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

I B.Tech Regular Examinations, Apr/May 2007
ENGINEERING MECHANICS
(Common to Mechanical Engineering, Mechatronics, Metallurgy & Material Technology, 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. Determine the resultant of the four forces and one couple that act on the plate shown.
   {As shown in the Figure1}

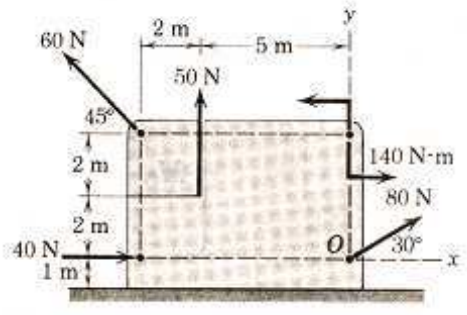

Figure 1

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 40mm. The screw pitch is 10mm. 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 2000N and
      iv. Efficiency while lowering the load
      v. What should be the pitch for the maximum efficiency of the screw and what should be the value of the maximum efficiency.

3. (a) Show that the maximum power can be transmitted at $T_{max} = 3\ T_c$
   (b) A belt embraces the shorter pulley by an angle of 165^0 and runs at a speed of 1700m/min. Dimensions of the belt are width = 200mm and 8mm thickness. It weight 1000 kg/m^3. Determine the maximum power that can be transmitted at the above speed, if the maximum permissible stress in the belt is not to exceed $2.5N/mm^2$ and $\mu = 0.25$. [8+8]

4. (a) Deduce an equation for moment of inertia of right circular solid cone about its generating axes of base radius 'R' and altitude 'h'

(b) Locate the centroid of a shaded area as shown in figure4b.

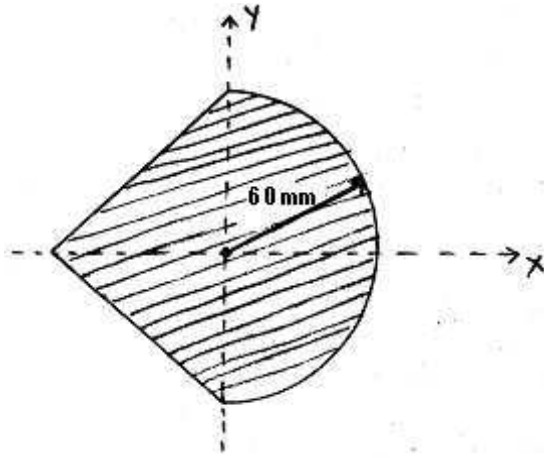

Figure 4b

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) Ram and Rahim are sitting in cars A and B respectively. The cars are 300m apart and at rest. Ram starts the car and moves towards B with an acceleration of $0.5m/s^2$. After three seconds , Rahim starts his car towards A with an acceleration of $1m/s^2$. Calculate the time and point at which two cars meet with respect to A.

   (b) A projectile is fired at a speed of 800 m/s at an angle of elevation of 50^0 from the horizontal. Neglecting the resistance of air, calculate the distance of the point along the inclined surface at which the projectile will strike the inclined surface which makes an angle of 15^0 with the horizontal.

7. (a) A homogeneous sphere of radius of a=100mm and weight W=100N 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}

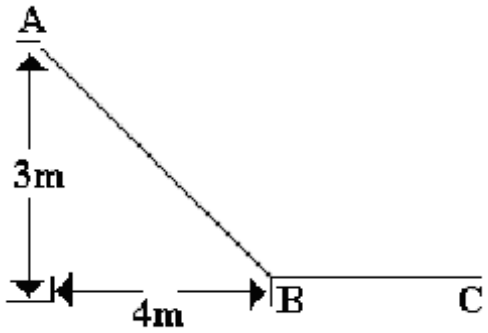

Figure 7b

8. A clock with a second's pendulum is running correct time at a place where the acceleration due to gravity is 9.81m/s^2. Find the length of the pendulum. This clock is taken at a place where the acceleration due to gravity is 9.80m/s^2. Find how much the clock will loose or gain in a day at this place?

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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 ZP 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 Figure1b. Assuming a smooth wall at B and a stop at A to prevent slipping, find the reactions at A and B.

