Printed pages: 2 K. N. I. T., SULTANPUR

(Paper code and roll No to be filled in your answer book)

Paper code: KME-102 Roll No. 1 4 6 4 9

B. Tech.
First Semester Examination, 2014-15
Engineering Mechanics

Time: 3 Hours **Total Marks: 100**

Note: Attempt all the questions. Assume missing data, if required.

1. **Attempt any two parts of the following:** **(5x4=20)**

(a) Find the horizontal force P required to lift the load of weight 200 N. The coefficient of friction between surfaces AC and BD is 0.3 Smooth rollers are placed between wedges A and B rollers and the wedges have negligible weights. Wedge angle is 10° as shown in fig.1.

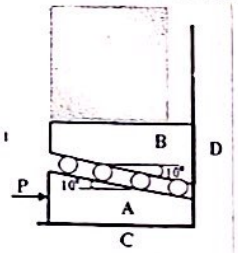
(b) Derive the relation $T_1 = T_2 e^{\mu\theta}$ in belt pulley system, where T_1 is tension on tight and slack side, μ is coefficient of friction, θ is the angle subtended at the centre by the belt.

(c) A screw jack carries a load of 600 N. It has a square thread, single start screw of 20 mm pitch and 50 mm mean diameter. The coefficient of friction between the screw and its nut is 0.30. Calculate the torque required to raise the load.

2. **Attempt any two parts of the following:** **(10x2=20)**

(a) The maximum allowable value of each of the reactions is 180 N neglecting the weight of the beam; determine the range of the distance d for which the beam is safe as shown in fig. 2.

Figure 1



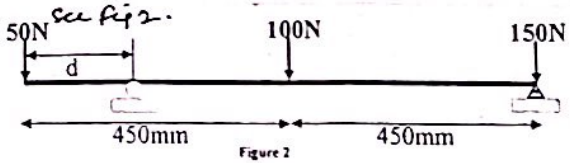


Figure 2

(b) Determine the forces in member AB, BD, DC and CA of the plane pin jointed truss as shown in fig. 3.

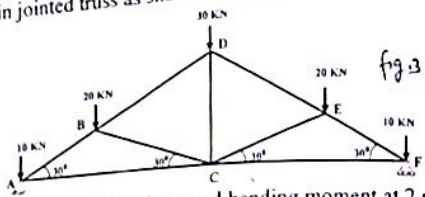
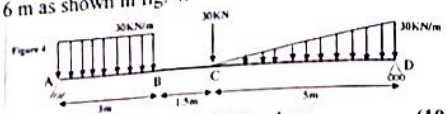


fig 3

(a) Calculate value of shear force and bending moment at 2 m, 4 m and 6 m as shown in fig. 4.

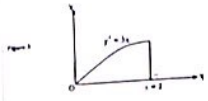


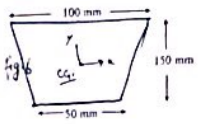
3. Attempt any two parts of the following: (10x2=20)

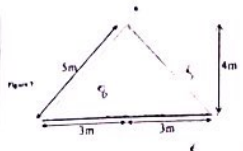
(a) Using integration find the centroid of the parabolic area OAB as shown in the fig. 5.

(b) Determine the moment of inertia and the radius of gyration about centroidal x & y axes as shown in fig. 6.

(c) A triangular metal sheet of uniform thickness 10 cm and uniform density 5000 Kg/m^3 is hinged on its base 6 m long as shown in fig. 7. Determine moment of inertia about hinge.



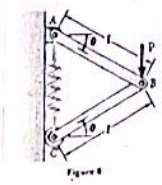


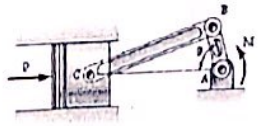


4. Attempt any two parts of the following: (10x2=20)

(a) Determine the expressions for θ for the tension in the spring which correspond to the equilibrium position of the mechanism. The unstretched length of the spring is h, and the constant of the spring is k. Neglect the weight of the mechanism. (Fig. 8)

(b) A 5-kN force P is applied as shown in fig. 9 to the piston of the engine system. Knowing that AB = 50 mm and BC = 200 mm, determine the couple M required to maintain the equilibrium of the system when (a) θ = 30°. (b) θ=150°.





(c) A load W of magnitude 500 N is applied to the linkage at B. The constant of the spring is K= 2.5 kN/m, and the spring is unstretched when AB and BC are horizontal. Neglecting the weight of the linkage and knowing that l = 300 mm, determine the value of θ corresponding to equilibrium (fig. 10).

5. Attempt any two parts of the following: (10x2=20)

(a) A shaft is accelerated uniformly from 600 rev./min to 900 rev / min in 2 seconds. It continues accelerating at this rate for a further period of 4 seconds and then continues to rate at the maximum speed attained. Make calculations for the time taken to complete the first 180 revolutions.

(b) A fighter plane flying horizontally at 2000 m height is directly over an anti-aircraft gun at time t = 0. The plane has a speed of 500 Km/hr. A shell is fired at t=0 in the attempt to hit the plane. If the muzzle velocity of the Gun is 1000 m/s, how many meters 'd' should the gun be aimed ahead of the plane, to hit it? What will be the time of impact?

(c) Two blocks having masses 2 kg and 3 kg are kept on rough horizontal plane as shown in fig., a force F (in Newton) acted on 3Kg block which vary with time.

(i) Find the time t when block starts moving.
(ii) Find acceleration velocity at t=8 second.
(iii) Find the distance travel between 0 to 10 second.

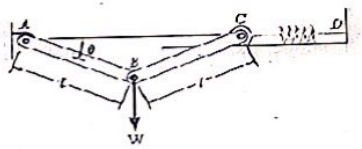


Figure 10

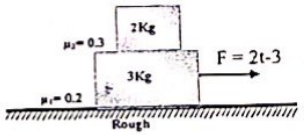


Figure 11