

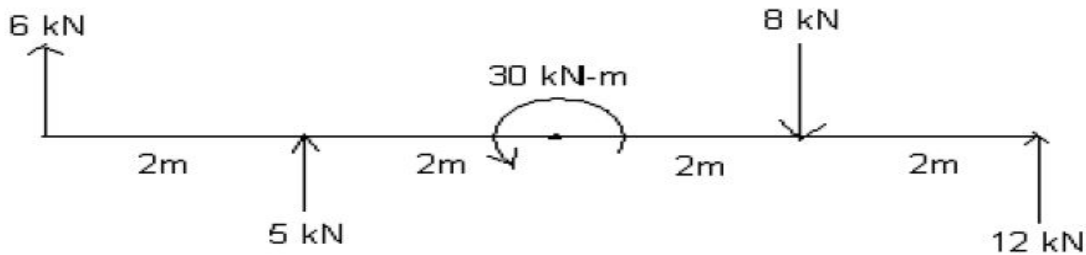
**MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY**  
**(Autonomous Institution – UGC, Govt. of India)**  
**UG Model question paper**  
**Engineering Mechanics**

**Time: 3 hours**

**Max Marks: 70**

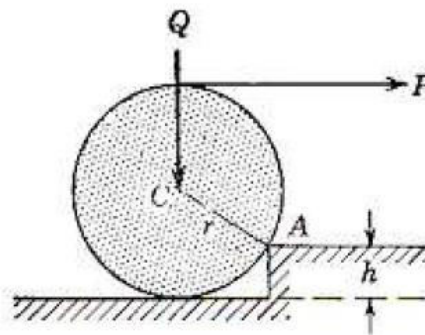
**Note:** This question paper contains of 5 sections. Answer five questions, choosing one question from each section and each question carries 14 marks.

- 1 a) How will you resolve a given force into a force and a couple?
- b) Three forces of magnitude 200 N, 500 N and 400 N are acting at the origin  $O(0,0,0)$  and are directed from the points  $A(2,1,6)$ ,  $B(4,-2,-5)$  and  $C(-6,-4,-4)$  respectively to the origin. Determine the magnitude of the resultant.
- c) Determine and locate the resultant  $R$  of the forces and one couple acting on the beam as shown in figure



**OR**

- 2 a) Define the following: i) Rigid body  
ii) Free body Diagram
  - b) A roller of radius  $r = 0.3$  m and weight  $Q = 2000$  N is to be pulled over a curb of height  $h = 0.15$  m by a horizontal force  $P$  applied to the end of a string wound around the circumference of the roller. Find the magnitude of  $P$  required to start the roller over the curb. [3 M]
- {As shown in the Figure }



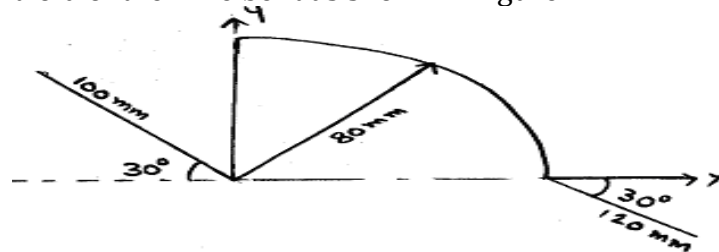
- 3 a) A block weighing 50 N is resting on a horizontal plane. A horizontal force of 10 N is applied to start the sliding of the block. Find
  - i. coefficient of friction
  - ii. angle of friction
  - iii. resultant force.

- b) A square thread screw of a hand press has a mean diameter of 40 mm and pitch 5 mm. The diameter of the wheel turning the screw is 1.2 m. If a horizontal effort of 200N is applied to the wheel, find the force exerted by the press on a cotton bale being compressed. Coefficient of friction is 0.1. Is the press self locking
- c) Find the force that should be applied upward at an angle  $30^\circ$  to the horizontal on the block of weight 100 N to cause impending sliding on a surface, the coefficient of friction between the surfaces being 0.3.

