Code No: R05010302 **Set No. 1**

I B.Tech Supplimentary Examinations, Aug/Sep 2008
ENGINEERING MECHANICS
(Common to Mechanical Engineering, Mechatronics, Metallurgy & Material Technology, Production Engineering, Aeronautical Engineering and Automobile Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Find the reactions R_a and R_b induced at the supports A and B of the right angle bar ACB supported as shown in Figure 1 and subjected to a vertical load P applied at the mid-point of AC. [16]

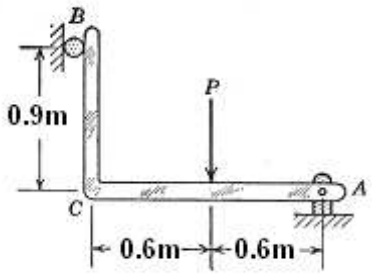

Figure 1

2. (a) A 108 N block is held on a 40^0 incline by a bar attached to a 150 N block on a horizontal plane Figure 2a. The bar which is fastened by smooth pins at each end, is inclined 20^0 to the horizontal. The co-efficient of friction between each block and its plane is 0.325. For what horizontal force P, applied to 150 N block will motion to the right be impending?

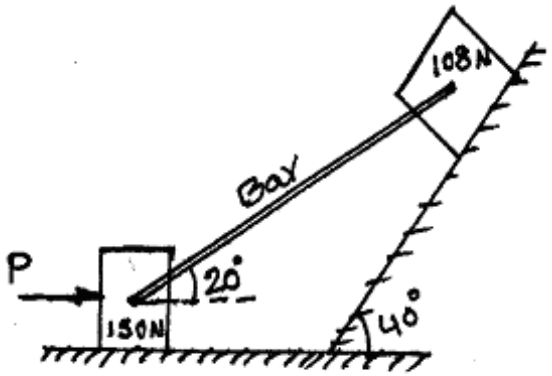

Figure 2a

(b) A block weighing 100 N is resting on a rough plane inclined 20^0 to the horizontal. It is acted upon by a force of 50N directed upward at angle of 14^0 above the plane. Determine the friction. If the block is about to move up the plane, determine the co-efficient of friction. [10+6]

3. (a) Distinguish between quarter turn and compound belt drives.
   (b) Determine the maximum power that can transmitted using a belt of 100 mm × 10 mm with an angle of lap of 160^0 . The density of belt is $1000kg/m^3$ and coefficient of friction may be taken as 0.25. The tension in the belt should not exceed $1.5N/mm^2$. [6+10]

4. (a) Differentiate between centroid and center of gravity.
   (b) Determine the product of inertia of shaded area as shown in Figure 4b about the x-y axis. [6+10]

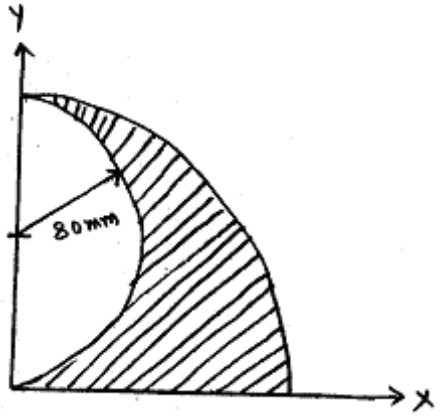

Figure 4b

5. A thin plate of mass 'm' is cut in the shape of a parallelogram of thickness 't' as shown in figure5. Determine the mass moment of inertia of the plate about the x-axis. [16]

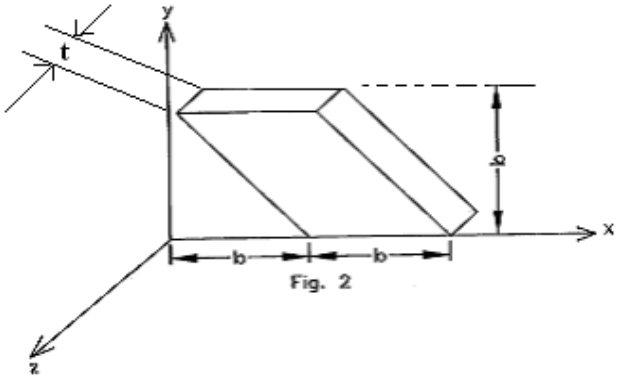

Figure 5

6. (a) A particle is projected with a velocity of 10 m/s at an angle of elevation of 60^0.
   Find
   i. The equation of the path of motion.
   ii. The length of latus rectum of the path of motion
   iii. Time required to cover the range.
   iv. The length of range.

