Code No: 07A1EC09 **Set No. 1**

I B.Tech Regular Examinations, May/Jun 2008
ENGINEERING MECHANICS
(Common to Metallurgy & Material Technology and Aeronautical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Two cylinders P and Q rest in a channel as shown in the figure 1. The cylinder P has a diameter of 100 mm and weighs 200 N where as the cylinder Q has diameter of 180 mm diameter and weighs 500 Newtons. If the bottom width of the box is 180 mm, with one side vertical and the other inclined at 60^0, determine the reactions at all the four points of contact. [16]

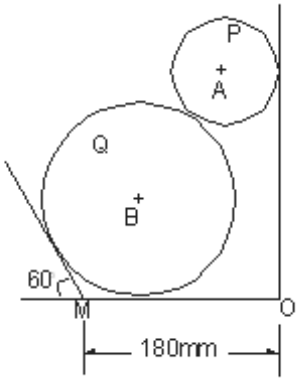

Figure 1

2. (a) A wooden block weighing 30 N is placed on a horizontal plane. A horizontal force of 12 N is applied and the block is on the point of moving. Find
   i. Coefficient of friction
   ii. Angle of friction and
   iii. The resultant reaction.
   (b) A block of weight 80 N is placed on a horizontal plane where the coefficient of friction is 0.25. Find the force that should be applied to the block at an angle of 30^0 with the horizontal to attain the condition of limiting equilibrium.[8+8]

3. (a) Find the power required to run the pulley belt drive if
   i. The differential tension is 2 kN.
   ii. The maximum tension is 8 kN.
   (b) What is meant by cross belt drive? Find the length of belt in a cross belt drive. [8+8]

4. (a) From the first principle find the centroid of a right angle triangle of height h and breadth b.

(b) Find the centroid of the area shown in figure 4b. All dimensions are in cm. [8+8]

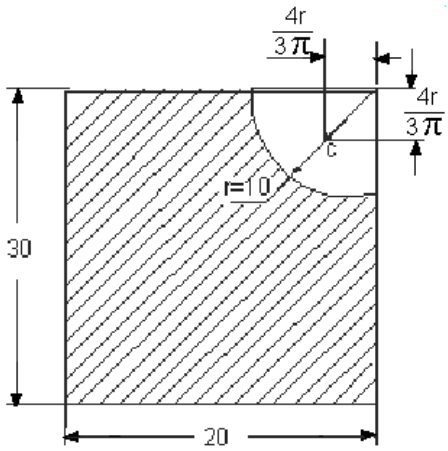

Figure 4b

5. Determine the product of inertia of a right angle triangle

   (a) with respect to x and y axes

   (b) with respect to x′ and y′ axes [x′ and y′ axes are passing through centroid and parallel to x and y axes.] [16]

6. (a) The motion of a particle is defined by the relation x = $t^3 - 12t^2 + 36t + 30$ where x is expressed in meters and t is in sec. Determine the time, position, and acceleration; when v = 0.

   (b) A stone is thrown upwards from the top of a tower 70 m high with a velocity of 19.2 m/s. Determine its position and velocity when t = 6 secs. [8+8]

7. A spring is used to stop a 60 kg package which is sliding on a horizontal surface. The spring has a constant k = 20 kN/m and is held by cables so that initially it is compressed to 120 mm. Knowing that the package has a velocity of 2.5 m/s in the position shown in the figure 7 and that the maximum additional deflection of the spring is 40 mm, determine.

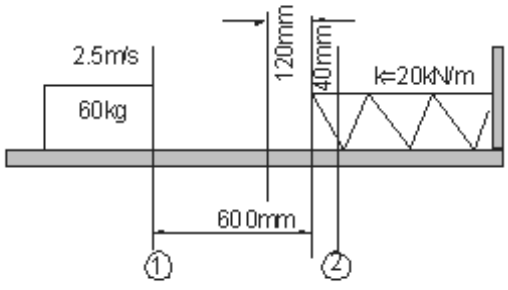

Figure 7

(a) The coefficient of kinetic friction between the package and the surface.

(b) The velocity of the package as it passes again through the position shown. [16]

8. A shaft 1.5 m long supported in flexible bearings at the ends carries two wheels each of 50 kg mass. One wheel is situated at the centre of the shaft and the other at a distance of 375 mm from the centre towards left. The shaft is hollow of external diameter 75 mm and the internal diameter 40 mm. The density of shaft material is 7700 kg/m^3 and its modulus of elasticity is 200 GN/m^2. Find the lowest whirling speed of the shaft, taking into account the mass of the shaft. [16]

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Code No: 07A1EC09 **Set No. 2**

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ENGINEERING MECHANICS
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) A horizontal line PQRS is 12 m long, where PQ = QR = RS = 4m. Forces of 1000, 1500, 1000 and 500 N act at P, Q, R and S respectively and action of these forces make angles of 90^0, 60^0, 45^0 and 30^0 respectively with PS. Find the magnitude, direction and position of the resultant force.