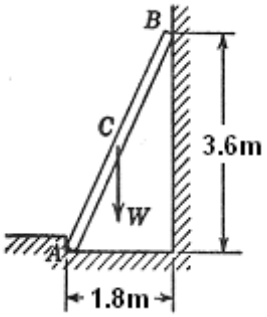

Figure 1b

2. A smooth circular cylinder of weight Q and radius r is supported by two semicircular cylinders each of the same radius r and weight Q/2, as shown in Figure2. If the coefficient of static friction between the flat faces of the semicircular cylinders and the horizontal plane on which they rest is $\mu = 0.5$ and friction between the cylinders themselves is neglected, determine the maximum distance b between the centers B and C for which equilibrium will be possible without the middle cylinder touching the horizontal plane.

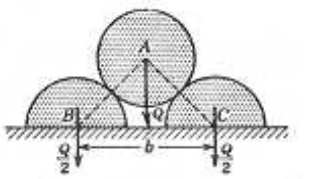

Figure 2

3. (a) Distinguish between cone pulley and loose & fast pulley drive.

   (b) A shaft rotating at 200 r.p.m drives another shaft at 300 r.p.m and transmits 6KW through a belt, the belt is 100mm wide and 10mm thick. The distance between the shafts is 4000mm the smaller pulley is 500mm in diameter calculate the stress in,

i. Open - belt and

ii. Crossed belt. Take $\mu = 0.3$. Neglect centrifugal tension.

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.

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 1m. 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 600mm diameter flywheel is brought uniformly from rest to a speed of 350rpm 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=100mm and weight W=100N 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}

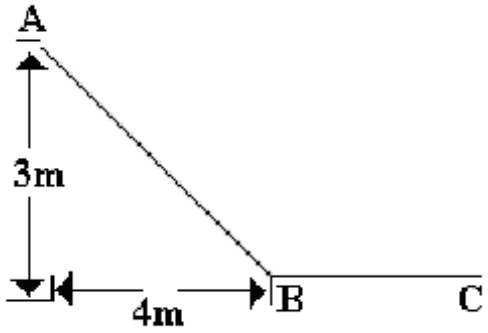

Figure 7b

8. In a mechanism, a cross-head moves in straight guide with simple harmonic motion. At distances of 125mm and 200mm from its mean position, it has velocities of 6m/sec and 3m/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.

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

I B.Tech Regular Examinations, Apr/May 2007
ENGINEERING MECHANICS
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. Calculate the magnitude of the force supported by the pin at B for the bell crank loaded and supported as shown.
   {As shown in the Figure1}

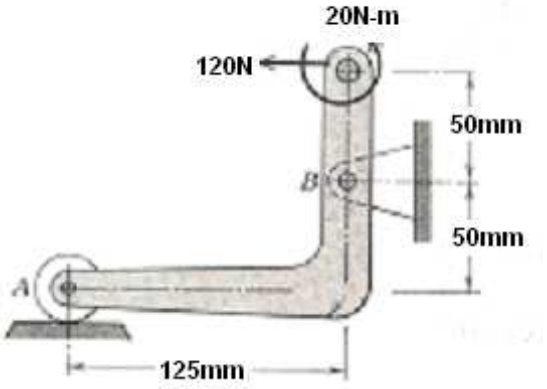

Figure 1

2. (a) A short semicircular right cylinder of radius 'r' and weight 'w' rests on a horizontal surface and is pulled at right angles to its geometric axis by a horizontal force applied at the middle B of the front edge. Find the angle 'α' that the flat face will make with the horizontal plane just before sliding begins if the coefficient of friction at the line of contact A is μ . The gravity force W must be considered as acting at the center of gravity 'C' as shown is the figure2a.

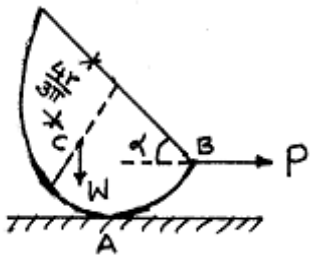

Figure 2a

   (b) The mean diameter of the threads of a square – threaded screw is 50 mm. The pitch of the thread is 6 mm. The coefficient of friction $\mu = 0.15$. What force must be applied at the end of a 600 mm lever, which is perpendicular to the longitudinal axis of the screw to raise a load of 17.5 kN? To lower the load.

3. A leather belt is required to transmit 9kW from a pulley 1200 mm in diameter running at 200 r.p.m The angle embraced is 165^0 and the coefficient of friction between leather belt and pulley is 0.3. If the safe working stress for the leather belt is $1.4N/mm^2$ the weight of leather is $1000Kg/m^3$ and the thickness of the belt is 10mm, determine the width of the belt taking the centrifugal tension in to account.

