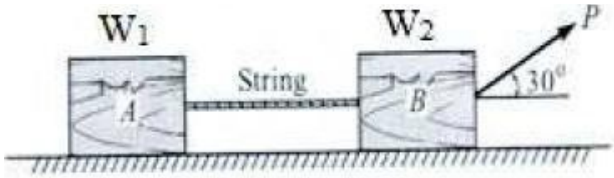
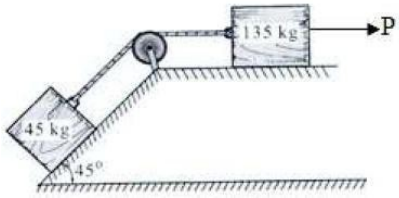
MECHANICS QUESTION BANK

Branch: **CSE (A B)**

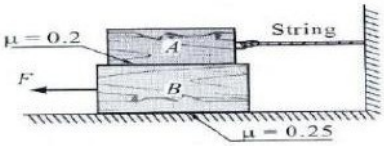
1. a) Two forces of magnitude 50 N and 30 N are acting at a point. If the angle between the two forces is 600, determine the magnitude and direction of the resultant force. (5M)
   b) In the Figure 1, the two blocks (A=30 N and B=50 N) are placed on rough horizontal plane. Coefficient of friction between the block A and the plane is 0.3 and that between B and plane is 0.2. Find the minimum value of the force P to just move the system. Also find the tension in the string.



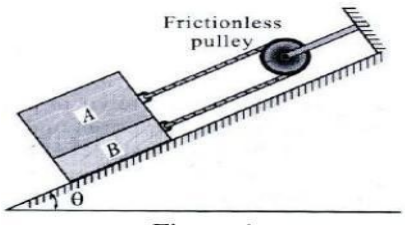
2. a) Two forces of 80N and 70N act simultaneously at a point. Find the resultant force, if the angle between them is 150^0. (5M)
   b) Determine the necessary force P acting parallel to the plane to cause motion to impend as shown in the Figure 1. Assume coefficient of friction as 0.25 and the pulley to be smooth. (5M)



3. a) Three collinear horizontal forces of magnitude 150N, 450N and 300N are acting on a rigid body. Determine the resultant of forces when (i) all the forces are acting in the same direction; (ii) the force of 300N act in the same direction. (5M)
   b) In the given Figure 1, weights of two blocks A and B are 100N and 150 N respectively. Find the smallest value of the horizontal force F to just move the lower block B if (i) the block is restrained by a string; (ii) When the string is removed. (5M)



4. a) The resultant of two concurrent forces is 2500N and the angle between the forces is 900. The resultant makes an angle of 460 with one of the forces. Find the magnitude of each force. (5M)
   b) Block A has a mass of 20 kg and block B has a mass of 10 kg in the Figure. Knowing that μs=0.15 between all surfaces of contact, determine the value of for which for which motion will impend. Take acceleration due to gravity = 10 m/s2. (5M)



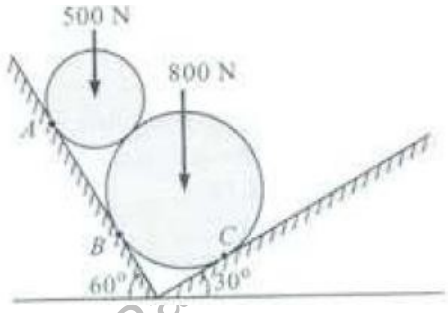
5. a) Define the terms: (i) Friction; (ii) Coefficient of friction. (iii) Coulomb Friction; (iv) Angle of friction. (v) Angle of repose. (5M)

b) Forces P_1,P_2,P_3,P_4 of magnitudes 10KN, 20KN, 25KN and 40 KN are concurrent in space and are directed through the points A(3,2,5), B(1,7,4), C(4,-2,4) and D(-2,4,-3) respectively. Determine the resultant of system of forces. Given the system of forces are concurrent at origin. (5M)

