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Total number of printed pages – 3

B. Tech
BE 2104

First Semester Examination – 2013

MECHANICS

QUESTION CODE : C- 616

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 following questions : 2×10
- Show the reactions at a fixed support with a sketch.
 - How the self-weight of a block resting on an inclined plane will act ? Show through a sketch.
 - Write a brief note on free body diagram through a sketch.
 - What is the unit of coefficient of kinetic friction? Justify your answer.
 - A rectangle has its depth (30 cm) vertical and width (20 cm) horizontal. Find its moment of inertia about one of its diagonal.
 - Show the differences between a just-rigid and a over-rigid truss.
 - What is the nature of work done by the frictional force acting on the wheel when it rolls? Justify your answer.
 - Whether the equation $v = u \pm at$ is valid for a variable acceleration or deceleration of a body ? Justify your answer.
 - Suppose you are a passenger in a car and not wearing a seat belt. Without changing speed the car makes a sharp left turn and you find yourself colliding with the right hand door. What is the correct analysis of the situation ?
 - A 2 HP motor of weight 200 N is mounted symmetrically on four ideal springs, each of stiffness of 2 N/mm. What is the frequency of the motor ?

P.T.O.

2. (a) A prismatic bar AB of weight $P = 500 \text{ N}$ is hinged to a vertical wall at A and supported at B by a cable BC (Figure 1). Determine the magnitude and direction of the reaction R_a at the hinge A and the tension force S in the cable BC. The directions of the bar and cable are shown in the Figure. 5

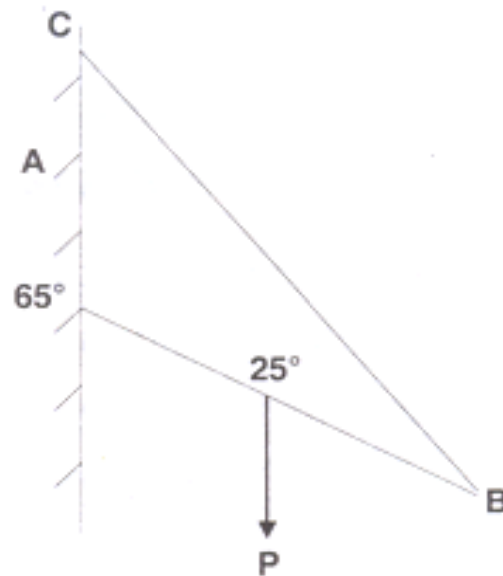


Figure 1

- (b) A body of weight 1 kN rests on a plane inclined at 30° to the horizontal. If the coefficient of friction between the body and the plane is 0.45 , determine the amount of force P applied on the body parallel to the plane to keep it in equilibrium on the inclined plane. 5

- 3 Find the forces in the members of the pin jointed truss shown in Figure 2. 10

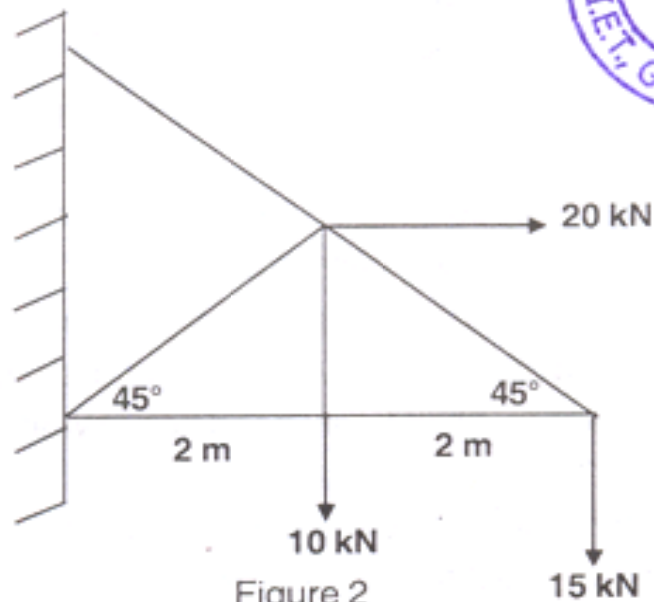


Figure 2



4. (a) A simply supported beam of span 5 m is loaded with a uniformly varying load whose intensity varies from 10 kN/m at one end to 100 kN/m at the other. Find the reactions at the supports. 5
- (b) Determine the centroid of the area enclosed between the curves $y = x^3/4$ and $x = y^3/2$. 5
5. (a) Determine the moment of inertia of the area enclosed between the curves $y = x^2/a$ and a straight line $y = x$ about both x and y axes. 5
- (b) Using the principle of virtual work, find the reactions at the supports of a simply supported horizontal beam (span = 6 m) loaded at its midpoint by a clockwise moment of 150 kNm. Neglect weight of the beam. 5
6. (a) A mass m kg is acted on by a constant force of P Newton for t seconds. In this interval of time, it moves a distance of x meters and acquires a velocity of V m/sec. Show that, $x = Pt^2/2m = mV^2/2P$. 5
- (b) The coefficient of friction between the mastic asphalt pavement and the tyres of a truck is found to be 0.3. At what maximum constant speed, the truck can move around a curve on the level path, without skidding ? Consider the radius of curvature as 400 m. 5
7. A cricket ball is thrown by a fielder from 2 m height at 45° to the horizontal with initial velocity of 25 m/sec. The ball hits the wickets at a height of 0.6 m from the ground. What is the distance of the fielder from the wickets ? 10
8. (a) Determine the length of a one-second pendulum and the time period of a one-meter pendulum. If the pendulums are taken to the surface of the moon, determine their time periods. 5
- (b) A man of mass 70 kg fires a bullet of mass 25 gm at muzzle velocity of 0.6 km/sec to hit a wooden block of weight 50 N resting on a rough floor having coefficient of friction 0.5. If the bullet gets embedded within the block, determine the distance by which the block will get displaced from its initial position. 5