Code No: R201203 **R20** SET - 1

**I B. Tech II Semester Regular/Supplementary Examinations, August - 2022**

# ENGINEERING MECHANICS

**(Only for CE))**

Time: 3 hours Max. Marks: 70

**Answer any five Questions one Question from Each Unit**
**All Questions Carry Equal Marks**

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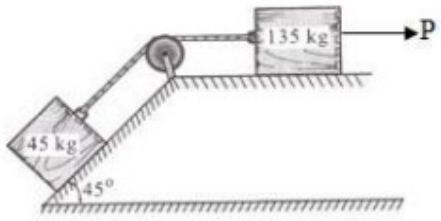
## UNIT-I

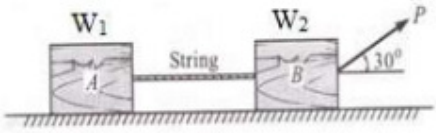
1 a) Two forces of magnitude 50 N and 30 N are acting at a point. If the angle between the two forces is $60^0$, determine the magnitude and direction of the resultant force. (5M)

b) Determine the necessary force P acting parallel to the plane to cause motion to impend as shown in the Figure. Assume coefficient of friction as 0.25 and the pulley to be smooth. (9M)




Or

2 a) In the Figure, 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 (9M)

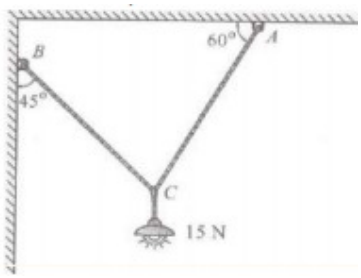



b) Two forces of 80N and 70N act simultaneously at a point. Find the resultant force, if the angle between them is $150^0$ (5M)

## UNIT-II

3 a) A force has the components Fx=100N; Fy=65N; Fz=-80N. Find the magnitude of the force and the angles θx ,θy and θz from the axes X, Y and Z respectively. (7M)

b) An electrical light weighing 15N hangs from a point C by the two strings AC and BC as shown in the Figure below. 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. (7M)




Or



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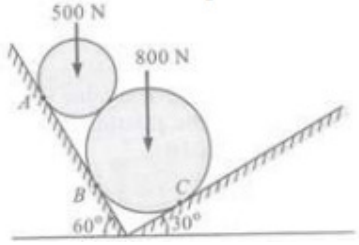
4 a) Two smooth cylinders with diameters 250 mm and 400 mm respectively are kept in a groove with slanting surfaces making angles $60^0$ and $30^0$ as shown in the Figure below. Determine the reactions at contact points A, B and C. (7M)

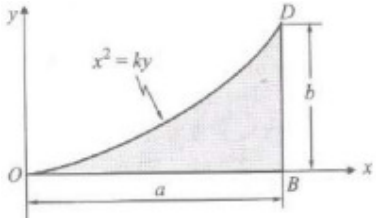



b) The force acts at the origin in a direction defined by the angles $\theta y=60^0$ and $\theta z=35^0$ . Knowing that the X-component of force is -80 kN, determine (i) the other components and magnitude of forces; (ii) the value of $\theta x$. (7M)

**UNIT-III**

5 a) Determine an expression for the center of gravity of a right circular solid cone about is base from first principles. (7M)

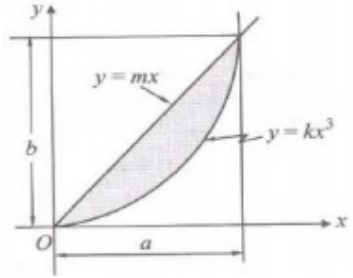
b) Determine the position of the center of gravity of the shaded area OBD as shown in the Figure. The curve OD is parabolic. (7M)




Or

6 a) Determine the centroid of the semi-circle whose radius is R (7M)

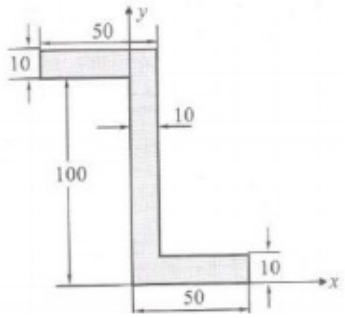
b) Find the center of gravity of the shaded area as shown in the Figure (7M)




