MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)
Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

Department of Mechanical Engineering
Question Bank - Academic Year (2021-22)

Course Code & Course Name : 19GES28 & Engineering Mechanics

Year/Sem/Sec : II/III/ B

Unit-I: Basics and Statics of Particles

Part-A (2 Marks)

1. Resolve the 100N force acting 30° to horizontal into two components, one along horizontal and other along 120° to horizontal
2. State the Second Law of Newton
3. Write the equations of equilibrium of a coplanar system of forces
4. State Lami's theorem with a neat sketch
5. State the Parallelogram law of forces
6. State the triangular law of forces
7. Solve the following: A force of magnitude 50 KN is acting along the line joining A (2, 0, 6) and B (3,-2, 0) m. Write the vector form of the force.
8. Compare 'Resultant' and 'Equilibrant'
9. Imagine if the resultant of an 800N force acting towards eastern direction and a 500N force acting towards north eastern direction
10. A force of 500N forms angle 60°, 45° & 120° respectively x, y, z axes. Write the force in vector form.

Part-B (16 Marks)

1. Five forces are acting on a particle. The magnitude of forces are 300 N, 600 N, 700 N, 900 N and P and their respective angles made with the horizontal are 0°, 60°, 135°, 210° and 270°. If the vertical component of all forces is -1000 N, find the value of P. Also calculate the magnitude and the direction of the resultant, assuming that the first force acts towards the point, while all the remaining forces act away from the point.
2. State and derive the expression for magnitude and direction of the resultant using the Parallelogram law of forces
3. Two concurrent forces act at an angle of 30°. The resultant force is 15 N and one of the forces is 10 N. Find the other force.
4. Find the magnitude of the two forces such that if they act at right angles, their resultant is (10) ^1/2 N. But if they act at 60°, their resultant is (13)^1/2 N

5.(i). The following forces act a point (i) 200 N inclined at 30° towards the North of East. (ii) 250 N towards North (iii) 300 N towards North West (iv) 350 N inclined at 40° towards South of West. Find the resultant of the force system

(ii). Forces of 2 N, 3 N, 4 N, 5 N and 6 N are acting at one of the angular points of regular hexagon towards the other angular points taken in order. Find the resultant and its direction

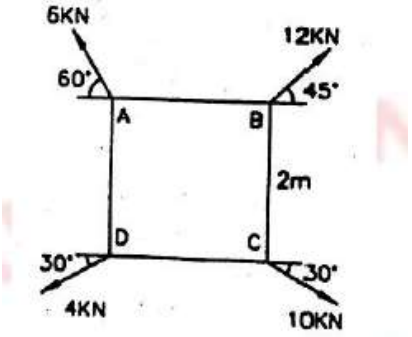
Unit-II : Equilibrium of Rigid Bodies

Part-A (2 Marks)

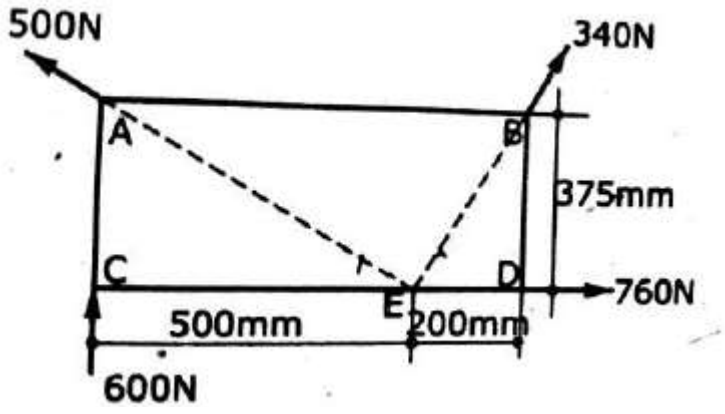
1. Define a force couple system.
2. State Varignon's theorem.
3. A Uniform ladder of weight 'W' leans against a vertical wall. Assuming the contact surfaces as rough, draw the free body diagram of the ladder with necessary assumptions.
4. State the different types of supports
5. Write down the conditions of equilibrium of a particle in space
6. Identify the reactions at a fixed support of a plane beam that are possible.
7. List the different types of beams
8. Distinguish between couple and moment
9. Illustrate free body diagram with one example.
10. Identify the reactions at the supports of a simply supported beam.

