate form in terms of the angle θ. Weight of the limbs AB, CD and EF is 10 kg each. 2+3+5=10



Q. No. 7 For the mechanism shown in Fig. 7, (a) make the free body diagram of the upper and lower blocks, (b) what is the normal reaction on the lower block? (c) calculate the force required to initiate motion of 24 kg block up the 10° incline plane. The coefficient of friction for each pair of surfaces is 0.30. 3+3+4=10