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Total number of printed pages – 6

B. Tech
BE 2104/ BENG 1101 (N/O)

First Semester Examination – 2010

MECHANICS (New and Old Course)

Full Marks – 70

Time : 3 Hours

Answer Question No. 1 which is compulsory and any **five** from the rest.

The figures in the right-hand margin indicate marks.

1. Answer the followings : 2×10
- (a) State a few idealisations in mechanics.
- (b) State which of the following is a basic concept in mechanics and why ?
- (i) charge
 - (ii) force
 - (iii) power
 - (iv) energy
 - (v) momentum

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- (c) Define tension and compression in a bar with sketches.
 - (d) Method of joints is a special case of method of sections. Explain.
 - (e) Differentiate between resultant and equilibrant.
 - (f) Locate the coordinates of the centroid of the length of a circular arc of radius R and central angle θ .
 - (g) Differentiate between limiting friction, static friction and dynamic friction.
 - (h) What quantities can be determined from velocity-time and acceleration-time diagrams?
 - (i) What is moment of inertia of a right circular cone of uniform density, radius of base R , and altitude h with respect to its geometric axis?
 - (j) What do you mean by 'degree of freedom'? Explain with an example.
2. (a) A ball is dropped from a height of 12 m on a smooth horizontal floor, from which it rebounds to a height of 9 m. The ball again strikes the floor and rises to an unknown height. Find the unknown height of the second rebound and the coefficient of restitution.

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- (b) Determine the moment of inertia I_x of a homogeneous rectangular parallelepiped having dimensions l_1 , l_2 and l_3 with respect to a centroidal axis parallel to the edges of length l_1 . 5
3. (a) Find the height of a tower from the top of which an object falls freely and during the last second of its fall, the object travels a distance equal to $2/3$ of the height of the tower. 5
- (b) A projectile is fired with an initial velocity of 250 m/s at a target located at a horizontal distance of 4 Km and vertical distance of 700 m above the gun. Determine the value of firing angle to hit the target. Neglect air resistance. 5
4. (a) A weight of 19 kN is supported by two chains AC and BC of lengths 8 m and 6 m respectively as shown below in Figure 1. Determine the forces in each chain. 5

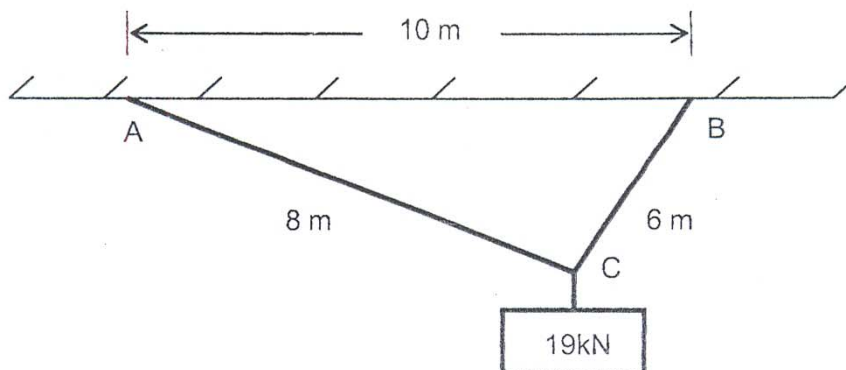


Figure 1

- (b) A right circular roller of radius 50 cm and weight 10 kN rests on a smooth horizontal surface and is held in position by an inclined bar AB of length 200 cm as shown in Figure 2. The roller is also pulled by a horizontal force of 20 kN through the center of the roller as shown. Find the tension in the bar AB and the vertical reaction at C.

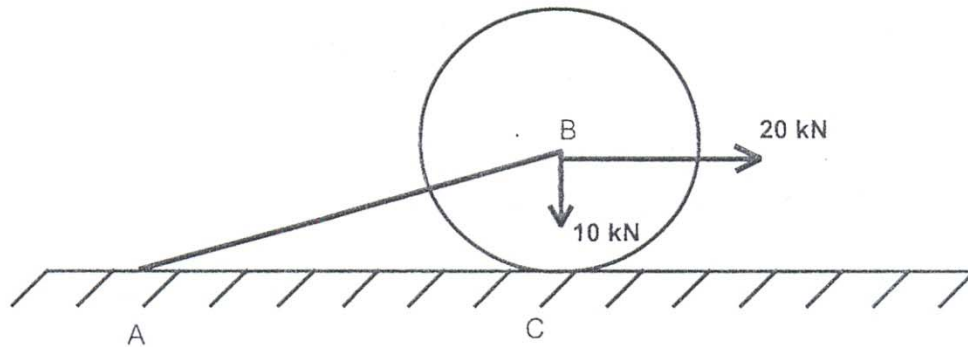


Figure 2

5. A truss of 10 m span and 4 m height is supported on a roller at A and hinge at B and loaded at E and D as shown in Figure 3 below. Find the forces in the members of the truss.