Part-B (16 Marks)

1. Four forces of magnitude and direction acting on a square ABCD of side 2 m are shown in the figure. Calculate the resultant in magnitude and direction and also locate its point of application with respect to the sides AB and AD.

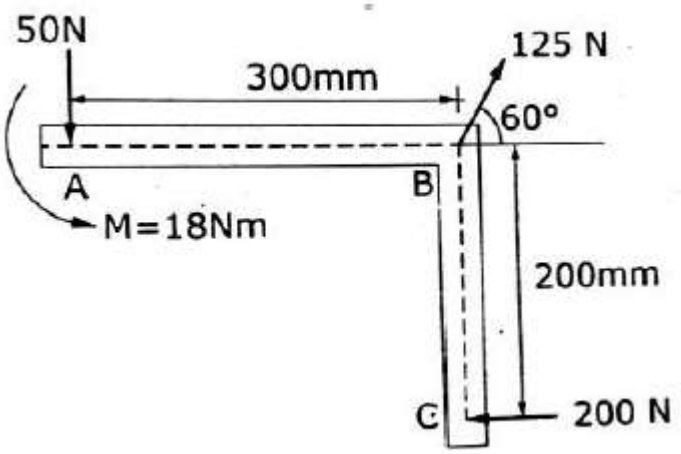


2. Four forces act on a 700 mm * 375 mm plate as shown in the figure. (a) Find the resultant of these forces. (b) Locate the two points where the line of action of the resultant intersects the edge of the plate.

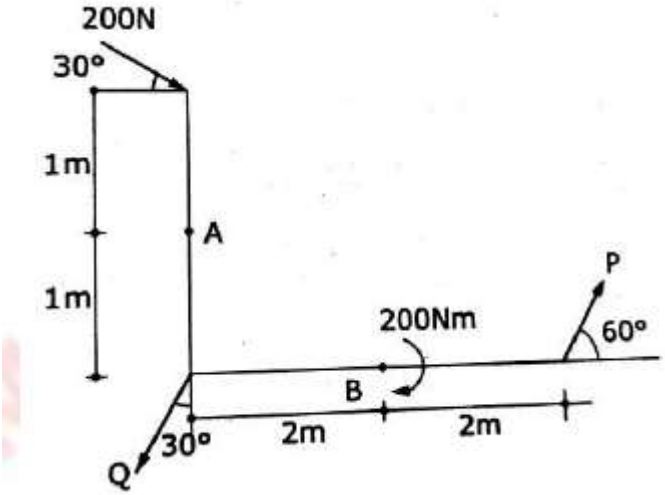


3. The three forces and a couple of magnitude, M = 18 Nm are applied to an angled bracket as shown in the figure. Find (i) Find the resultant of this system of forces. (ii)

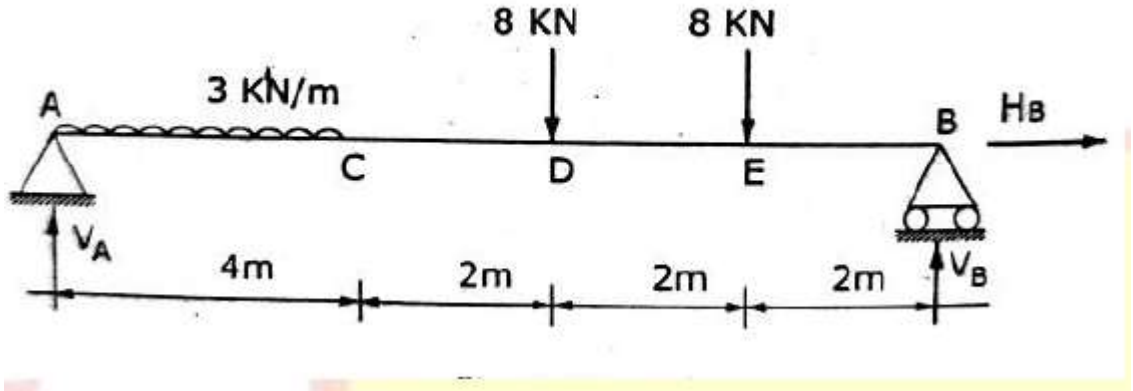
Locate the points where the line of action of the resultant intersects line AB and line BC.