4. (a) Locate the centroid of given parabola bounded by x- axis the line x = a. {As shown in the Figure4a}

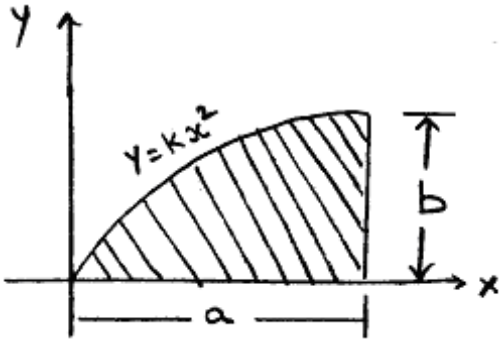

Figure 4a

(b) Locate the centroid of the wire bent as shown in figure4b.

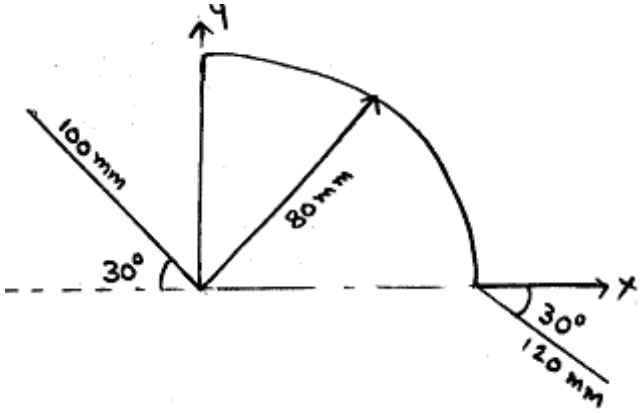

Figure 4b

5. (a) Define mass moment of inertia and explain Transfer formula for mass moments of inertia

(b) Derive the expression for the moment of inertia of a homogeneous sphere of radius 'r' and mass density' w' with reference to its diameter.

6. (a) With respect to the plane motion of rigid bodies, explain

i. Instantaneous centre of Rotation

ii. Centrode

iii. Absolute and relative velocity

(b) A bomber flies along a horizontal line at an altitude of 1500m with a velocity of 400 km per hour

i. Find at what horizontal distance before passing over a target on the ground, a bomb should be dropped so as to hit the target on the ground.
ii. calculate the magnitude and direction of the velocity with which the bomb will hit the target.
iii. Where will be the bomber when the bomb strikes the target? Take g = 9.81 m/sec^2.

7. If W_a:W_b:W_c is in the ratio of 3:2:1 , find the accelerations of the blocks A, B, and C. Assume that the pulleys are weightless.
{As shown in the Figure7}

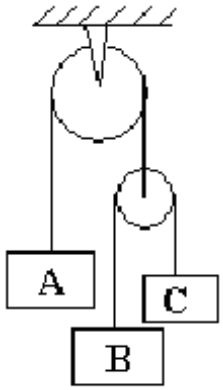

Figure 7

8. The shaft shown in the (figure8) carries two masses. The mass A is 300Kg with radius of gyration of 0.75m and the mass B is 500Kg with radius of gyration of 0.9m. Determine the frequency of torsional vibrations. It is desired to have the node at the mid-section of the shaft of 120mm diameter by changing the diameter of the section having a 90mm diameter. What will be the new diameter?

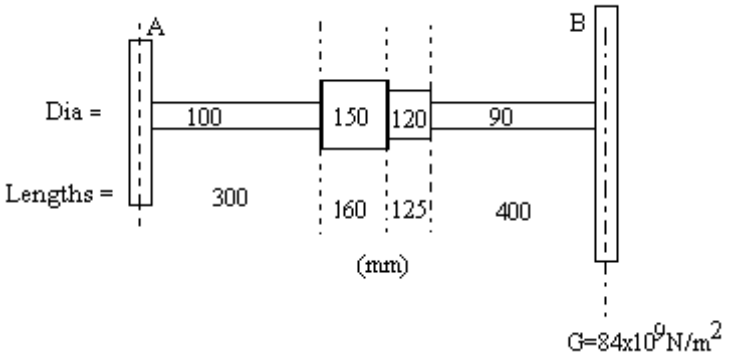

Figure 8

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

I B.Tech Regular Examinations, Apr/May 2007
ENGINEERING MECHANICS
(Common to Mechanical Engineering, Mechatronics, Metallurgy & Material Technology, 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 Figure1 and subjected to a vertical load P applied at the mid-point of AC.