UNIT-2

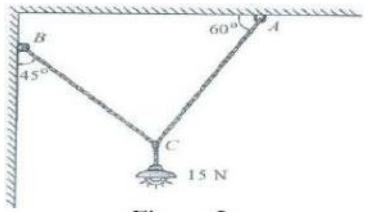
1. a) A force has the components Fx=100N; Fy=65N; Fz=-80N. Find the magnitude of the force and the anglesθ_x θ_y and θ_z from the axes X, Y and Z respectively. (5M)

b) Two smooth cylinders with diameters 250 mm and 400 mm respectively are kept in a groove with slanting surfaces making angles 600 and 300 as shown in the Figure. Determine the reactions at contact points A, B and C. (5M)



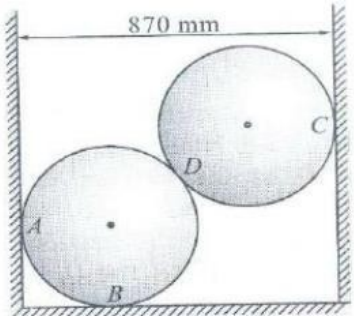
2. a) The force acts at the origin in a direction defined by the angles θ_y =600 and θ_z =350. Knowing that the X-component of force is -80 kN, determine (i) the other components and magnitude of forces; (ii) the value of θ_x (5M)

b) An electrical light weighing 15N hangs from a point C by the two strings AC and BC as shown in the Figure. AC is inclined at 600 to the horizontal and BC at 450 to the vertical. Using Lami"s theorem, find the forces in the strings AC and BC. (5M)

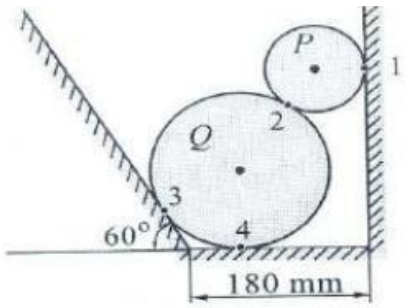


3. a) The x, y and z components of a force are 30 kN, -25kN and 20 kN respectively. Find the component of this force along the line joining A(2,3,-4) and B(-2,-3,3).(3M)

b) Two smooth spheres of weight 100N and radius 250 mm each are in equilibrium each are in equilibrium in a horizontal channel of width 870 mm as shown in the Figure. Find the reactions at the surfaces of contact A, B, C, D assuming all surfaces to be smooth.

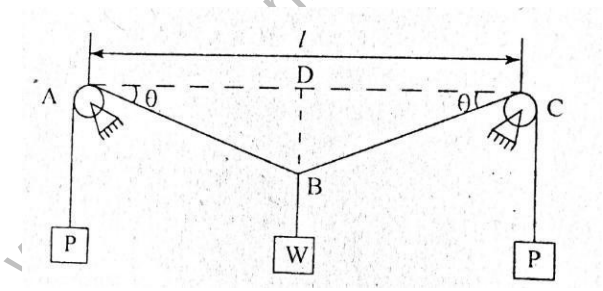


4. a) A force of 450N forms angles of 450, 1200 and 600 with X, Y and Z axes respectively. Find the components Fx, Fy and Fz of the force. (3M)
b) Two cylinders P and Q in a channel are as shown in the Figure 2. The cylinder P has a diameter of 100 mm and weight 200 N and Q has 180 mm and 500 N. Determine the reaction at all contact surfaces.



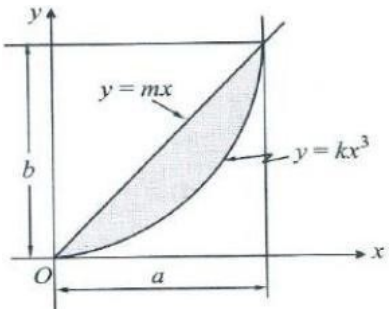
5. a) i)State Lami"s theorem. ii) What do you understand by a "Free Body Diagram"? How free body diagram is constructed? [4M]

b) A weight of W is suspended from a point B of a cable ABC. The ends of the cable are pulled by equal weights P overhanging small pulleys A and C. which are on the same level. Neglecting the redii of the pulleys. Determine the sag BD if l = 3m, P = 80N, W = 40N.



