B.Tech. (Main & COP)
First Semester Examination, 2016-17
Engineering Mechanics

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

Note: Attempt all questions. Assume missing data suitably.

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

(a) The three forces applied to an angle bracket is shown in Fig. 1. (i) Find the resultant force and its position. (ii) Reduce the given system of forces to an equivalent force system in such a way that the resultant will pass through point B.

(b) Two smooth cylinders 'A' and 'B' each of mass 1000 kg and radius 15 cm connected at their centres by a string AB of length 40 cm and rest upon a horizontal plane as shown in Fig. 2. Above these two cylinders there is a third cylinder 'C' of mass 3000 kg and radius 15 cm. Find the tension in the string AB and reactions at the contact points on the floor.

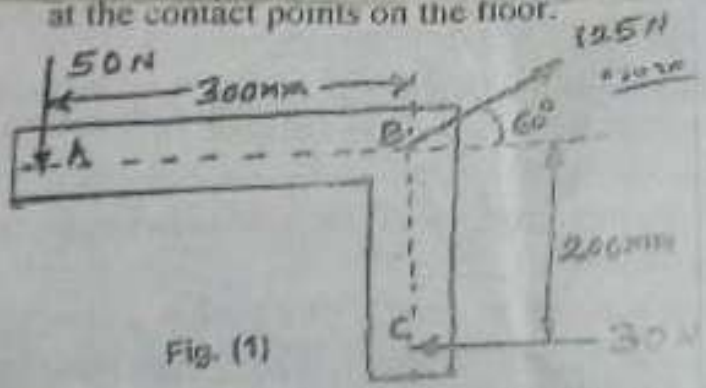

Fig. (1)

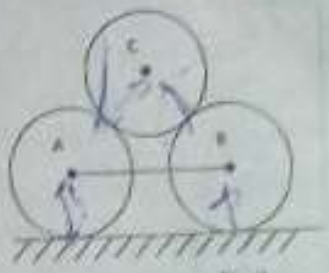

Fig. 2

(c) Determine the force 'P' required to start the wedge in downward as down in fig. 3. The angle of limiting friction for all surfaces of contact is 15^0. Neglect weight of the wedge A.

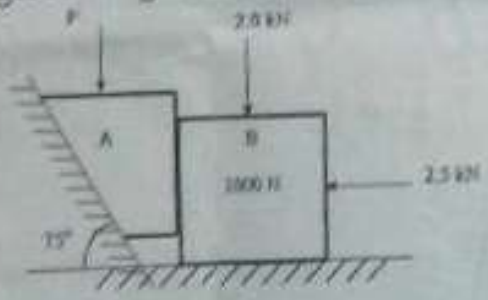

Fig. 3

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

(a) A linearly varying load is acting over entire length of a 6 m long cantilever beam. The load is varying from 0 kN/m at fixed end to w kN/m at the free end. If the shear force at the mid-point of cantilever is 45 kN, what is the value of w? Determine the bending moment at a distance of 2 m from the fixed end.

(b) For the given overhanging beam shown in Fig. 4, calculate (i) the value of maximum bending moment and its position and (ii) point of contra-flexure. All the dimensions are in meters.

(c) (i) Derive the expression between number of members and number of joints for a perfect plane truss.

(ii) For the truss shown in Fig.5, determine the force in members BC, BD and BE.

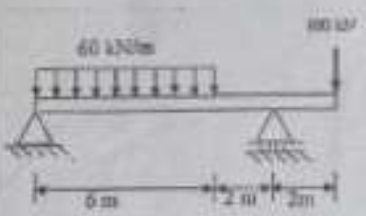

Fig. 4

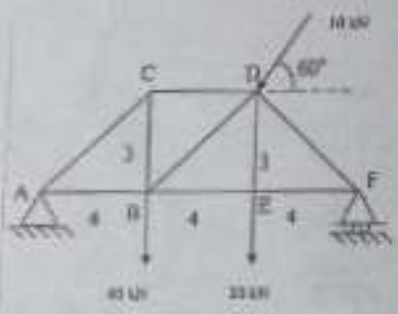

Fig. 5

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

(a) Determine the centroid of the wire ABCDEFA (Fig. 6) from point A. All the dimensions are in mm.

(b) Determine the second moment of area bounded between $y = 2x^2$, $y = 0$ and $x = 2$ about x and y axes.

(c) Determine the mass moment of inertia of a hollow cylinder of radii R_1 and R_2, mass M and length L about centroidal axis normal to the axis of the cylinder.