(b) An electric train which starts from one station is uniformly accelerated for the first 10 seconds, during which period it covers 150 metres. It then runs with constant speed until it is finally retarded uniformly in the last 40 metres. Calculate the maximum speed and the time taken over the journey to the next stopping station which is 600 m form the previous station. [8+8]

7. (a) A homogeneous sphere of radius of a=100 mm and weight W=100 N can rotate freely about a diameter. If it starts from rest and gains, with constant angular acceleration, an angular speed n=180rpm, in 12 revolutions, find the acting moment. .

(b) A block starts from rest from'A'. If the coefficient of friction between all surfaces of contact is 0.3, find the distance at which the block stop on the horizontal plane. Assume the magnitude of velocity at the end of slope is same as that at the beginning of the horizontal plane.
As shown in the Figure7b [8+8]

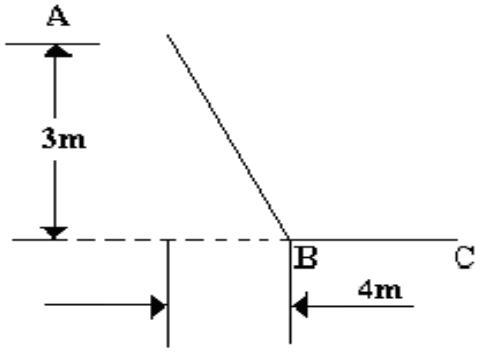

Figure 7b

8. A weight of 10N attached to a spring oscillates at a frequency of 60 oscillations per minute. If the maximum amplitude is 30mm, find the tension induced in the spring. Also find the spring constant and the maximum velocity in the spring. [16]

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Code No: R05010302 **Set No. 2**

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

Answer any FIVE Questions
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⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Two forces equal to 2P and P respectively act on a particle. If first be doubled and the second increased by 12N the direction of the resultant is unaltered, find the value of 'P'?

   (b) A 675 N man stands on the middle rung of a 225 N ladder, as shown in Figure 1b. Assuming a smooth wall at B and a stop at A to prevent slipping, find the reactions at A and B. [8+8]

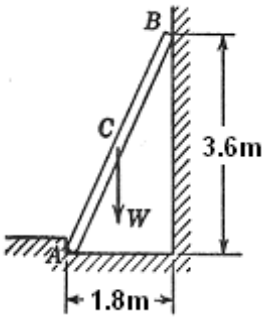

Figure 1b

2. (a) Find the least horizontal force 'P' to start motion of any part of the system of three blocks resting upon one another as shown in figure2a. The weights of the blocks are A = 3000N, B = 1000N, C = 2000N. Between A and B μ= 0.3, between B and C, μ = 0.2 and between C and the ground μ = 0.1.

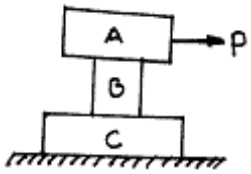

Figure 2a

   (b) A block overlying a 10^0 wedge on a horizontal floor and leaning against a vertical wall and weighing 1500N is to be raised by applying a horizontal force to the wedge. Assuming the coefficient of friction to be 0.3, determine the minimum horizontal force to be applied to raise the block. As shown in the Figure2b.

