Indian Institute of Technology Guwahati

ME 101: Engineering Mechanics

Tutorial - 6

Q1. The position of the automobile jack shown (Fig. 1) is controlled by a screw ABC that is single-threaded at each end (right-handed thread at A, left-handed thread at C). Each thread has a pitch of 2.5 mm and a mean diameter of 10 mm. If the coefficient of static friction is 0.15, determine the magnitude of the couple moment M that must be applied to raise the automobile. **[10 marks]**

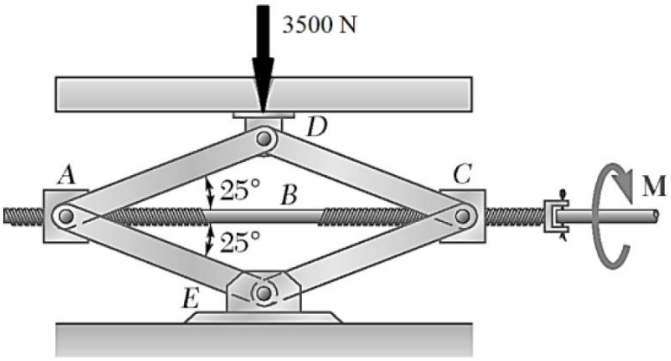

Fig. 1

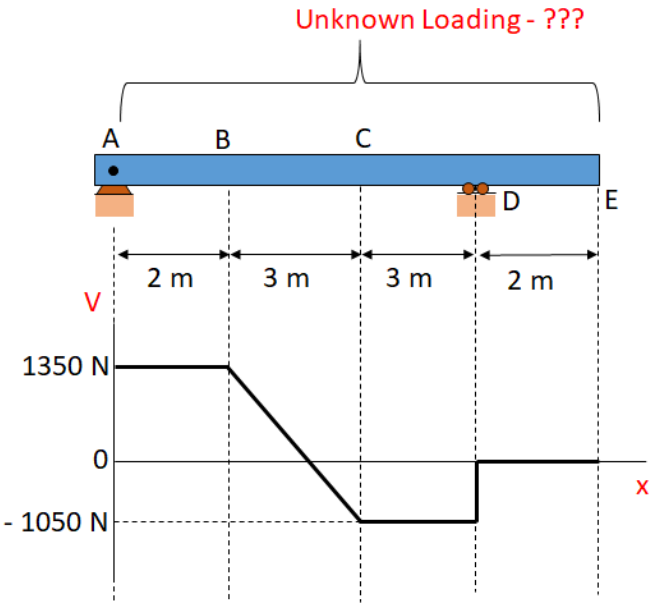

Fig. 2(b)

Q2. **(a)** For a beam under distributed loading, derive the relations between (i) load intensity and shear force (ii) shear force and bending moment. **[2 marks]**

(b) The shear-force diagram for the beam with unknown loading is shown in Fig. 2(b). Assuming that there are no couples acting on the beam and also assuming that the unknown loading is vertical, (i) Calculate the reactions at the supports (ii) draw the corresponding bending moment diagram (iii) compute the maximum bending moment and its location on the beam. **[8 marks]**

Q3. (a) In journal bearings, derived the expression for the radius of the friction circle. **[3 marks]**

(b) A scooter is to be designed to roll down a 2 percent slope (2 vertical: 100 horizontal) at a constant speed. Assuming that the coefficient of kinetic friction between the 25-mm-diameter axles and the bearings is 0.10, determine the required diameter of the wheels including the effect of a coefficient of rolling resistance of 1.75 mm between the wheels and the ground. **[7 marks]**

Q4. **(a)** Explain different types of stability and state their conditions in terms of potential energy. **[4 marks]**

(b) Using the principle of virtual work, determine the magnitude of forces P_1 to hold the frame in equilibrium under the action of force P applied on the frame as shown in Fig. 4(b), length of each link is 2a. What is P_1 for $\theta=45°$? **[6 marks]**