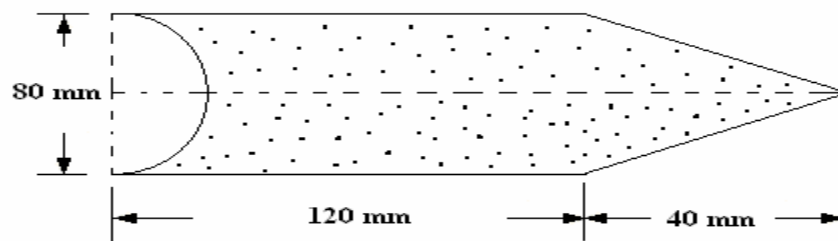
OR

- 4 a) Explain about Screw jack? Differentiate between Screw Jack and Differential screw Jack?
- b) Find the maximum power transmitted and initial tension in a flat belt 8 mm thick and 100 mm wide. The belt transmits power between two pulleys running at 31.67 m/s. The angle of lap of smaller pulley is  $165^\circ$  and the coefficient of friction between the belt and pulley is 0.3. Mass of the belt is 0.9 kg per m length, and the maximum permissible stress in the belt is  $2 \text{ MN/m}^2$
- c) A square threaded screw jack has a pitch of 1 cm and a mean diameter of 7.5 cm. The mean diameter of the bearing surface between the cap and the screw is 9 cm. The coefficient of friction between all surfaces is 0.10. What force is required at the end of a lever 90 cm long to raise a load of 40 kN?

- 5 a) Locate the centroid of the wire bent as shown in figure



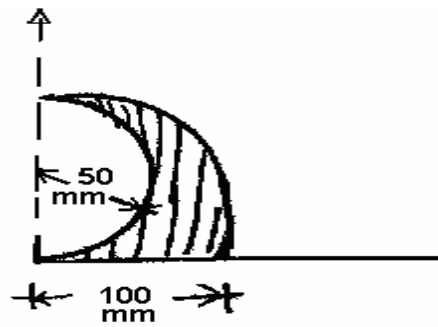
- b) Find the Centroid for the shaded area about y - axis. As shown in the Figure



- c) State and prove Pappus theorem[3]

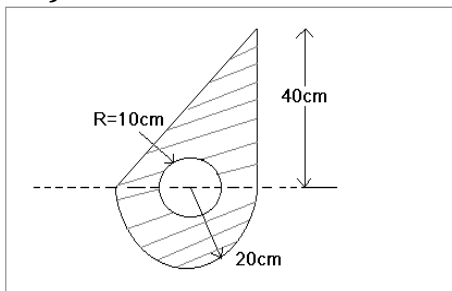
Or

- 6 a) Locate the centroid of the shaded area shown in figure



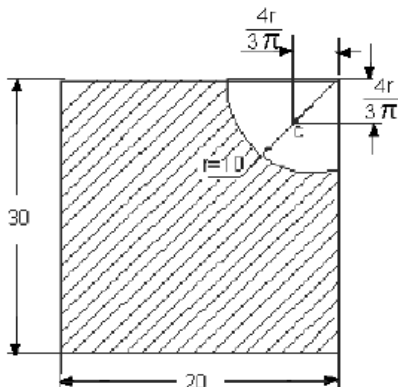
- b) Find the centroid of Quarter circle having the radius  $R$   
 c) Determine the centre of gravity of solid cone of base Radius ' $R$ ' and height ' $h$ '

- 7 a) From first principles deduce an expression to determine the Moment of Inertia of a triangle of base ' $b$ ' and height ' $h$ '.  
 b) Find the moment of inertia about the horizontal centroidal axis.



- c) Determine the mass moment of inertia of sphere about its diametrical axis

- 8 a) Determine moment of inertia of a quarter circle having the radius ' $r$ '  
 b) Locate the centroid and calculate moment of inertia about horizontal and vertical axis through the centroid as shown in figure  
 c) Find the Moment of inertia of the shaded area shown in figure about Centroidal X and Y axis. All dimensions are in cm.

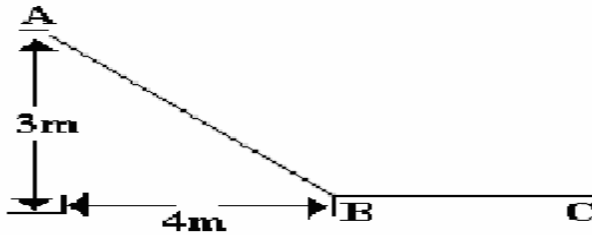


- 9 a) Derive the Expression for the Equations of motion of the body when it is accelerated uniformly.

