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No. of Pages : 3

B. Tech
BE 2104

First Semester Examination, 2012-13

MECHANICS

Full Marks: 70

Time: 3 Hours

Answer **Q. No.1** which is compulsory and **any FIVE** from the rest

Figures in the right hand margin indicate marks

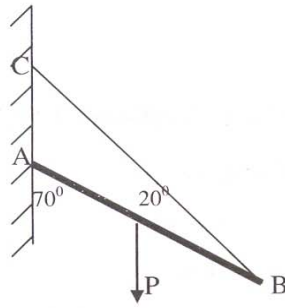
Q. No. 1 Answer the followings

(2 X 10)

- (a) What is the difference between collinear and concurrent forces?
- (b) In a concurrent force system, two forces are acting on a point at an angle 30° . The resultant force is 50 KN and one of the forces is 20 KN. Determine the unknown force.
- (c) Explain the term 'support reactions'. What are various types of support? Sketch a fixed support.
- (d) Under what conditions the followings coincide?
 - (i) Centroid of volume and centre of mass
 - (ii) Centre of gravity and centre of mass
- (e) Show the differences between 'method of section' and 'method of joints'.
- (f) Show the difference between kinetics and kinematics.
- (g) A mortar fires a projectile across a level field so that the range R is maximum and equal to 1800 m. Find the time of flight.
- (h) What do you mean by coefficient of restitution? What are its values for different types of impact?
- (i) How does D' Alembert's principle differ from that of Newton's law?
- (j) What are the governing equations for angular velocity and angular rotation of a rigid body rotating about a fixed axis under action of a constant moment?

Q. No. 2

- (a) What do you mean by 'equilibrium of three forces'? How can they be in equilibrium?
A man of weight $W = 0.6$ kN holds one end of a rope that passes over a pulley vertically above his head and to the other end of which is attached a weight $Q = 0.324$ N. Find the force with which the man's feet press against the floor. **(5)**
- (b) A prismatic bar AB of weight $P = 600$ 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)

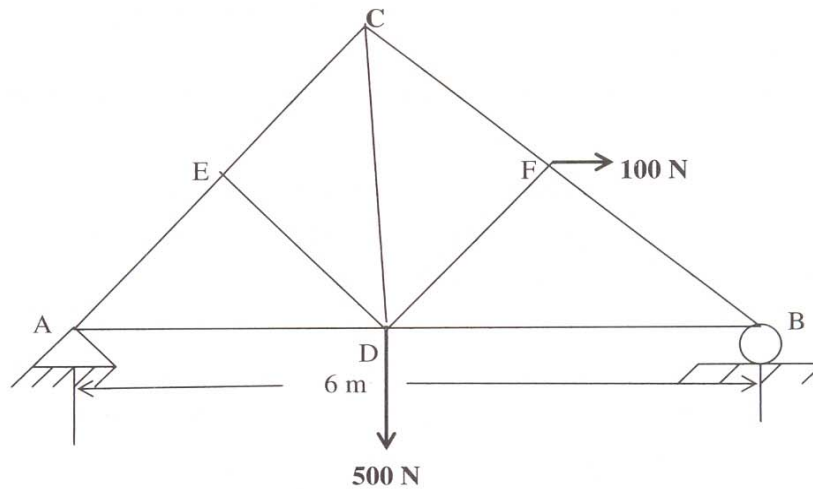
Q. No. 3

(a) A uniform ladder, of weight 200 N and length 6 m, rests on a floor, with one end against a smooth vertical wall. The foot of the ladder is at a distance of 2 meters from the wall. Find the friction between the ladder and wall. (5)

(b) Determine through derivation the centroid of the quadrant of a circle of radius R. (5)

Q. No. 4

A pin jointed truss of span 6 m is hinged at A, supported on a roller at B and loaded as shown in Figure 2. ABC is an equilateral triangle. D, E and F are mid points of sides AB, AC and BC. Find the forces in the members of the truss. (10)



(Figure 2)

Q. No. 5

(a) A simply supported beam AB of span 6 m is hinged at A and supported on a roller at B. It is loaded with a down ward vertical force of 100 kN and a clockwise moment of 100 kNm at 2 m

and 4 m respectively from the end A. Using the principle of virtual work, find the reactions at the supports A and B. (5)

(b) Find the polar moment of inertia of the area of a circular sector of radius 7 cm and central angle 30° with respect to its center from the first principles. (5)

Q. No. 6

(a) A stone is thrown up with a velocity of 144 kmph. While coming down, it strikes a glass plane; held at half the height through which it has risen and loses half of its velocity in breaking the glass. Find the velocity with which it strikes the ground. (5)

(b) A shot is fired with a velocity of 36 m/sec from a point 18 meters in front of a vertical wall 6 meters high. Find the angle of projection, to the horizontal to enable the shot just clear the top of the wall. (5)

Q. No. 7

(a) The masses of two balls are in the ratio 2:1 and their respective velocities are in the ratio 1:2, but in the opposite direction before impact. If the coefficient of restitution be $5/6$, prove that after impact each ball will move back with $5/6^{\text{th}}$ of its original velocity. (5)

(b) A man weighing 650 N jumps into a swimming pool from a tower of height 20 m. He was found to go down in water by 2 m and then started rising. Find the average resistance of water. (5)

Q. No. 8

(a) A vehicle weighing 1200 Kg is to turn a circular curve of radius 100 m with a velocity of 30 kmph. The height of its centre of gravity above the road level is 1 m and the distance between the centre lines of the wheels is 1.5 m. Find the reactions at the wheels. (5)

(b) The crank of a reciprocating engine is rotating at 200 rpm. The lengths of the crank and connecting rod are 25 cm and 125 cm respectively (**Figure 3**). Find the velocity at the point A (i.e. the velocity of the piston) when the crank has turned through an angle of 60° . (5)

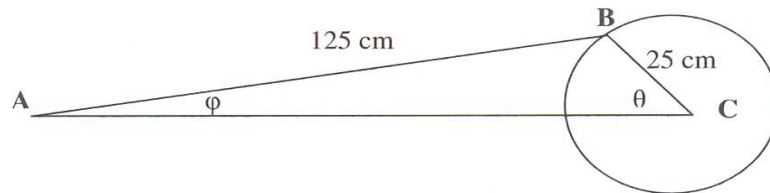


Figure 3