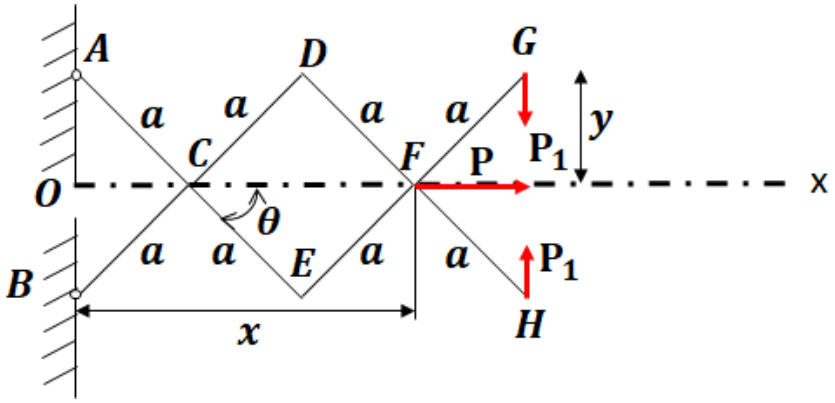

Fig. 4(b)

Q5. The frame, shown in Fig. 5 supports a 500-kg load in the manner shown in figure. Neglect the weights of the members compared with the forces induced by the load, compute the horizontal and vertical components of all forces acting on each of the Members. **[10 marks]**

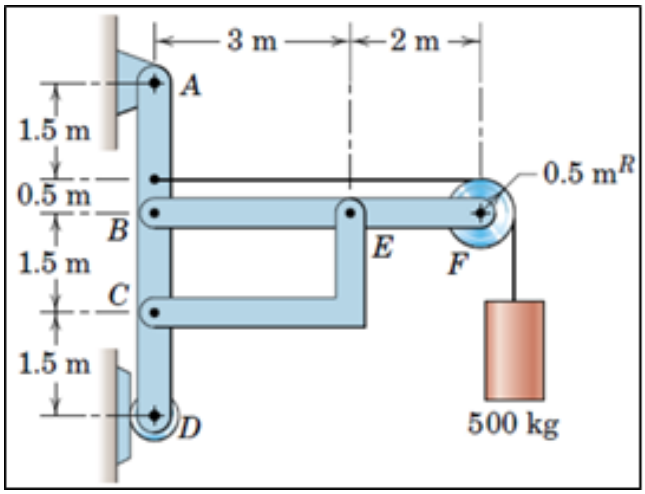

Fig. 5

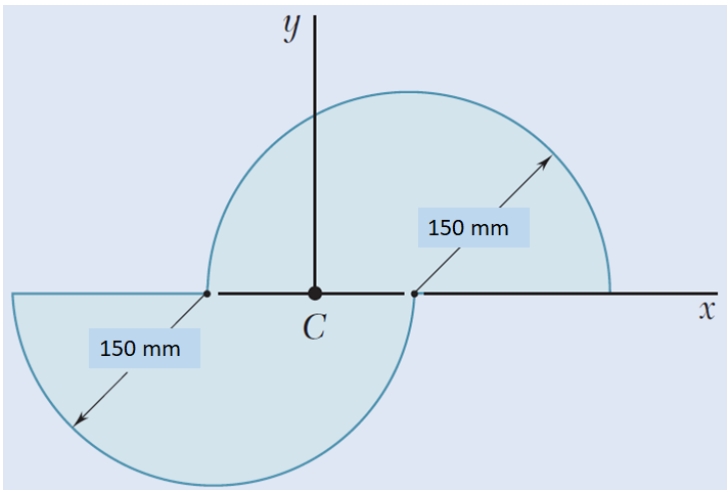

Fig. 6

Q6. For the area shown in Fig. 6, $I_x = 397.61\times10^6$ mm^4, $I_y = 795.22\times10^6$ mm^4, $I_{xy} = 337.5\times10^6$ mm^4. Using *Mohr's circle*, determine the moments of inertia and the product of inertia of the area with respect to new centroidal axes obtained by rotating the x and y axes 60^0 counter clockwise. **[10 marks]**