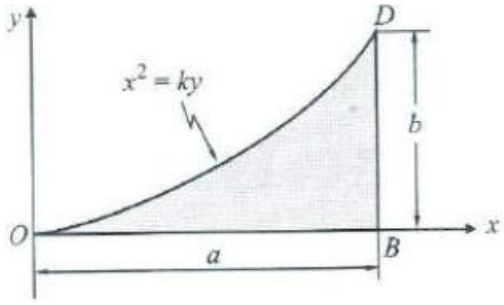
UNIT-3

1. a) Determine an expression for the center of gravity of a right circular solid cone about is base from first principles.
b) Find the center of gravity of the shaded area as shown in the Figure.

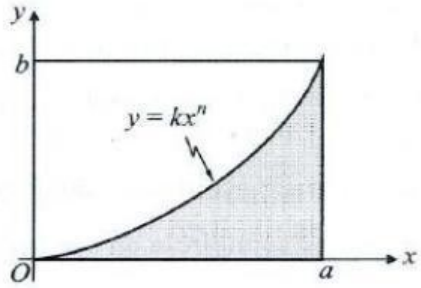


2. a) Determine the centroid of the semi-circle whose radius is R. (M)

b) Determine the position of the center of gravity of the shaded area OBD as shown in the Figure. The curve OD is parabolic.

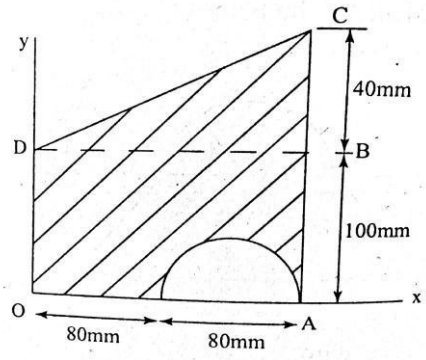


3. a) Deduce an expression to determine the centroid of a triangle of base „b" and height „h". (5M)
b) Find the center of gravity of the shaded area under the curve as shown in Figure (5M)



4. a) State parallel axis theorem and perpendicular axis theorem (3 M)

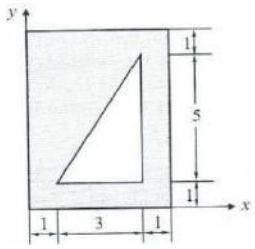
b) A semicircle is removed from the trapezoid as shown. Determine the centroid of the remaining area [7M]



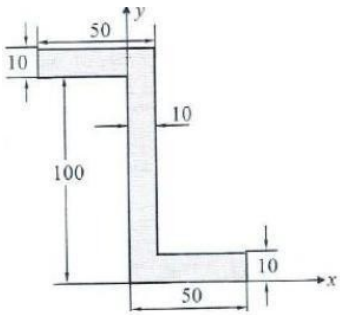
5. a) State and prove Pappus Thorem – I
b) State and prove Second theorem of Pappus

UNIT -4

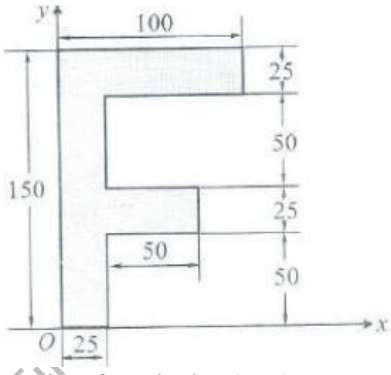
1. a) Derive an equation for moment of inertia of a Quarter circle. (5M)
b) Find the Moment of Inertia about the centroidal axis in the given Figure. (5M)



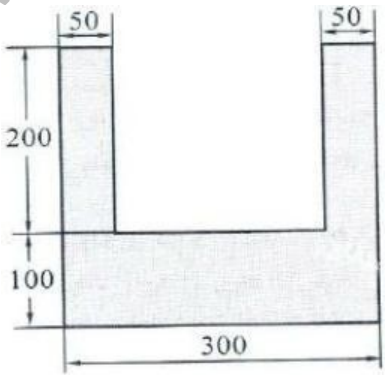
2. a) Describe the method of finding Moment of Inertia of composite areas. (5M)
b) Find the Moment of Inertia about the centroidal axis in the given Figure (5M)