- b) A particle under a constant deceleration is moving in a straight line and cover a distance of 20 m in first 2 seconds and 40 m in next 5 seconds. Calculate the distance it covers in the subsequent 3 seconds and the total distance covered before it comes to rest?
- c) State and Explain D'Alemberts principle

**OR**

- 10 a) The motion of a particle in a rectilinear motion is defined by the relation  $s=2t^3-9t^2+12t-10$  Where s is metres and t in seconds
- Find the acceleration of the particle when velocity is zero
  - the position and total distance travelled when the acceleration is zero
- b) With an initial velocity of 126 m/s, a bullet is fired upwards at an angle of elevation of  $35^\circ$  from a point on a hill and strikes the target which is 100 m lower than the point of projection. Neglecting the air resistance calculate
- The maximum to which it will rise above the horizontal plane from which it is projected
  - Velocity with which it will strike the target [4M]
- c) A block starts from rest from 'A'. If the coefficient of friction between all surfaces of contact is 0.3, find the distance at which the block stop on the horizontal plane. Assume the magnitude of velocity at the end of slope is same as that at the beginning of the horizontal plane [4M]



**MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY**  
**(Autonomous Institution – UGC, Govt. of India)**  
**UG Model question paper**  
**Engineering Mechanics**

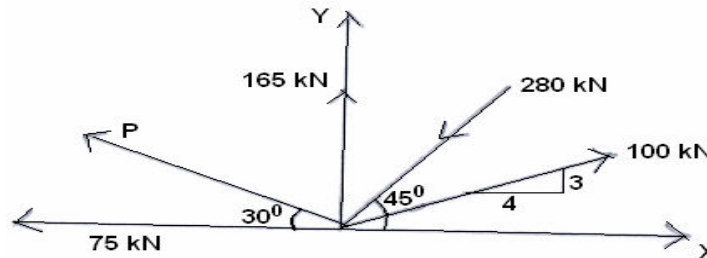
**Time: 3 hours**

**Max Marks: 70**

**Note:** This question paper contains of 5 sections. Answer five questions, choosing one question from each section and each question carries 14 marks.

**SECTION-I**

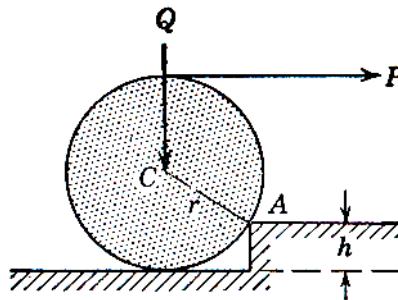
- 1 a) State and prove Varignon's theorem. [5M]  
 b) Calculate the magnitude of "P" and the resultant of the force system shown in figure. The algebraic sum of horizontal components of all these forces is -325 kN. [5 M]



- c) Three forces of magnitude 200 N, 500 N and 400 N are acting at the origin  $O(0,0,0)$  and are directed from the points  $A(2,1,6)$ ,  $B(4,-2,-5)$  and  $C(-6,-4,-4)$  respectively to the origin. Determine the magnitude of the resultant. [4 M]

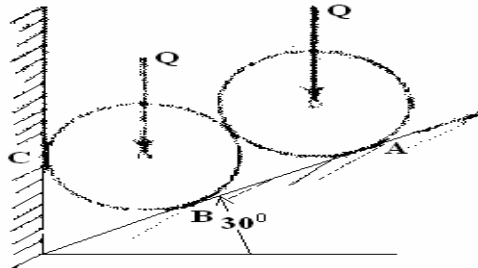
**OR**

- 2 a) What is a Force and write the characteristics of a force [2 M]  
 b) State and prove parallel axis theorem [5 M]  
 c) A roller of radius  $r = 0.3$  m. and weight  $Q = 2000$  N is to be pulled over a curb of height  $h = 0.15$  m. by a horizontal force  $P$  applied to the end of a string wound around the circumference of the roller (Ref. Figure 1). Find the magnitude of  $P$  required to start the roller over the curb [7 M]

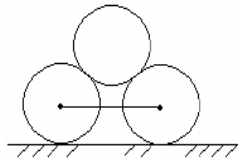


**SECTION-II**

- 3 a) Two identical rollers, each of weight 100 N, are supported by an inclined plane and a vertical wall as shown in Figure. Assuming smooth surfaces, find the reactions induced at the points of support A, B and C. [5 M]



