

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.

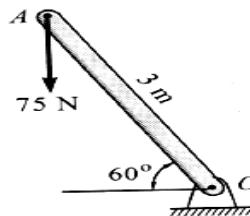
Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

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° , 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 $R = 520$ N is required. Two men pull with force P and Q, by means of ropes, to do this. The ropes makes an angle of 30° and 40° respectively with the sides of the river as shown in figure 2. Determine the force P and Q, If $\theta_1 = 30^\circ$, find the value of θ_2 such that the force in the rope Q is minimum. What is the minimum force Q?

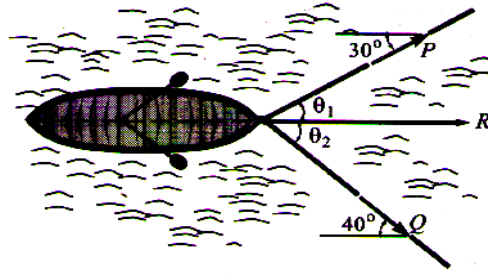


Figure: 2

- 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]

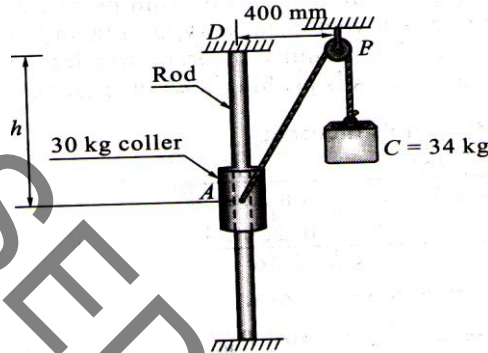


Figure: 3

- 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° . Find the smallest weight W_1 of the block A for which the equilibrium can exist, if $W_2 = 2250$ N.

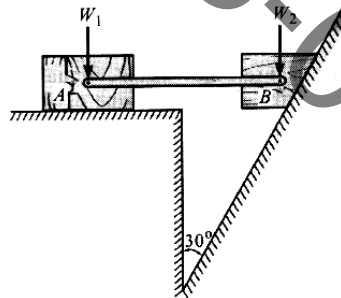


Figure: 4

- 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]

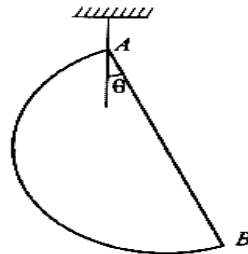


Figure: 5

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° at all rubbing faces.

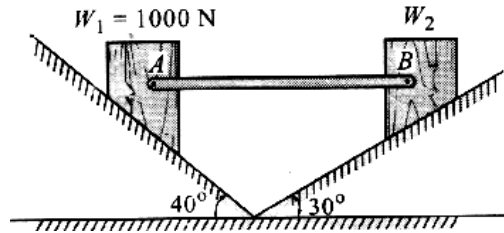


Figure: 6

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

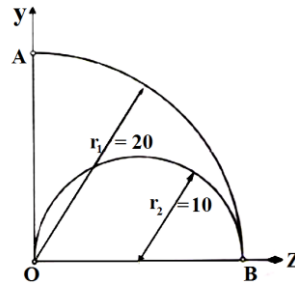


Figure: 7

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

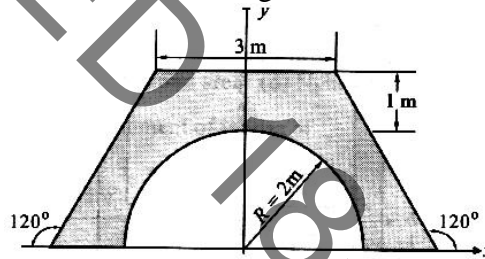


Figure: 8

- 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]

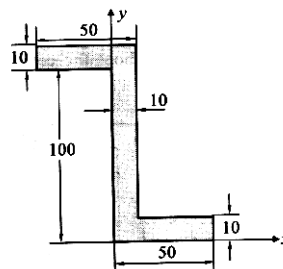


Figure: 9

- 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° 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.

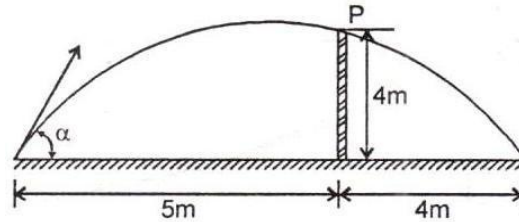


Figure: 10

- 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° 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 μ 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]

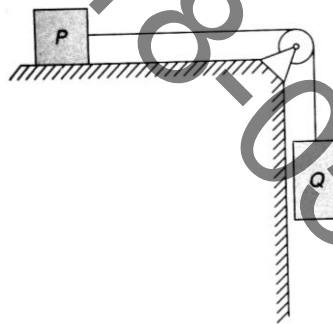


Figure: 11
OR

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]

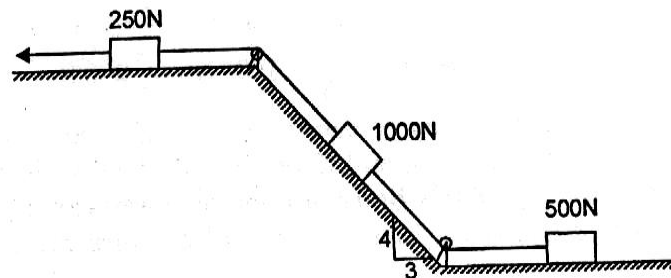


Figure: 12