4. For the system of forces shown in the figure, determine the magnitude of P and Q such that the resultant of the system passes through A and B.



5. A beam AB of span 10 m span is loaded as shown in the figure. Determine the reactions at A and B.



Unit-III : Properties of Surfaces and Solids

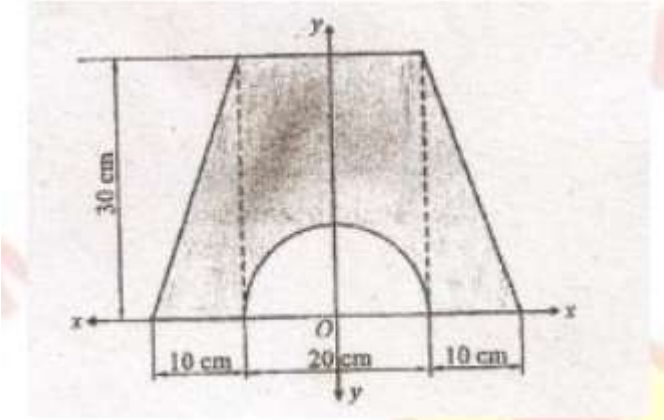
Part-A (2 Marks)

1. Define centroid and centre of gravity
2. State parallel axis theorem
3. Define principal axes
4. Find the polar moment of inertia of a hollow circular section of external diameter ‘D’ and internal diameter ‘d’

5. Locate the centroid and solve the moment of inertia about centroidal axes of a semicircular lamina of radius ‘r’
6. A semicircular area having radius of 100 mm is located in the XY plane such that its diameter coincides with the Y-axis. Determine the X-coordinate of the center.
7. Define product of inertia
8. Define polar moment of inertia
9. Compare and contrast the Area moment of Inertia with mass moment of inertia.
10. Create the centroidal distances of a sector of radius ‘r’

Part-B (16 Marks)

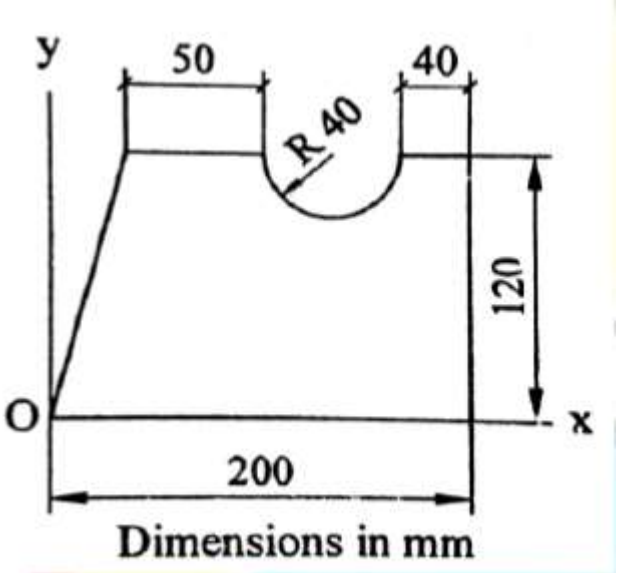
1. Find the moment of inertia of shaded area as shown in figure about I_{xx} axis and I_{yy} axis.



2. A solid hemisphere of density 2ρ is attached centrally to a solid cylinder of density ρ. Find the height of the cylindrical portion to have the CG of the solid combination on the axis of symmetry at the junction between the hemisphere and the cylinder. Take the cylinder diameter as 100mm.