[8+8]

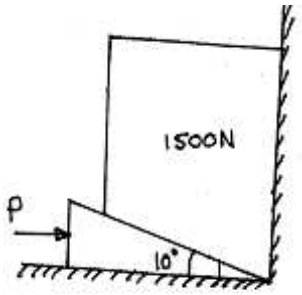

Figure 2b

3. (a) Deduce an expression for centrifugal tension of belt drive.
   (b) The maximum allowed tension in a belt is 1500 N. The angle of lap is 170^0 and coefficient of friction between the belt and material of the pulley is 0.27. Neglecting the effect of centrifugal tension, calculate the net driving tension and power transmitted if the belt speed is 2 m/s. [6+10]

4. (a) Determine the centroid for a semicircular arc about its diameteral base.
   (b) Determine the volume generated by the shaded area as shown in figure4b. about X – axis. [8+8]

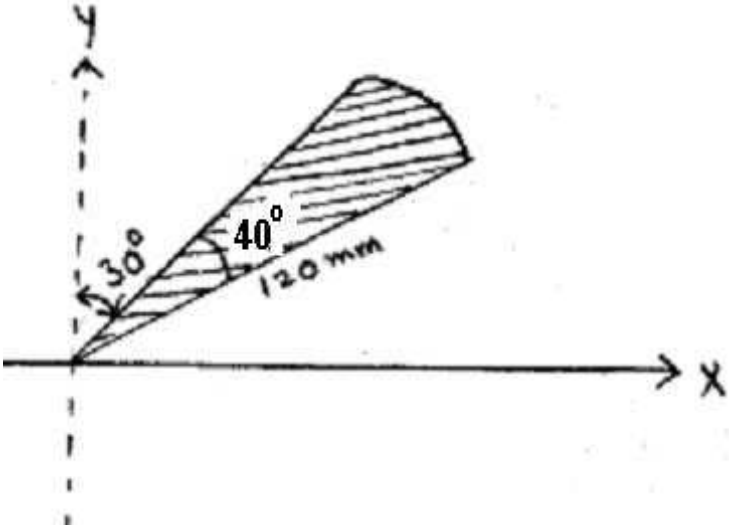

Figure 4b

5. (a) Show that the moment of inertia of a thin circular ring of mass 'M' and mean radius 'R' with respect to its geometric axis is MR^2.
   (b) Find out the mass moment of inertia of a right circular cone of base radius 'R' and mass 'M' about the axis of the cone. [8+8]

6. (a) A railway car is moving with a velocity of 20m/s. The diameter of the wheel is 1 m. The wheel is running on a straight rail without slipping. Find the velocity of the point on the circumference at 60^0 in the clockwise direction from the top at any instant.

(b) A 600 mm diameter flywheel is brought uniformly from rest to a speed of 350 rpm in 20 seconds. Determine the velocity and acceleration of a point on the rim 2 seconds after starting from rest. [8+8]

7. (a) A homogeneous sphere of radius of a=100 mm and weight W=100 N can rotate freely about a diameter. If it starts from rest and gains, with constant angular acceleration, an angular speed n=180rpm, in 12 revolutions, find the acting moment. .

(b) A block starts from rest from'A'. If the coefficient of friction between all surfaces of contact is 0.3, find the distance at which the block stop on the horizontal plane. Assume the magnitude of velocity at the end of slope is same as that at the beginning of the horizontal plane.
As shown in the Figure7b [8+8]

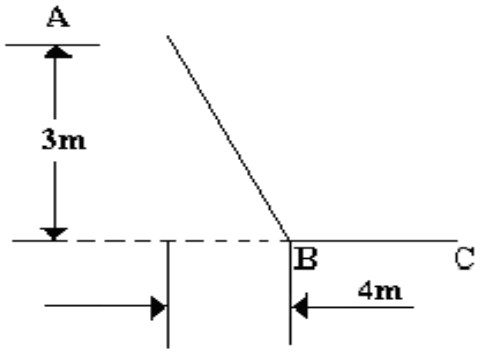

Figure 7b

8. In a mechanism, a cross-head moves in straight guide with simple harmonic motion. At distances of 125 mm and 200 mm from its mean position, it has velocities of 6 m/sec and 3 m/sec respectively. Find the amplitude, maximum velocity and period of vibration. If the cross-head weighs 2N, calculate the maximum force on it in the direction of motion. [16]

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Code No: R05010302 **Set No. 3**

I B.Tech Supplimentary Examinations, Aug/Sep 2008
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) Define free body diagram, Transmissibility of a force and resultant of a force.
   (b) Two identical rollers, each of weight 100 N, are supported by an inclined plane and a vertical wall as shown in Figure1b. Assuming smooth surfaces, find the reactions induced at the points of support A, B and C. [6+10]