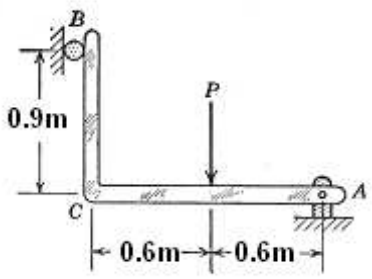

Figure 1

2. The vertical position of the 100-kg block is adjusted by the screw-activated wedge. Calculate the moment M which must be applied to the handle of the screw to raise the block. The single-threaded screw has square threads with a mean diameter of 30 mm and advances 10 mm for each complete turn. The coefficient of friction for the screw threads is 0.25, and the coefficient of friction for all mating surfaces of the block and wedge is 0.40. Neglect friction at the ball joint A.
{As shown in the Figure2}

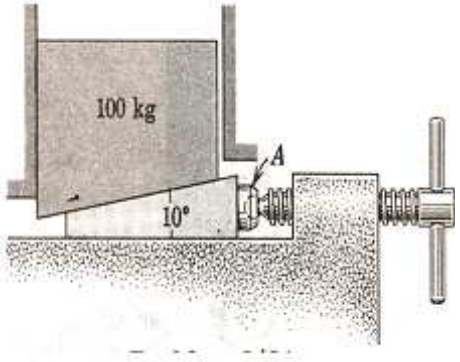

Figure 2

3. (a) Distinguish between cone pulley and loose & fast pulley drive.
   (b) A shaft rotating at 200 r.p.m drives another shaft at 300 r.p.m and transmits 6KW through a belt, the belt is 100mm wide and 10mm thick. The dis-

tance between the shafts is 4000mm the smaller pulley is 500mm in diameter calculate the stress in,

i. Open - belt and

ii. Crossed belt. Take $\mu = 0.3$. Neglect centrifugal tension.

4. (a) Explain the terms:

i. Moment of inertia

ii. Polar moment of inertia

iii. Product of inertia

(b) Locate the centroid of the shaded area
{As shown in the Figure4b}

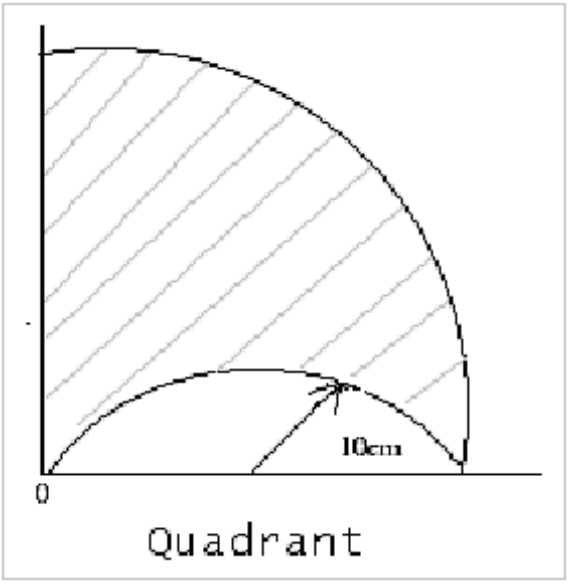

Figure 4b

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 particle under a constant deceleration is moving in a straight line and covers a distance of 20m in first two seconds and 40m in the next 5 seconds. Calculate the distance it covers in the subsequent 3 seconds and the total distance covered, before it comes to rest.

(b) Deduce the general expression to determine the maximum height and horizontal range of projectile.

7. (a) A homogeneous sphere of radius of a=100mm and weight W=100N 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}

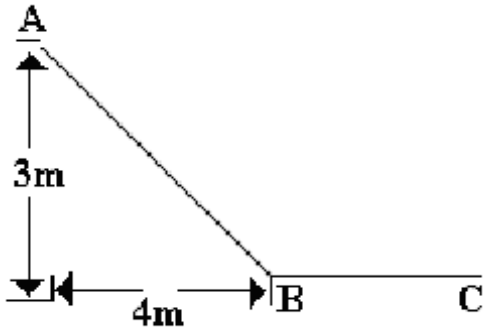

Figure 7b

8. (a) Explain how a simple pendulum differ from a compound pendulum, briefly with the help of differential mathematical equations.

(b) Determine the stiffness in N/cm of a vertical spring to which a weight of 50 N is attached and is set vibrating vertically. The weight makes 4 oscillations per second.

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