3. A Cylinder of height of 10 cm and radius of base 4 cm is placed under sphere of radius 4 cm such that they have a common vertical axis. If both of them are made of the same material, find the centre of gravity of the combined unit.

4. Find the moment of inertia of the section shown in the figure about the centroidal axes.



5. Derive the expression for mass moment of inertia of prism along three axes.

Unit-IV : Dynamics of Particles

Part-A (2 Marks)

1. A car accelerates uniformly from a speed of 30 kmph in 5 seconds. Determine the acceleration of the car and the distance travelled by the car during 5 seconds.
2. Compare and contrast the rectilinear and curvilinear motion.
3. Compare and contrast the impact and elastic impact.
4. Distinguish between impulse and impulsive force.
5. Solve the following: A stone is projected in space at an angle of 45° to horizontal at an initial velocity of 10 m/sec. Find the range of the projectile.
6. Define range of projectile.
7. Discuss about the equations of motion of a particle under gravitation
8. Differentiate linear and angular momentum.
9. State the law of conservation of momentum
10. A car starts from rest with a constant acceleration of 4m/sec2. Determine the distance travelled in the 7th second.

Part-B (16 Marks)

1. A body moving with uniform acceleration observed to travel 33m in 8th second and 53m in 13 second of its travel. calculate the velocity at start and uniform acceleration
2. Two stones A and B are projected from the same point at inclinations of 45^{O} and 30^{O} respectively to the horizontal. Find the ratio of the velocities of projection of A and B if the maximum height reached by them is the same
3. A train is traveling from A to D along the track shown in fig. Its initial velocity at A is zero. The train takes 5 min to cover the distance AB, 2250 m length and 2.5 minutes to cover, the distance BC, 3000 m in length, on reaching the station C, the brakes are applied and the train stops 2250 m beyond, at D (i) Find the retardation on CD, (ii) the time it takes the train to get from A to D, and (iii) its average speed for the whole distance.
4. Water drips from a tap fitted to a barrel at the rate of four drops per second. Find the vertical separation between two consecutive drops after the lower drop has attained a velocity of 3m/s
5. A particle is projected with a initial velocity of 12m/s at an angle M with the horizontal. After sometime, the position of the particle is observed by its x and y distances of 6m and 4m respectively from the point of projection. Find the angle of projection.

Unit-V : Friction

Part-A (2 Marks)

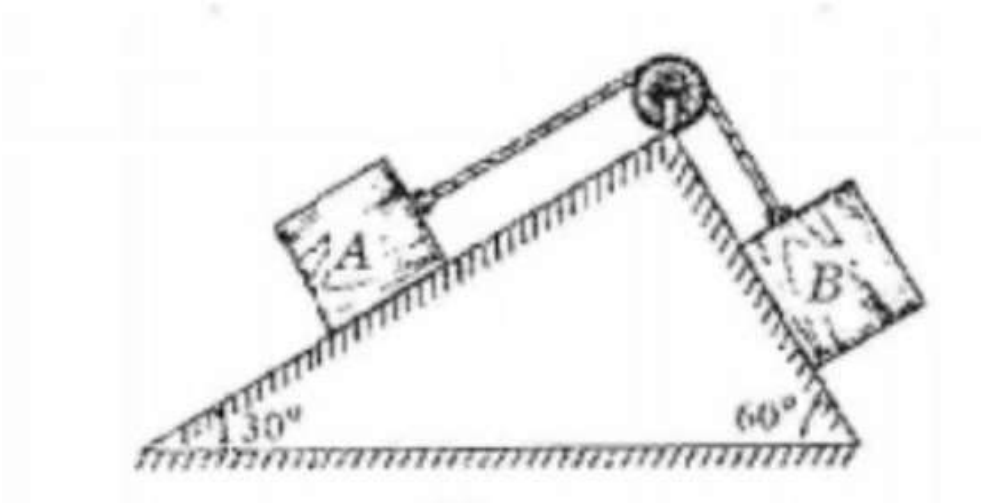
1. Define friction.
2. Classify the type of friction
3. Define limiting friction.
4. What is co-efficient of Rolling resistance?
5. Define rolling resistance.