   (b) A force of 100 N is acting at a point A as shown in figure 1b. Determine the moments of this force about 0. [8+8]

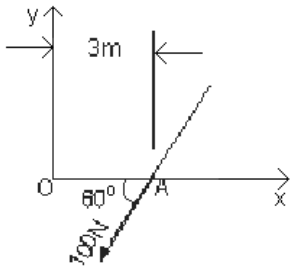

Figure 1b

2. (a) A wooden block weighing 30 N is placed on a horizontal plane. A horizontal force of 12 N is applied and the block is on the point of moving. Find
   i. Coefficient of friction
   ii. Angle of friction and
   iii. The resultant reaction.

   (b) A block of weight 80 N is placed on a horizontal plane where the coefficient of friction is 0.25. Find the force that should be applied to the block at an angle of 30^0 with the horizontal to attain the condition of limiting equilibrium.[8+8]

3. Two parallel shafts, whose centre lines are 4.8 m apart, are connected by open belt drive. The diameter of the larger pulley is 1.5 m and that of smaller pulley is 1 m. The initial tension in the belt when stationary is 3 kN. The mass of the belt is 1.5 kg/m length. The coefficient of friction between the belt and pulley is 0.3. Taking centrifugal tension into account, calculate the power transmitted, when the smaller pulley rotates at 400 r.p.m. [16]

4. (a) From the first principle find the centroid of a right angle triangle of height h and breadth b.

(b) Find the centroid of the area shown in figure 4b. All dimensions are in cm. [8+8]

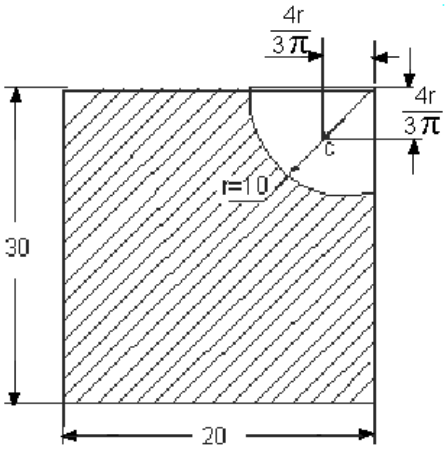

Figure 4b

5. (a) Starting from the first principles determine the moment of inertia of a triangle with respect to its base.

   (b) Determine the radius of gyration for rectangle

   i. about x axis and

   ii. about its base. [8+8]

6. A bus starts from rest at point A and accelerates at the rate of 0.9 m/s^2 until is reaches a speed of 7.2 m/s. It then proceeds with the same speed until the brakes are applied. It comes to rest, at point B, 18 m beyond the point where the brakes are applied. Assuming uniform acceleration, determine the time required for the bus to travel from A to B. Distance AB = 90 m. [16]

7. Two blocks are joined by an inextensible cable as shown in figure 7. If the system is released from rest, determine the velocity of block A after it has moved 2 m. Assume that μ equals to 0.25 between block A and the plane and that the pulley is weightless and frictionless. [16]

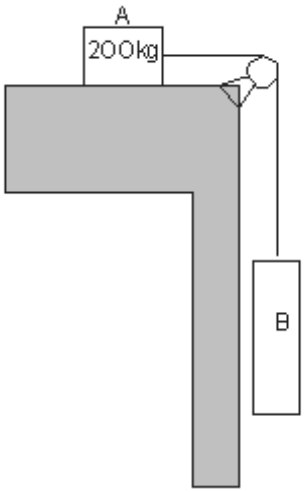

Figure 7

8. A shaft 1.5 m long supported in flexible bearings at the ends carries two wheels each of 50 kg mass. One wheel is situated at the centre of the shaft and the other at a distance of 375 mm from the centre towards left. The shaft is hollow of external diameter 75 mm and the internal diameter 40 mm. The density of shaft material is 7700 kg/m^3 and its modulus of elasticity is 200 GN/m^2. Find the lowest whirling speed of the shaft, taking into account the mass of the shaft. [16]

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Code No: 07A1EC09 **Set No. 3**