**UNIT-IV**

7 a) Derive an equation for moment of inertia of a Quarter circle. (7M)

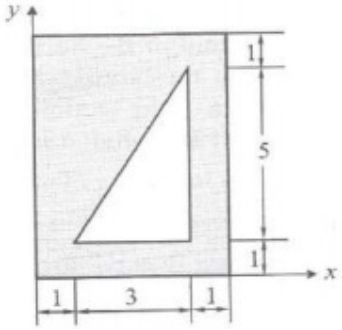
b) Find the Moment of Inertia about the centroidal axis in the given Figure (7M)




Or

8 a) Describe the method of finding Moment of Inertia of composite areas. (7M)

b) Find the Moment of Inertia about the centroidal axis in the given Figure (7M)




**UNIT-V**

9 a) A vehicle running at 36km/h on a straight road accelerates uniformly to 72km/h over a distance of 200m. Determine the acceleration and time taken. How much distance will be covered by the vehicle in the 5th second? (7M)

b) Determine the power required for lifting a weight of 10 kN at constant speed of 2 m/s. If the velocity is later on increased to 3 m/s within a duration of 2 seconds (7M)

Or

10 a) A projectile is fired with an initial velocity of 250m/s at a target located at a horizontal distance of 4km and vertical distance of 700 m above the gun. Determine the value of firing angle to hit the target. Neglect air resistance. (7M)

b) A body of mass 10 kg is suspended by a string of length 1m. It is struck by a bullet travelling horizontally with a velocity of 450 m/sec. The bullet weights 30 grams and gets embedded into the body after striking it. Determine the maximum angle through which the body swings. (7M)

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**I B. Tech II Semester Regular/Supplementary Examinations, August - 2022**

# ENGINEERING MECHANICS

**(Only for CE))**

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**Answer any five Questions one Question from Each Unit**
**All Questions Carry Equal Marks**

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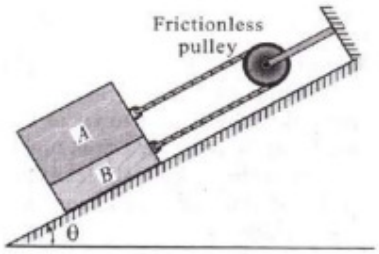
## UNIT-I

1 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. (7M)

b) Block A has a mass of 20 kg and block B has a mass of 10 kg in the Figure 1. Knowing that μs=0.15 between all surfaces of contact, determine the value of Θ for which for which motion will impend. Take acceleration due to gravity = 10 m/s$^2$ . (7M)




Or

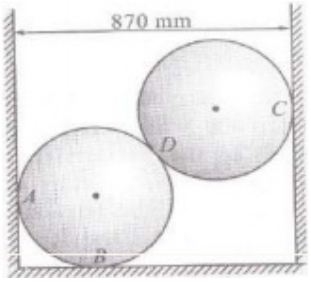
2 a) The resultant of two concurrent forces is 2500N and the angle between the forces is 90$^0$. The resultant makes an angle of 46$^0$ with one of the forces. Find the magnitude of each force (7M)

b) Show that the algebraic sum of the resolved parts of a number of forces in a given direction is equal to the resolved part of their resultant in the same direction. (7M)

## UNIT-II

3 a) State and prove Lami's theorem. (7M)

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 below. Find the reactions at the surfaces of contact A, B, C, D assuming all surfaces to be smooth. (7M)




Or

4 a) A force of 450N forms angles of 45$^0$ , 120$^0$ and 60$^0$ with X, Y and Z axes respectively. Find the components Fx, Fy and Fz of the force. (7M)



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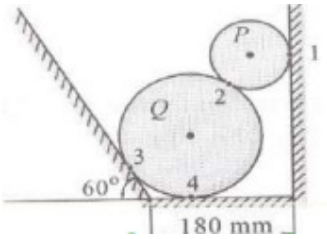
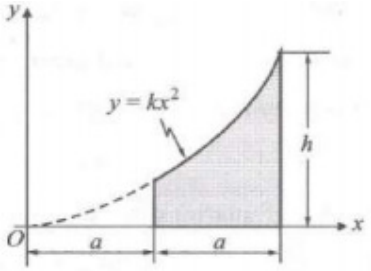
b) Two cylinders P and Q in a channel are as shown in the Figure . The cylinder P has a diameter of 100 mm and weight 200 N and Q has 180 mm and 500 N. Determine the reaction at all contact surfaces. (7M)