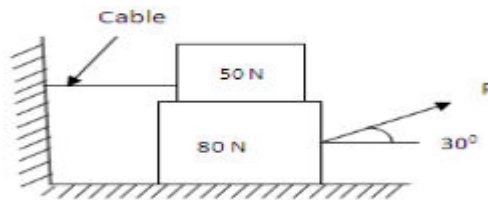
- b) Two smooth cylinders of 3 m diameter and 100 N weight are separated by a chord of 4m long. They support another smooth cylinder of diameter 3m and 200N weight as shown in figure. Find the tension in the chord. [7 M]



- c) Define the following i) Equilibrium ii) Free body diagram with examples [2 M]

**OR**

- 4 a) State laws of Friction [2 M]  
 b) Explain the principles of operation of a screw-jack with a neat sketch. [4 M]  
 c) Two blocks weighing 50N and 80N respectively are in equilibrium in the position shown in fig. Calculate the force P required to move the lower block, and tension in the cable. Take coefficient of friction at all contact surfaces to be 0.3 [8 M]

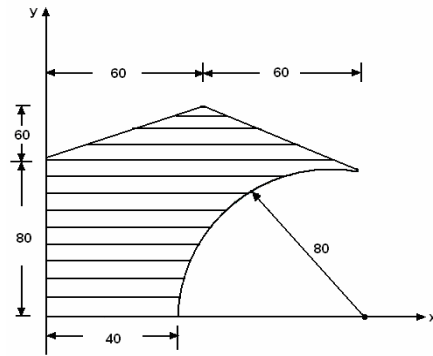


**SECTION-III**

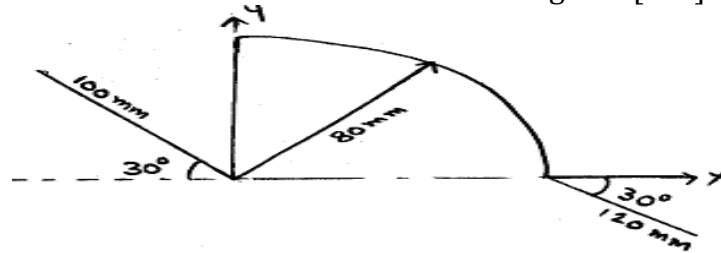
- 5 a) Write the difference between centroid and centre of gravity [2 M]  
 b) Determine the Centroid of a parabolic spandrel  $y=kx^n$  [7 M]  
 c) State Theorems of pappus [5 M]

**OR**

- 6 a) Find the coordinates of the centroid of the shaded area shown in figure [6 M]



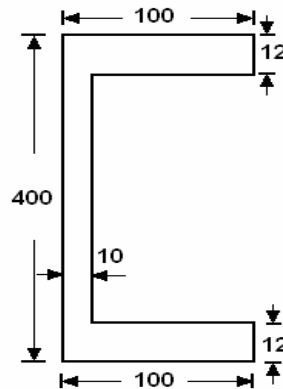
b) Locate the centroid of the wire bent as shown in figure [3 M]



c) Find the centroid of Quarter circle having the radius R [5 M]

#### SECTION-IV

7 a) Compute the moment of inertia of the channel section shown in figure about centroidal x, y axes [8M]



b) Derive expression for moment of inertia for a triangle about its base and centroidal axis [6M]

OR

8 a) Derive the expression for the transfer formula for mass moments of inertia [6M]

b) Derive the expression for the mass moment of inertia of a hemisphere [6M]

c) Define product of inertia and how the product of inertia is zero about its axis of symmetry

[2 M]

#### SECTION-V

9 a) Derive the equations of motions when the body is moving with uniform acceleration [5 M]

b) A ball is thrown vertically upwards with an initial velocity of 36 m/s. After 2 seconds, another ball is thrown vertically upwards. What should be its initial velocity so that it crosses the first ball at a height of 30 m? [6M]

c) Distinguish between kinetics and kinematics

[3M]

OR

10 a) What is D'Alembert's principle [4 MARKS]

b) Blocks A and B weighing 500 N and 1500 N respectively are connected by a weightless rope passing over a frictionless pulley as shown in the figure. The coefficient of friction is 0.3 on all contact surfaces. Determine:

i) Tension in the rope.

ii) Velocity of the system 5 sec after starting from rest.

[10M]