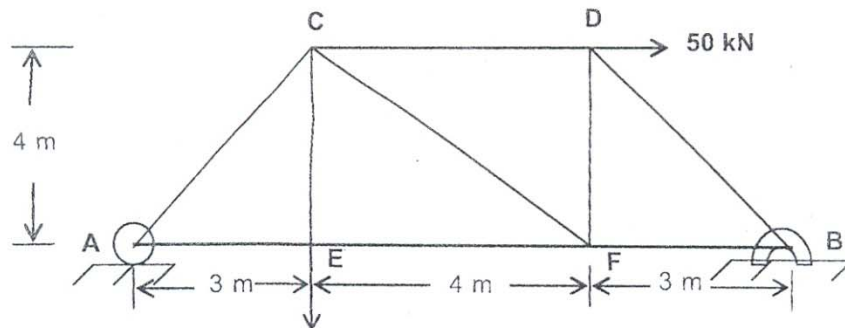


Figure 3

6. A man wishing to slide a stone block of weight 1 kN over a horizontal concrete floor, ties a rope to the block and pulls it in a direction inclined upward at an angle 20° to the horizontal. Calculate the minimum pull necessary to slide the block if the coefficient of friction $\mu = 0.6$. Calculate also the pull required if the inclination of the rope with the horizontal is equal to the angle of friction and prove that this is the least force required to slide the block. 10
7. (a) Two bodies directly in line and 10 m apart are held stationary on an inclined plane having inclination of 20° . The coefficient of friction (μ) between the plane and the lower body is 0.08 and that between the plane and the upper body is 0.05. If both the bodies are set in motion at the same instant, calculate the distance through which each body travels before they meet together. 4
- (b) A uniform homogeneous cylinder rolls without slip along a horizontal level surface with a translational velocity of 20 m/sec. If the weight is 0.1 N and its radius is 10 cm, what is its total kinetic energy? 3
- (c) The radius of gyration of a flywheel which weighs 6 kN is 50 cm. If the wheel starts from rest and attains a speed of 200 rpm in 2 minutes, determine the average torque exerted on the flywheel. 3

8. Find the moment of inertia about centroidal X and Y axis of the section shown in Figure 4. The thickness of the section is 15 mm throughout. 10

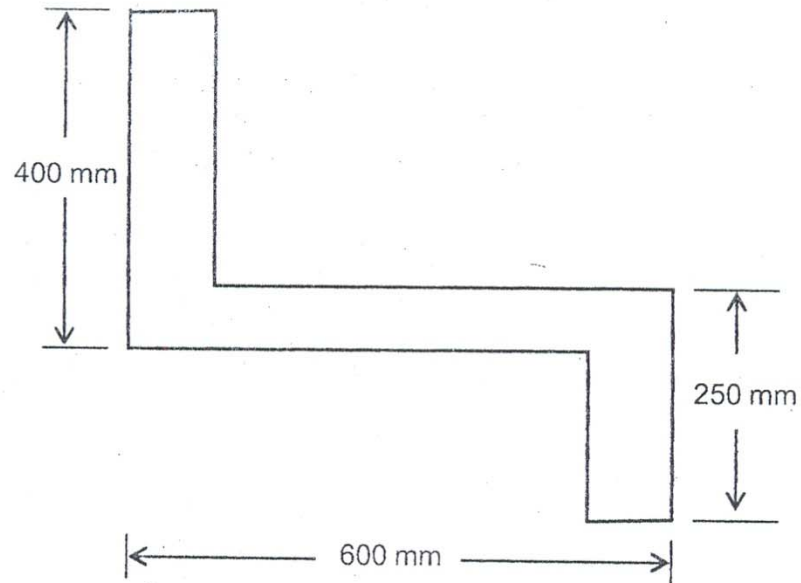


Figure 4