**UNIT-III**

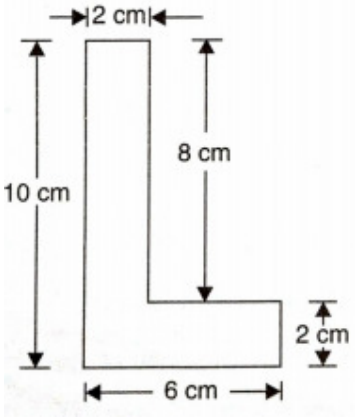
5 a) Find the center of gravity of the shaded area shown in the Figure. (7M)




b) Determine the volume generated by rotating a semi-circular area of radius `r` about a non-intersecting axis using Pappus theorem. (7M)

Or

6 a) Find the centre of gravity of the L-section shown in figure. (7M)




b) Determine the centroid of the quarter-circle whose radius is R. (7M)

**UNIT-IV**

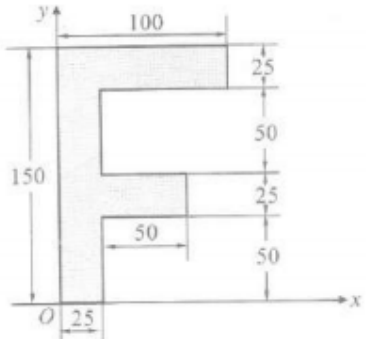
7 a) Derive an equation for moment of inertia of a Circle. (7M)

b) Determine moment of inertia of a cylinder shaft of 120mm diameter and 1.75m height about the centre of gravity XX, YY, ZZ axes. (density, $\rho$= 8000kg/m$^3$ ). (7M)

Or

8 a) An isosceles triangle section ABC has a base of 100mm and 60mm height. Determine the moment of inertia of triangle about the centroid and about base. (7M)

b) Find the Moment of Inertia of the centroidal axis as shown in the Figure. (7M)




**UNIT-V**

9 a) The motion of a flywheel around its geometrical axis is described by the equation: $\omega=15t^2+3t+2$ rad/s and angular displacement is 160 radians at t=3 seconds. Find the angular acceleration, velocity, displacement at t = 1 second (7M)

b) A car starts from rest on a curved road of 250 m radius and accelerates at a constant tangential acceleration of 0.6 m/sec$^2$. Determine the distance and time for which that car travel before the magnitude of total acceleration attained it becomes 0.75 m/sec$^2$. (7M)

Or

10 a) A particle undergoing central force motion has a tangential velocity of 20m/s while at a distance of 300m from the central point. Using the fact that the areal velocity of the particle must be constant, find its tangential velocity when it is 400m away from central point. (7M)

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 (7M)
(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.

Code No: R201203 **R20** SET - 3

**I B. Tech II Semester Regular/Supplementary Examinations, August - 2022**

# ENGINEERING MECHANICS

**(Only for CE))**

Time: 3 hours Max. Marks: 70

**Answer any five Questions one Question from Each Unit**
**All Questions Carry Equal Marks**

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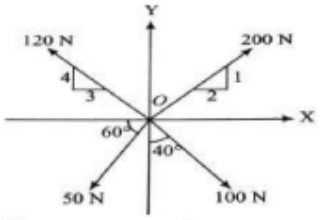
## UNIT-I

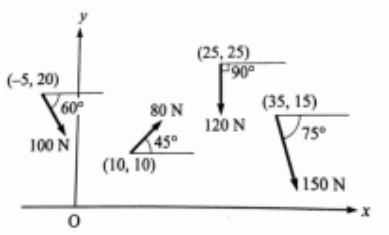
1 a) A system of four forces acting on a body is shown in figure. Determine the resultant force and its direction. (7M)



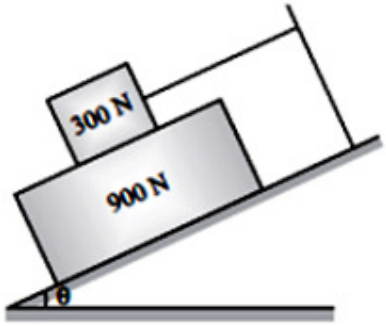

b) Explain the procedure to find the resultant of parallel forces by taking a suitable example. (7M)