3. a) Derive an equation for moment of inertia of a Rectangle. (5M)
b) Find the Moment of Inertia of the centroidal axis as shown in the Figure



4. a) Derive an equation for moment of inertia of a Circle. (5M)
b) Calculate the Moment of Inertia about the centroidal x and y for the section shown in the Figure (5M)



5. a. What is polar moment of inertia? [3]
b. Derive the Mass Moment of inertia of a rectangular plate [7]

UNIT-5

1. a) A wheel has an initial clock wise angular velocity of 8 rad/s and a constant angular acceleration of 2 rad/s2. Determine the number of revolutions the wheel must undergo to acquire a clockwise angular velocity of 15 rad/s. What is the time required? (5M)
   b) Two trains P and Q leave the same station on parallel lines. Train P starts at rest with uniform acceleration of 0.2 rad/s2 attains a speed of 10 m/s. Further the speed is kept constant. Train Q leaves 30 seconds later with uniform acceleration of 0.5 m/s2from rest and attains a maximum speed of 20 m/s, when will train Q overtake train P. (5M)
2. a) A wheel accelerates uniformly from rest to a speed of 200 rpm in ½ sec. It then rotates at that speed for 2 sec before decelerating to rest in 1/3 sec. How many revolutions does it make during the entire time interval? (5M)
   b) Two trains R and S start from rest simultaneously from stations A and B facing each other with accelerations 0.5 m/s2and 2/3 m/s2reaching their maximum speeds of 90 kmph and 72 kmph respectively. If they cross each other midway between the stations, find the distance between the stations and the time taken by each other. (5M)
3. a) The motion of a flywheel around its geometrical axis is described by the equation:_=15t2+3t+2 rad/s and angular displacement is 160 radians at t=3 seconds. Find the angular acceleration, velocity, displacement at t = 1 second. (5M)
   b) An aircraft moving horizontally at a speed of 360 kmph and at a height of 490 m towards a target on the ground, releases a bomb, which hits a target. Find (i) Time required for the bomb to reach the target on the ground; (ii) the velocity and the direction with which the bomb hits the target.(5M)
4. a. A stone is vertically thrown upwards from the top of a building with a velocity of 20m/s. If it reaches the ground after 5 seconds, determine the height of the building [5]
   b. The maximum range of a projectile is 2000m. What should be the angle of elevation so as to obtain a range of 1400m if the initial velocity remains unchanged? [5]
5. a. A motorist is travelling at 80kmph, when he observes a traffic light 200m ahead of him turns red. The traffic light is timed to stay red for 10sec. If the motorist wishes to pass the light without stopping, just as it turns green, determine (1) the required uniform deceleration of the motor
   (2) The speed of the motor as it passes the light. [7] b. Write about D"Alembert"s principle [3]

UNIT – 6

1. a) Determine the work done in stretching a spring to an elongation of x from its unscratched position [5]
   b) Discuss the impulse momentum principle [5]
2. a) What is the work energy equation for translation [5]
   b) Discuss about connected bodies [5]
3. a) Discuss (i) Work (ii) Power [4+2]
   b. What is the work energy equation in the case of fixed axis rotation [4]
4. A flywheel weighing 50kn and having radius of gyration 1m loses its speed from 400rpm to 280rpm in 2 minutes. Calculate i. The retarding torque acting on it
   ii. Change in its kinetic energy during the above period [10]
5. A 1500 N block is in contact with a level plane, the coefficient of friction between two contact surfaces being 0.1. If the block is acted upon by a horizontal force of 300n, what time will elapse before the block reaches a velocity of 16m/sec starting from rest? If 300N force is then removed, how much longer with the block continue to move? Solve the problem using impulse momentum equation? [10]
6. A 20kN automobile is moving at a speed of 70kmph when the brakes are fully applied causing all four wheels to skid. Determine the time required to stop the automobile

A. On concrete road for which coefficient of friction is 0.75 B.
On ice for which coefficient of friction is 0.08 [10]