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ENGINEERING MECHANICS
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Four forces equal to P, 2P, 3P and 4P are acting along the four sides of a square ABCD respectively taken in order. Side = 40 mm. Find the magnitude, direction and position of the resultant force.
   (b) Four forces of magnitude 10 N, 20 N, 30 N and 40 N are acting respectively along the four sides of a square ABCD as shown in figure 1b. Determine the resultant moment about the point A. Each side of the square is given as 2m. [8+8]

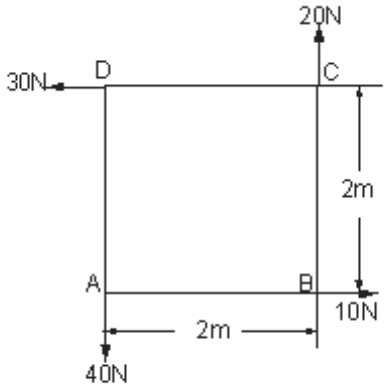

Figure 1b

2. A body weighing 50 N is just pulled up on inclined plane of 30^0 by a force of 40 N applied at 30^0 above the plane. Find the coefficient of friction. [16]

3. (a) Find the power required to run the pulley belt drive if
      i. The differential tension is 2 kN.
      ii. The maximum tension is 8 kN.
   (b) What is meant by cross belt drive? Find the length of belt in a cross belt drive. [8+8]

4. (a) From the first principle find the centroid of a right angle triangle of height h and breadth b.
   (b) Find the centroid of the area shown in figure 4b. All dimensions are in cm. [8+8]

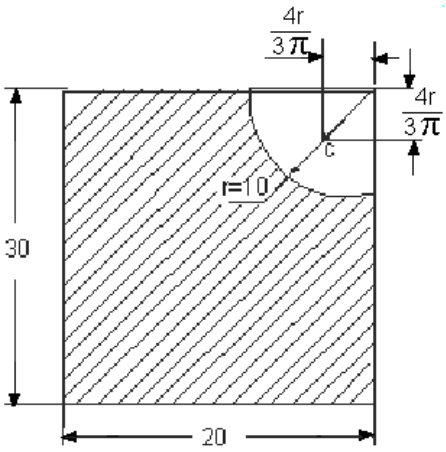

Figure 4b

5. (a) Starting from the first principles determine the moment of inertia of a triangle with respect to its base.

   (b) Determine the radius of gyration for rectangle

      i. about x axis and

      ii. about its base. [8+8]

6. (a) The motion of a particle is defined by the relation x = $t^3 - 12t^2 + 36$t + 30 where x is expressed in meters and t is in sec. Determine the time, position, and acceleration; when v = 0.

   (b) A stone is thrown upwards from the top of a tower 70 m high with a velocity of 19.2 m/s. Determine its position and velocity when t = 6 secs. [8+8]

7. A spring is used to stop a 60 kg package which is sliding on a horizontal surface. The spring has a constant k = 20 kN/m and is held by cables so that initially it is compressed to 120 mm. Knowing that the package has a velocity of 2.5 m/s in the position shown in the figure 7 and that the maximum additional deflection of the spring is 40 mm, determine.

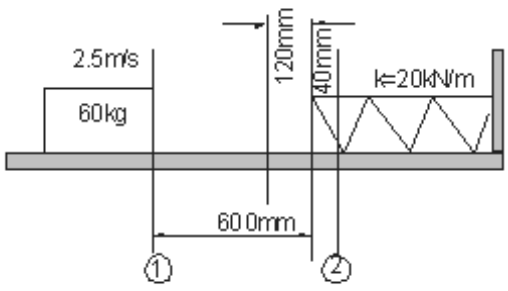

Figure 7

   (a) The coefficient of kinetic friction between the package and the surface.

   (b) The velocity of the package as it passes again through the position shown. [16]

8. A shaft 1.5 m long supported in flexible bearings at the ends carries two wheels each of 50 kg mass. One wheel is situated at the centre of the shaft and the other at a distance of 375 mm from the centre towards left. The shaft is hollow of external diameter 75 mm and the internal diameter 40 mm. The density of shaft material is 7700 kg/m^3 and its modulus of elasticity is 200 GN/m^2. Find the lowest whirling speed of the shaft, taking into account the mass of the shaft. [16]

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Code No: 07A1EC09 **Set No. 4**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Determine the magnitudes of F_1 and F_2 for the following system of forces which are in equilibrium as shown in figure 1a.