Or

2 a) Determine the resultant of the force system shown in the figure. Assume that the coordinates of different points are in meters. (7M)




b) What should be the value of θ in figure, which will make the motion of 900 N block down the plane to impend? The coefficient of friction for all contact surfaces is 0.3. (7M)




## UNIT-II

3 a) How will you prove that a body will not be in equilibrium when the body is subjected to two forces which are equal and opposite but are parallel? (7M)
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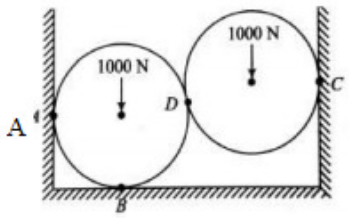
b) Two spheres each of 1000N and of radius 25cm rest in a horizontal channel of width 90cm as shown in figure below. Find the reaction at the point of contact A, B and C. (7M)



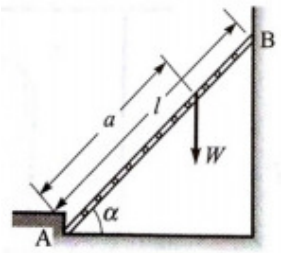

Or

4 a) Explain the graphical method for finding the resultant of coplanar concurrent force system. (7M)

b) Define space diagram and free body diagram. Explain with examples. (7M)

**UNIT-III**

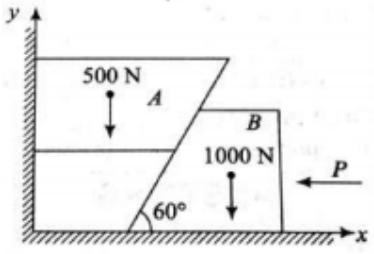
5 a) On a ladder supported at A and B, as shown in the figure, a vertical load W can have any position as defined by the distance a from the bottom. Neglecting friction, determine the magnitude of the reaction at B. Neglect the weight of the ladder. (7M)




b) Determine the area generated by rotating a line of length `l` about x-axis from a distance `r` using Pappus theorem. (7M)

Or

6 a) Two blocks A and B are resting against a wall and the floor as shown in figure. Find the value of the horizontal force P applied to the lower block that will hold the system in equilibrium. Coefficients of frictions are 0.25 at the floor, 0.3 at the wall and 0.2 between the blocks. (9M)




b) From basic principles determine the centroid of a circular plane. (5M)

**UNIT-IV**

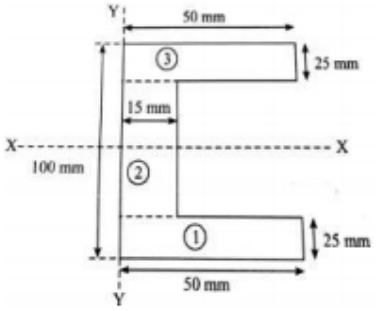
7 a) Determine the mass moment of inertia of a cylinder shaft of 100mm diameter and 2.5m height above the center of gravity axes. (Density,ρ=8000kg/$m^3$ ) (7M)

b) State and prove the parallel-axis theorem. (7M)

Or

8 a) Determine moment of inertia of a steel sphere 150mm diameter with respect to centre of gravity axes. Given density of steel as 7830 kg/$m^3$. (7M)

b) Determine moment of inertia of given section about centroidal XX axis. (7M)




**UNIT-V**

9 a) An elevator gross weight 15 kN is moving in the upward direction, such that the displacement is given by x = $t^3$- 4$t^2$ + 6t + 7m. Determine the tension in the cable supporting the elevator at t = 2 seconds. (7M)

b) A motorist takes 10 seconds to cover a distance of 20m and 15 seconds to cover a distance of 40m. Find the uniform acceleration of the car and the velocity at the end of 15 seconds. (7M)

Or

10 a) Two bodies A and B are connected by a thread and move along a rough horizontal plane (μ = 0.3) under the action of force of 400 N applied to the body B. Determine the acceleration of the two bodies and tension in the thread using D'Alembert's principle. (7M)

b) A block of 2 kg mass rests on a rough horizontal surface, whose coefficient of kinetic friction is 0.2. It is acted by a horizontal force of 10 N for 5 sec and then it is removed. Determine how far it would travel before coming to rest, assuming the frictional resistance to be uniform. Also, determine the total distance travelled from rest. (7M)

