Code No: 152AH **R18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech I Year II Semester Examinations, February - 2025

ENGINEERING MECHANICS

(Common to CE, ME, MCT, MMT, AE, MIE)

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

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

1.a)	Classify the force systems with examples.	[2]
b)	The maximum resultant of two forces P and Q is 1000 N and minimum magnitude is 400 N. Find values of P and Q.	[3]
c)	Define centre of gravity and centroid.	[2]
d)	Distinguish between static and kinetic friction.	[3]
e)	What is radius of gyration? What is its significance?	[2]
f)	Enumerate the applications of mass moment of inertia.	[3]
g)	An automobile accelerates uniformly from rest to 90 km/h in 25 s. Find its constant acceleration and its displacement during this time.	[2]
h)	What are the various forms of mechanical energies? Define them along with their mathematical expressions.	[3]
i)	Define instantaneous centre and state some examples.	[2]
j)	State and explain D'Alembert's principle.	[3]

PART - B

(50 Marks)

2.a)	State the general algebraic conditions of equilibrium for (i) concurrent and coplanar forces and (ii) concurrent and non-coplanar forces.	
b)	A force acts at the origin. The rectangular components of the force along the three coordinate axes are 75 N, 30 N, and -70 N. Determine the moment of the force P about a line through the points (1, 0, -1) and (4, 4, -1). Coordinates are in meters.	[5+5]

OR

3.	Three cylinders, each of diameter 300 mm and weight 500 N are stacked as shown in figure 1. Determine reactions exerted on cylinders by the inclined surfaces.	[10]

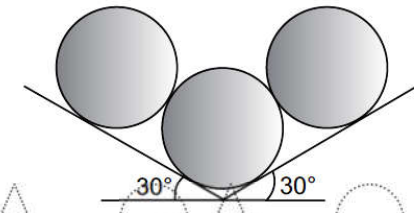

Figure 1

4.a) Locate the centroid of the area shown in figure 2 with respect to co-ordinate axes. All dimensions are in mm.

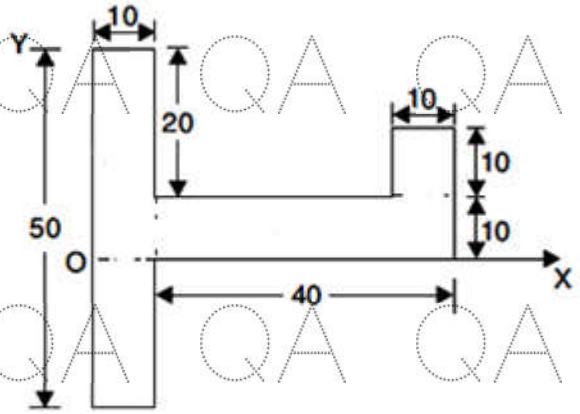

Figure 2

b) Starting from the first principles, derive the expression for centroid of area of circular sector with an included angle of 2θ. [5+5]

OR

5. A block of 1000 N is rest on horizontal surface as shown in figure 3. Neglecting the weight of the wedge determine the force 'P' required to produce impending motion of the block. Assume coefficient of static friction at all contact surfaces as 0.3. [10]

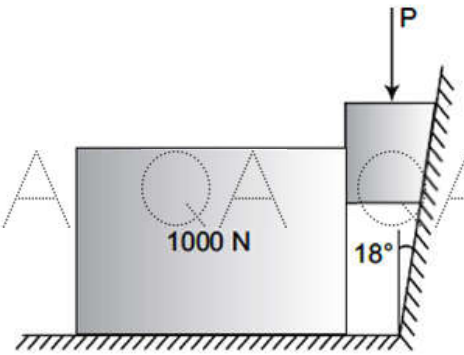

Figure 3

6. A right angled triangular lamina is defined by the base 'B' and height 'H' along the X-axis and Y-axis respectively. Determine the moment of inertia of the right triangle with respect to the X and Y axes using direct integration. Also deduce moment of inertia of the right triangle with respect to centroidal axes parallel to the X and Y axes. [10]

OR

7.a) A circular steel plate with a radius of 500 mm has a density of 8000 kg/m^3. Determine its mass moment of inertia about an axis perpendicular to the plate and passing through the center of the circular plate.

b) State and prove transfer formula for product of inertia. [6+4]

8.a) The 100-mm-diameter pulley on a generator is being turned by a belt moving at 20 m/s and accelerating at 6 m/s^2. A fan with an outside diameter of 150 mm is attached to the pulley shaft. What are the linear velocity and acceleration of the tip of the fan?

b) The racing car traveling at 90 km/h enters the semicircular curve of radius 100 m and leaves the curve at 144 km/h. Find acceleration of the car if the speed increases at a uniform rate. [6+4]

OR

9.a) An elevator weighing 6 tons together with the passengers descends with a speed of 4m/s. If the tension in the cable must not exceed 50kN, what is the shortest distance in which the elevator can be stopped?

b) Determine the kinetic energy of a 10 cm diameter solid cylinder with a mass of 10 kg rolling without slip on a horizontal surface. The velocity of its center is 10 m/s. [6+4]

10. In a cylindrical roller and belt system, two belts run in opposite direction as shown in figure 4. Determine the linear and angular velocity of roller. If lower belt RS also runs with same uniform speed of 6 m/sec in the opposite direction then determine the linear and angular velocity of roller. Use instantaneous center method. [10]

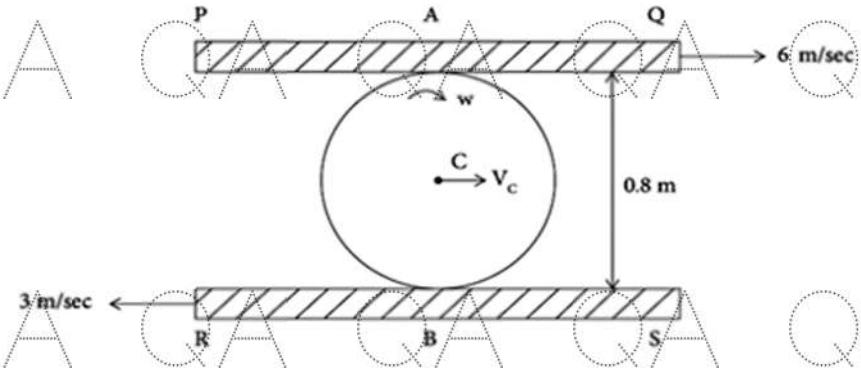

Figure 4

OR

11. Two weights, each of 20 N, are suspended from a two-step pulley as shown in figure 5. Find the accelerations of weight A and B. The weight of pulley is 200 N and its radius of gyration is 200 mm. Determine tension in strings also. [10]

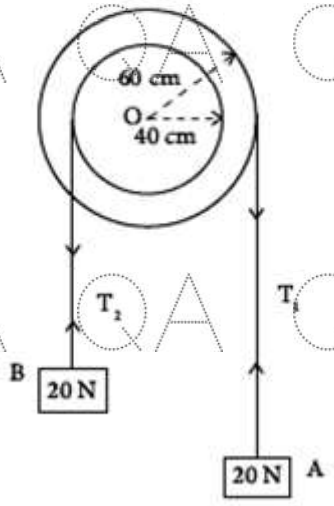

Figure 5

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