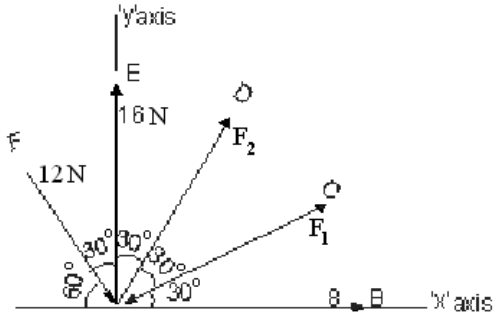

Figure 1a

   (b) Find the magnitude of 2 forces such that if they act at right angles, their resultant is $\sqrt{10}$ N, but if they act at 60^o, their resultant is $\sqrt{13}$ N. [8+8]

2. A 8 m long ladder rests against a vertical wall making an angle of 50^0 with the wall and resting on a floor. If a boy, whose weight is one half that of the ladder climbs it, at what distance along the ladder will he be, when the ladder is about to slip? The coefficient of friction between the ladder and the wall is 1/3 and that between the ladder and the floor is 1/2. [16]

3. (a) Find the power required to run the pulley belt drive if
      i. The differential tension is 2 kN.
      ii. The maximum tension is 8 kN.
   (b) What is meant by cross belt drive? Find the length of belt in a cross belt drive. [8+8]

4. (a) Find the centroid of the area shown in figure 4a.

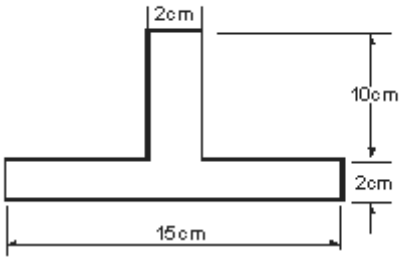

Figure 4a

(b) Find the centroid of the area shown in figure 4b. All dimensions are in cm. [8+8]

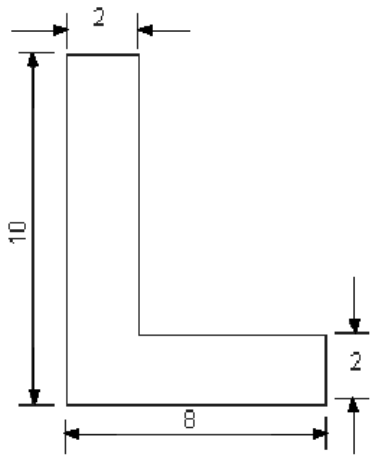

Figure 4b

5. Calculate the mass moment of inertia of the frustum of the cone shown in figure 5 with respect to the axis Z-Z and A-B assuming the density of the cone, as 2500 kg/m^3. [16]

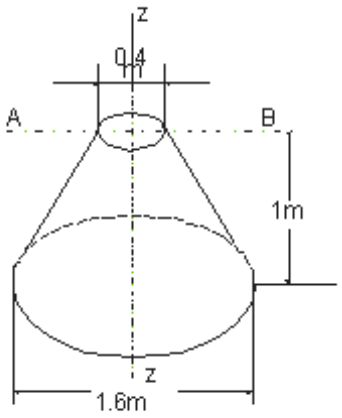

Figure 5

6. (a) The motion of a particle is defined by the relation x = $2t^3 - 6t^2 + 15$ where x is in meters and t is in seconds. Determine the time, position, and acceleration when the velocity is zero.

   (b) The position of a particle which moves along a straight line is defined by the relation x = $t^3 - 6t^2$ - 15t + 40 where x expressed in m and t is in sec. Determine

   i. The time at which the velocity is zero.

   ii. The position and distance traveled by the particle at that time.

   iii. The acceleration of the particle at that time.

   iv. The distance traveled by the particle from t = 4s to t = 6. [8+8]

7. Two blocks are joined by an inextensible cable as shown in figure 7. If the system is released from rest, determine the velocity of block A after it has moved 2 m. Assume that μ equals to 0.25 between block A and the plane and that the pulley is weightless and frictionless. [16]

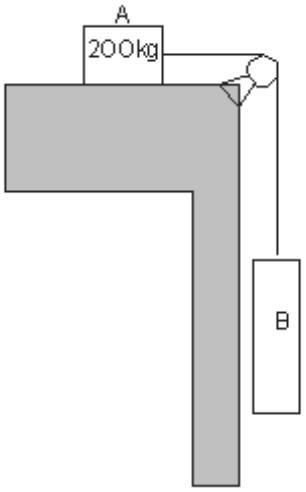

Figure 7

8. The mass of a single degree damped vibrating system is 7.5 kg and makes 24 free oscillations in 14 seconds when disturbed from its equilibrium position. The amplitude of vibration reduces to 0.25 of its initial value after five oscillations. Determine the stiffness of the spring, logarithmic decrement and damping factor. [16]

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