Code No: R201203 **R20** SET - 4

**I B. Tech II Semester Regular/Supplementary Examinations, August - 2022**

# ENGINEERING MECHANICS

**(Only for CE))**

Time: 3 hours Max. Marks: 70

**Answer any five Questions one Question from Each Unit**
**All Questions Carry Equal Marks**

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## UNIT-I

1 a) A uniform ladder of weight 800N and of length 7 m rests on a horizontal ground and leans against a smooth vertical wall. The angle made by the ladder with the horizontal is $60^0$ . When a man of weight 600N stands on the ladder at a distance 4m from the top of the ladder, the ladder is at the point of sliding. Determine the coefficient of friction between the ladder and the floor. (9M)

b) Define the following. (5M)
(i) Law of transmissibility (ii) Parallelogram law of forces

Or

2 a) Define cone of friction and coefficient of friction (5M)

b) A pull of 60 N inclined at $25^0$ to the horizontal plane, is required just to move a body placed on a rough horizontal plane. But the push required to move the body is 75N. If the push is inclined at $25^0$ to the horizontal, find the weight of the body and coefficient of friction. (9M)

## UNIT-II

3 a) Discuss the graphical method of finding resultant of coplanar forces. (7M)

b) Three concurrent forces have magnitudes of 80 N, 120 N and 100 N respectively. Determine the angles among them that will produce a state of equilibrium. (7M)

Or

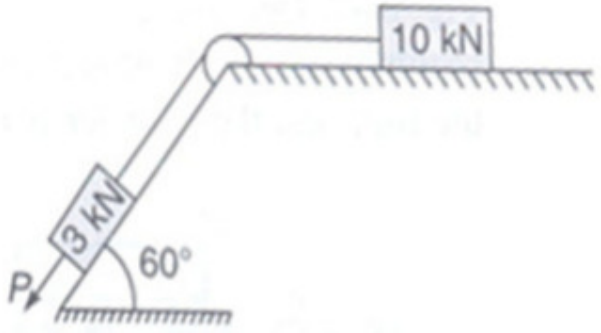
4 a) How will you prove that a body will not be in equilibrium when the body is subjected to two forces which are equal and opposite but are parallel? (7M)

b) State and prove triangular law of forces. (7M)

## UNIT-III

5 a) State and prove Pappus Theorems I and II (7M)

b) For the system shown in the fig 2., determine the magnitude P so that the system just starts to move down. Assume that the pulley is smooth and coefficient of friction as 0.26 for horizontal and inclined planes. (7M)




Or



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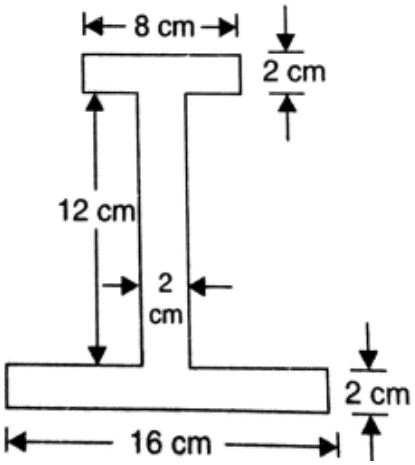
6 a) A uniform ladder of 200 N weights rests against a smooth vertical wall and a rough horizontal floor making an angle of $60^0$ with the horizontal. Use the method of virtual work, find the frictional force between the foot of the ladder and the rough horizontal floor. (7M)

b) From basic principles determine the centroid of a wire bent in semi circular shape. (7M)

**UNIT-IV**

7 a) What is moment of inertia? Distinguish between area moment of inertia, polar moment of inertia and mass moment of inertia (7M)

b) For the I-section shown in figure, find the moment of inertia about the centroidal axis X-X perpendicular to the web. (7M)




Or

8 a) State and prove perpendicular axis theorem for area moment of inertia (7M)

b) Determine the polar mass moment of inertia of a circular ring of mean radius R and mass M. (7M)

**UNIT-V**

9 a) Derive work energy equation. (7M)

b) An object falls from rest from an unknown height. In the last second of its motion the object travels a distance of 50m.If g = 9.8 $m/s^2$ determine (7M)
(i) height from which the object falls and (ii) total time taken by the object in falling.

Or

10 a) Derive impulse momentum equation. (7M)

b) Give a brief note on the rigid body kinetics. (7M)