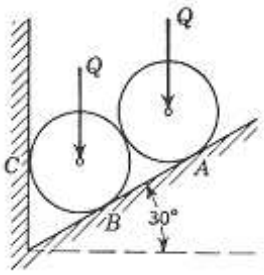

Figure 1b

2. (a) Explain the principles of operation of a screw jack with a neat sketch.
   (b) Outside diameter of a square threaded spindle of a screw Jack is 40 mm. The screw pitch is 10 mm. If the coefficient of friction between the screw and the nut is 0.15, neglecting friction between the nut and collar, determine
      i. Force required to be applied at the screw to raise a load of 2000N
      ii. The efficiency of screw jack
      iii. Force required to be applied at pitch radius to lower the same load of 2000 N and
      iv. Efficiency while lowering the load
      v. What should be the pitch for the maximum efficiency of the screw? and
      vi. What should be the value of the maximum efficiency? [6+10]

3. (a) Derive an expression for ratio of tensions of a belt in standard form
   (b) The centre of two pulleys of diameter 120 mm and 240 mm are 300 mm apart. They are connected by an open belt. If the coefficient of friction for the larger pulley be 0.28, what would be its value for the smaller pulleys simultaneously? [6+10]

4. (a) State and prove parallel axis theorem.

(b) Find the moment of inertia about the horizontal centroidal axis of shaded portion for the Figure 4b. [6+10]

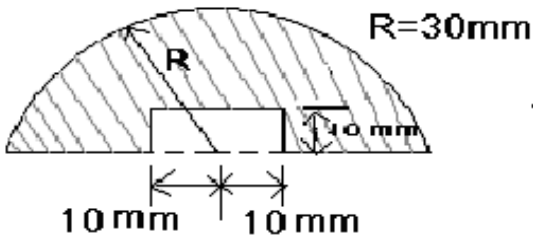

Figure 4b

5. Compute the mass moment of inertia about the x – axis of the steel link shown in figure5. [16]

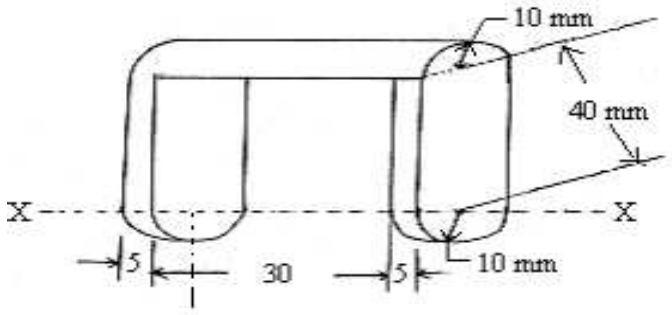

Figure 5

6. (a) Maximum range of a field gun is 2000 m. If a target at a distance of 1200 m is to be hit, what should be the angle of projection.

   (b) A stone dropped into a well is heard to strike the water in 3.5 seconds. Find the depth of the well assuming the velocity of sound is 335 m/sec. [8+8]

7. (a) A homogeneous sphere of radius of a=100 mm and weight W=100 N can rotate freely about a diameter. If it starts from rest and gains, with constant angular acceleration, an angular speed n=180rpm, in 12 revolutions, find the acting moment. .

   (b) A block starts from rest from'A'. If the coefficient of friction between all surfaces of contact is 0.3, find the distance at which the block stop on the horizontal plane. Assume the magnitude of velocity at the end of slope is same as that at the beginning of the horizontal plane.
   As shown in the Figure7b [8+8]