6. Analyze the coefficient of friction and express its relationship with angle of friction.
7. Compare Co-efficient of friction and angle of friction
8. Define frictional force and its direction.
9. Why is static coefficient of friction μ, always greater than kinetic coefficient of friction μ_k ?
10. Define the belt friction and write the relation between ratio of tensions and coefficient of belt friction.

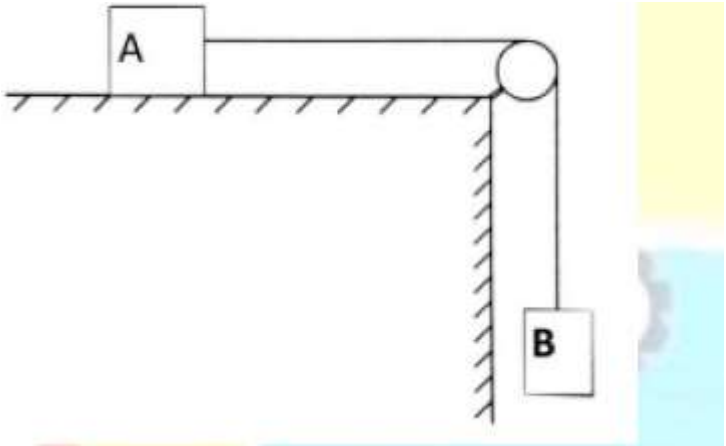
Part-B (16 Marks)

1. Two rough planes are joined together. One of them is horizontal and the other is inclined at 45^O to the horizontal. A 100 kg block is on the inclined plane and is connected to a 60 kg block on the horizontal plane through a cable passing over a smooth pulley at the junction of the planes. A dragging force of A is applied on 60 kg block at an angle of Θ to the horizontal. Find the magnitude of the force and the value of Θ for the motion is about to start. Assume μ = 0.25

2. Two blocks A and B are placed on inclined planes as shown. The block A weighs 1000N. Determine minimum weight of the block B for maintaining the equilibrium of the system. Assume that the blocks are connected by an inextensible string passing over a frictionless pulley. Coefficient of friction μA between the block A and the plane is 0.25. Assume the same value for μB.

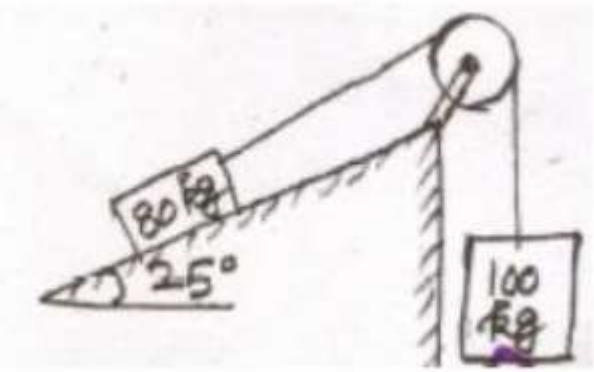


3. Two blocks 'A' and 'B' of masses m_A = 280 kg and m_B = 420 kg are joined by an inextensible cable as shown in Fig. Assume that the pulley is frictionless and μ = 0.30 between block 'A' and the surface. The system is initially at rest. Determine (i) Acceleration of block A (ii) velocity after it has moved 3.5 m and (iii) velocity after 1.5 seconds.



4. A block and pulley system is shown in figure below. The coefficient of kinetic friction between the block and the plane is 0.25. The pulley is frictionless. Find the acceleration

of the blocks and the tension in the string when the system is just released. Also find the time required for 100 kg block to come down by 2 m.



5. Block A weighing 1000 N rests on a rough inclined plane whose inclination to the horizontal is 45°. It is connected to another block B, weighing 3000 N rests on a rough horizontal plane by a weightless rigid bar inclined at an angle of 30° to the horizontal as shown in fig. Find the horizontal force required to be applied to the block B just to move the block A in upward direction. Assume angle of friction as 15° at all surfaces where there is sliding.