R18

Code No: 152AH

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech I Year II Semester Examinations, May - 2019
ENGINEERING MECHANICS
(Common to CE, ME, MCT, MMT, AE, MIE, PTM)

Time: 3 hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART- A

(25 Marks)

1.a) State varignon's theorem. [2]
b) Distinguish types of friction. [2]
c) What is product of inertia illustrate with example. [2]
d) State the principle of impulse-momentum. [2]
e) Write work energy equation for rotating bodies. [2]
f) Discuss the equations of equilibrium for coplanar system of forces. [3]
g) State and explain pappus theorem II. [3]
h) What is perpendicular axis theorem? [3]
i) Define normal and tangential accelerations of a particle. [3]
j) Explain D'Alembert's principle in plane motion. [3]

PART-B

(50 Marks)

2.a) Find the magnitude of forces F_1 and F_2 if they act at right angle, their resultant is $\sqrt{34}$ N. If they act at 60^0, their resultant is 7 N.

b) A 75 N vertical force is applied to the end of a pole 3 m long which is attached to a shaft at O as shown in figure 1. Determine:
i) The moment of the 75N force about O,
ii) The magnitude of the horizontal force applied at A which creates the same moment about O and
iii) The smallest force applied at A which creates the same moment about O,
iv) How far from the shaft at O a 200 N vertical force must act to create the same moment about O? [10]

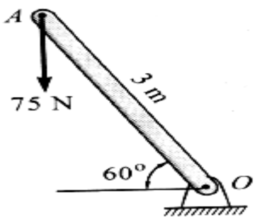

Figure: 1

OR

3.a) To move a boat uniformly along the river at a given speed, a resultant force R = 520N is required. Two men pull with force P and Q, by means of ropes, to do this. The ropes makes an angle of 30^0 and 40^0 respectively with the sides of the river as shown in figure 2. Determine the force P and Q, If $\theta_1 = 30^0$, find the value of θ_2 such that the force in the rope Q is minimum. What is the minimum force Q?

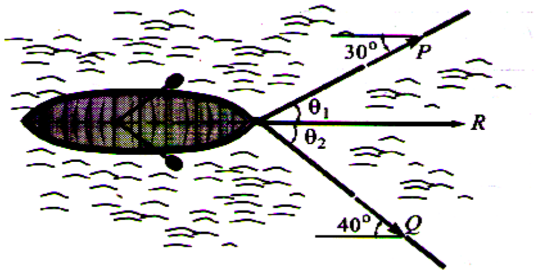

Figure: 2

b) A 30 kg collar may slide on frictionless vertical rod and is connected to a 34 kg counter weight as shown in figure 3. Find the value of h for which the system is in equilibrium. [5+5]

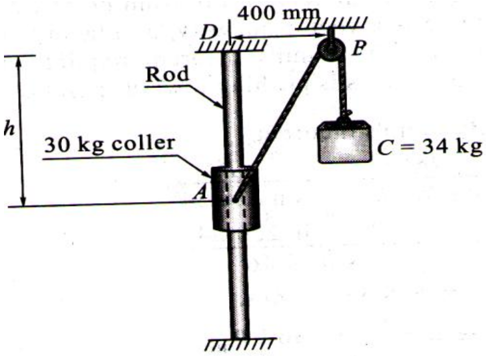

Figure: 3

4.a) Two blocks W_1 and W_2 which are connected by a horizontal bar AB are supported on rough planes as shown in figure 4. The coefficient of friction for the block A = 0.4. The angle of friction for the block B is 20^0. Find the smallest weight W_1 of the block A for which the equilibrium can exist, if W_2 = 2250 N.

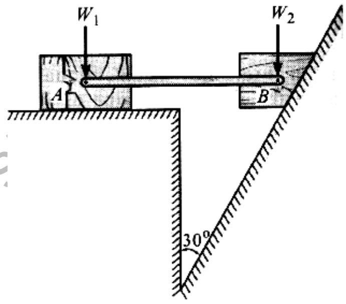

Figure: 4

b) A thin homogeneous semi circular plate of radius r is suspended from its corner A as shown in figure 5. Find the angle made by its straight edge AB with the vertical. [5+5]

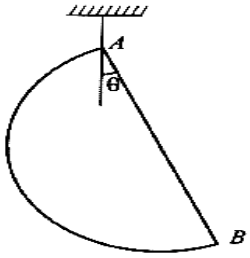

Figure: 5

OR

5.a) Two blocks W_1 and W_2 resting on two inclined planes, are connected by a horizontal bar AB as shown in figure 6. If W_1 equals 1000 N, determine the maximum value of W_2 for which the equilibrium can exist. The angle of limiting friction is 20^0 at all rubbing faces.