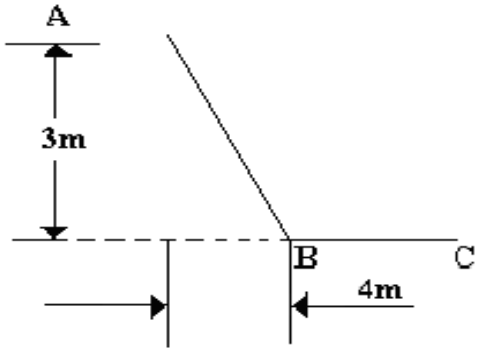

Figure 7b

8. A centrifugal pump rotating at 400 rpm is driven by an elastic motor at 1200 rpm through a single stage reduction gearing. The moment of inertia of the pump impeller at the motor are 1500 kg.m^2 and 450 kg.m^2 respectively. The lengths of the pump shaft and the motor shaft are 500 and 200 mm, and their diameters are 100 and 50 mm respectively. Neglecting the inertia of the gears, find the frequency of torsional oscillations of the system. G = 85 GN/m^2. [16]

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Code No: R05010302 **Set No. 4**

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

Answer any FIVE Questions
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1. (a) Define free body diagram, Transmissibility of a force and resultant of a force.
   (b) Two identical rollers, each of weight 100 N, are supported by an inclined plane and a vertical wall as shown in Figure1b. Assuming smooth surfaces, find the reactions induced at the points of support A, B and C. [6+10]

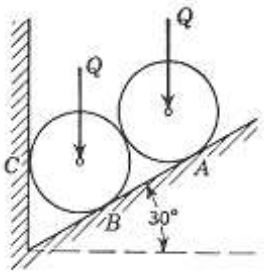

Figure 1b

2. (a) Define the following:
   i. Friction
   ii. Angle of friction
   iii. Limiting friction
   iv. Cone of friction
   (b) A ladder 5 m long and of 250 N weight is placed against a vertical wall in a position where its inclination to the vertical is 30^0. A man weighing 800 N climbs the ladder. At what position will he induce slipping? The co-efficient of friction for both the contact surfaces of the ladder viz. with the wall and the floor is 0.2. [8+8]

3. (a) Deduce an expression for centrifugal tension of belt drive.
   (b) The maximum allowed tension in a belt is 1500 N. The angle of lap is 170^0 and coefficient of friction between the belt and material of the pulley is 0.27. Neglecting the effect of centrifugal tension, calculate the net driving tension and power transmitted if the belt speed is 2 m/s. [6+10]

4. (a) From the first principles determine product of inertia for right angle triangle of base ' b' and altitude ' h'.
   (b) State and prove transfer formula for product of inertia. [8+8]

5. Derive the expression for the moment of inertia of a cylinder length 'l', radius 'r' and density 'w' about longitudinal centroidal axis and about the centroidal transverse axis. [16]

6. (a) A train is uniformly accelerated and passes successive kilometer stones with velocities of 18 km/hr and 36 km/hr respectively. Calculate the velocity when it passes the third kilometer stone. Also find the time taken for each of the two intervals of one kilometer.

   (b) A ball projected vertically upwards attains a maximum height of 400 metres. Calculate the velocity of projection and compute the time of flight in air. At what altitude will this ball meet a second ball projected vertically upwards 4 seconds later with a speed of 120 metres per second? [8+8]

7. (a) A body weighing 20 N is projected up a 20^0 inclined plane with a velocity of 12 m/s, coefficient of friction is 0.15. Find

      i. The maximum distance S, that the body will move up the inclined plane

      ii. Velocity of the body when it returns to its original position.

   (b) Find the acceleration of the moving loads as shown in figure 7b. Take mass of P=120 kg and that of Q=80 Kg and coefficient of friction between surfaces of contact is 0.3. Also find the tension in the connecting string. [8+8]

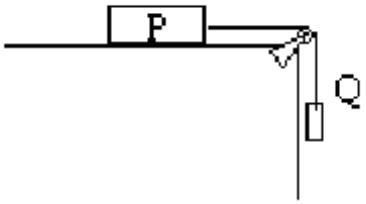

Figure 7b

8. A gun is so designed that on firing, the barrel recoils against a spring. A dashpot, at the end of the recoil, allows the barrel to come back to its initial position within the minimum time without any oscillation. A gun barrel has a mass of 500kg and a recoil spring of 300 N/mm. The barrel recoils 1m on firing. Determine

   (a) the initial recoil velocity of the gun barrel and

   (b) the critical damping coefficient of the dashpot engaged at the end of the recoil strike. [16]

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