ME-101 Engineering Mechanics

Tutorial 4 – Virtual Work and Moment of Inertia (25-02-2020)

1. Taking the tension in cable as T=20 kN, find the load W which can be lifted with the frame hoist on a truck as shown in Fig. 1?

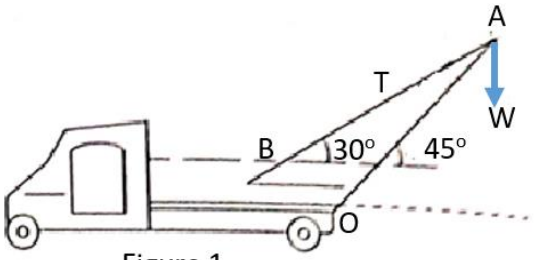

Figure 1

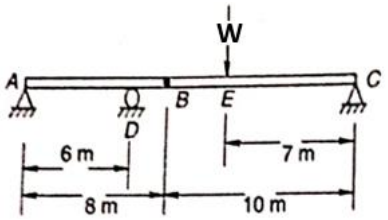

Fig. 2

2. Two beams AB and BC of length 8 m and 10 m respectively are hinged at B. These are supported on roller at D and hinged at ends A and C. A roller support is provided at D, 6 m from A as shown in Fig. 2. Using the principle of virtual work, determine the force transmitted by the hinge B and the reaction at the support D, when a load W of 1500 N acts at a point 7 m from D as shown in the Fig. 2.

3. A structure with pin joined member is shown in Fig. 3. Here, BD = 100 cm, BC = AE = 50 cm, AB = CE = 120 cm. Using the principle of virtual work, determine the ratio of P/W if angle θ = 60°. Neglect the friction at the joints and weight of the members.

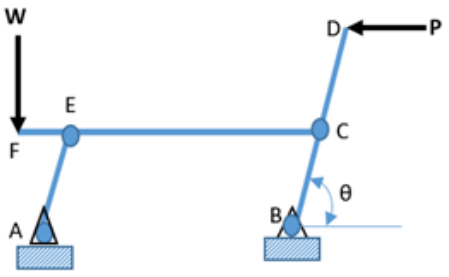

Fig. 3

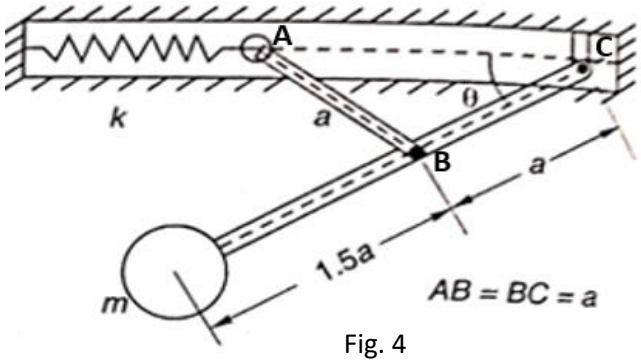

Fig. 4

4. For the device shown in Fig. 4, the spring is unstretched for θ=0°. Write the expression for potential energy of the system when the link rotate by an angle θ. Determine the stiffness ***K*** of the spring which will establish an equilibrium configuration in the virtual plane for angle θ. The mass of the link is negligible in comparison to the mass *m* at the end of the link. Take *m* = 5 kg and *a* = 0.5 m.

5. Taking I_X = 100 unit, I_y = 50 unit and I_{Xy} = - 30 unit, draw the Mohr circle to determine the principal moment of inertia. Also, determine moment of inertia and product of moment of inertia about any axis which makes 60° with the X axis. Use the instrument box to solve this problem.