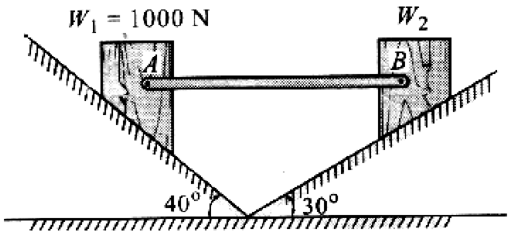

Figure: 6

b) Find the coordinates of the centroid of the area shown in figure 7. All dimensions are in mm. [5+5]

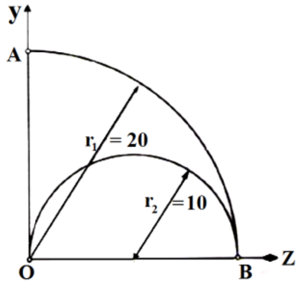

Figure: 7

6.a) Find the MI about the centroidal axis in figure 8.

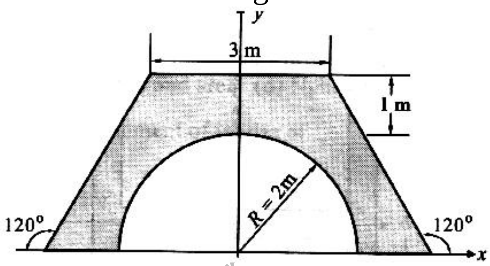

Figure: 8

b) Determine the mass moment of inertia of a circular plate of uniform thickness, about centroidal axes. [5+5]

OR

7. Find the MI about the centroidal axis and about xy axis for figure 9 shown. All dimensions are in mm. [10]

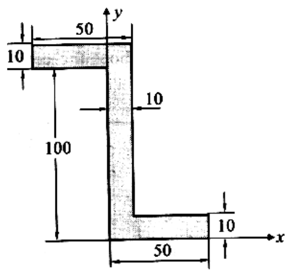

Figure: 9

8.a) A railway car is moving with a velocity of 20m/s. The diameter of the wheel is 1m. The wheel is running on a straight rail without slipping. Find the velocity of the point on the circumference at 60^0 in the clockwise direction from the top at any instant.

b) A 600mm diameter flywheel is brought uniformly from rest to a speed of 350 rpm in 20 seconds. Determine the velocity and acceleration of a point on the rim 2 seconds after starting from rest. [5+5]

OR

9.a) Find the least initial velocity with which a projectile is to be projected so that it clears a wall 4m height located at a distance of 5m, and strikes the ground at a distance 4m beyond the wall as shown in figure 10. The point of projection is at the same level as the foot of the wall.

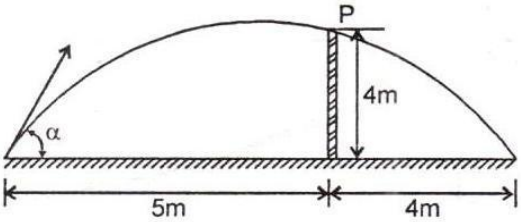

Figure: 10

b) A ball drops from the ceiling of a room and after rebounding twice from the floor reaches a height equal to one-fourth of the height of the ceiling. Show that the coefficient of restitution is 0.707. [5+5]

10.a) A body weighing 20 N is projected up a 20^0 inclined plane with a velocity of 12 m/s, coefficient of friction is 0.15. Find the maximum distance the body will move up the inclined plane.

b) Two blocks of weights P and Q are connected by a flexible but inextensible cord and supported as shown in figure 11. If the coefficient of friction between the block P and the horizontal surface is m and all other friction is negligible, find (i) the acceleration of the system and (ii) the tensile force S in the cord. The following numerical data are given: P = 54 N ; Q = 25 N; $\mu = 1/3$. [5+5]

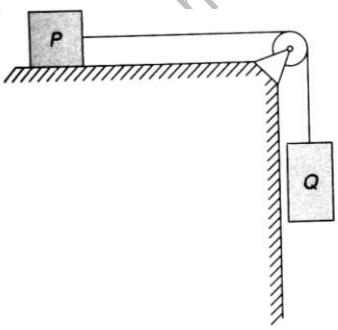

Figure: 11

OR

11. Determine the constant force P that will give the system of bodies shown in Figure 12. A velocity of 3m/sec after moving 4.5m from rest. Coefficient of friction between the blocks and the plane is 0.3. Pulleys are smooth. [10]

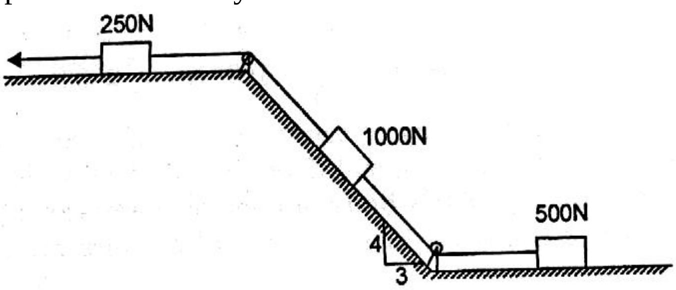

Figure: 12

---ooOoo---