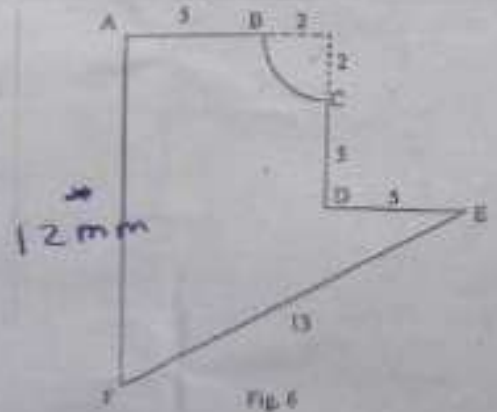

Fig. 6

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

(a) A shell is fired from a hill 200 above a place. The angle of firing is 20^0 with the horizontal and the velocity of firing is 500 m/s. At what horizontal distance will the shell hit the plane? Neglect air resistance. Determine the maximum height of the trajectory from the plane and the trajectory of the shell.

(b) A slotted member AB as shown in Fig.7 rotates about the hinge A such that $\theta = t^{3/2}$ where θ is in radians and t is in seconds. The pin slides freely in the slot according to the relationship $r = 0.5+0.1t^3$, where r is in meter. When t= 5 s, determine the position, speed and magnitude of acceleration of the pin.

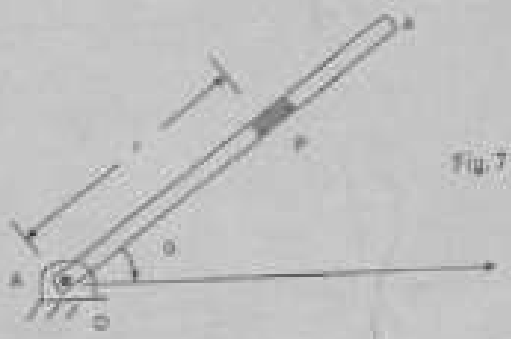

Fig.7

(c) Two bodies A (40kg) and B (25kg) are connected by a flexible cable as shown in the Fig. 8. The kinetic coefficient of friction between body A and inclined surface is 0.30 and the horizontal surface supporting body B is smooth. When the bodies are in the position shown, body B is moving to the right. Determine the tension in the cable connecting the bodies.

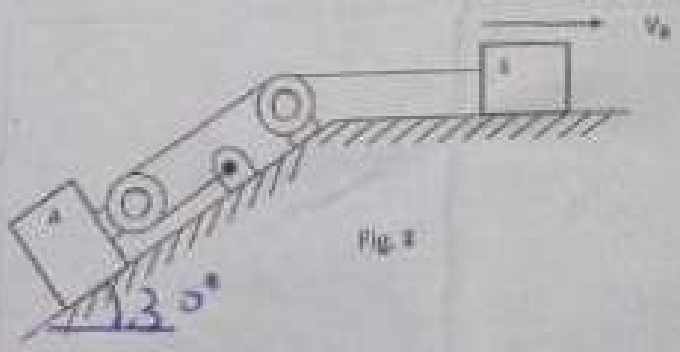

Fig. 8

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

(a) Determine the expression for θ and for the tension in the spring which correspond to equilibrium position of the spring (Fig. 9). The un-stretched length of the spring is h and spring constant is k. Neglect the weight of the mechanism.

(b) A pulley crank mechanism (Fig. 10) is used to raise 400 N weight. Using the principle of virtual work, determine the force P. Neglect the weight of the pulley.

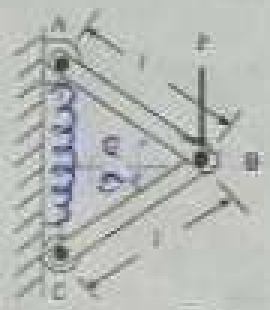

Fig. 9

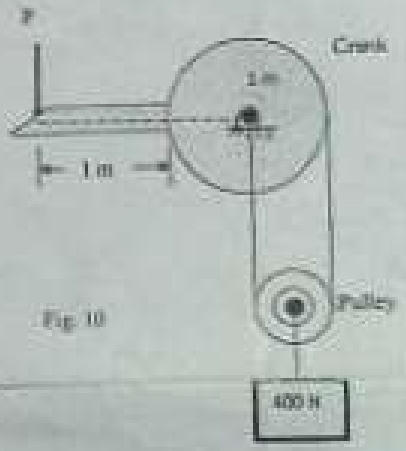

Fig. 10

(c) An overhanging beam is shown in Fig. 11. Using virtual work principle, find the reactions at both the support. All the dimensions are in m.

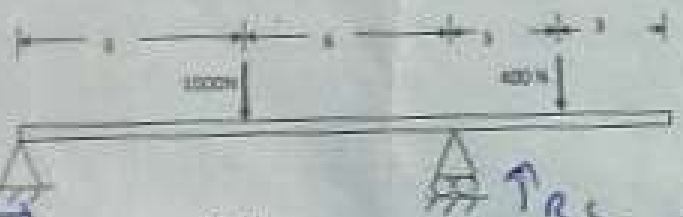

Fig. 11

R_A R_B R_C

$R_A = 460$