Ex/CON/PE/T/122/2018

J A D A V P U R U N I V E R S I T Y

Bachelor in Construction Engineering Examination - 2018

First Year – 2nd Semester

Engineering Mechanics II

Time : 3 Hours | Full Marks : 100

Answer **Group – A (Compulsory),** ***any three*** *from* **Group – *B* & *any three*** *from* **Group – *C*.** *[(20+20)+(3x10)+(3x10)=100]*

Group – A (Compulsory) [(10x2) + (5x4) =40]

1. (i) What is the momentum of a body of 2 kg at its highest point, when thrown with a velocity of 15 m/s at an angle of 70° with the horizontal? (10x2=20)

(ii) A particle attached to one end of an inextensible string is described a vertical circle of radius r. What will be its minimum velocity?

(iii) The velocity of a particle of mass 4 kg is (5 $\hat{i}$ + 3 $\hat{j}$) m/s when it is at the point (2,1)m. Find out its angular momentum.

(iv) A link OA is moving at constant speed in a horizontal plane as shown in **Fig.1** . A block 'M' can slide along the link. At any instant when the block is 2 m from the centre its radial velocity and tangential velocity are 5 m/s & 10 m/s respectively. Calculate the coriolis component of acceleration.

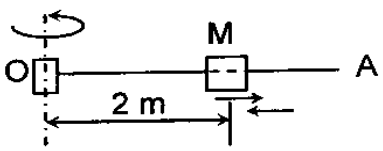

Fig. 1

(v) An object of 30 kg is moved with a velocity of 2 m/s on a horizontal smooth surface. What is the velocity of the block for 4 seconds if force of 40 N is applied on it in the direction of force?

(vi) What is the length of a train which crosses a bridge of length 150 m in 20 second with a speed of 40 km/h?

(vii) Two balls of equal mass and of perfectly plastic material are lying on the floor. One of the balls with velocity v is made to strike the second ball. What will be velocity of both the balls after impact?

(viii) A solid circular cylinder of radius 80 cm and weight 12 N rolls without slip along a horizontal level surface with a translation velocity of 2.5 m/s. What is its total KE?

(ix) A man can throw a ball upto a maximum distance of 30 m on a horizontal plane. Find out the maximum height he can throw the ball?

(x) Find the critical damping coefficient of a system with a mass of 1 kg attached to the end of a spring with a stiffness 0.9 N/ mm

2. (a) Two blocks of weight 1 kg_f and 2 kg_f are connected by an inextensible cord which passes over a light frictionless pulley as shown in **Fig. 2.** If the weight 2 kg_f falls with acceleration 'a' determine the acceleration and the tension in the cord.

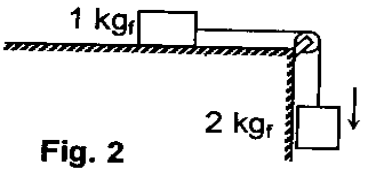

Fig. 2

(5x4=20)

(b) State and prove the Kepler's second law of planetary motion.

(c) A mass of weight 2 Kgf is projected with a velocity of 5 m/sec along a rough plane inclined 30° with the horizontal. If the coefficient of friction between the plane and the block is 0.2, determine how far up the plane the body will move before coming to rest.

(d) A man weighing 160 Kgf stands in a boat so that he is 15 m from a pier on the shore. He walks 8 m in the boat toward the pier and then stops as shown in **Fig. 3**. How far from the pier will he be at end of this time? The boat weighs 200 Kgf and there is assumed to be no friction between it and the water.

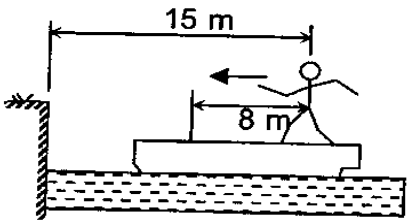

Fig. 3

(e) Determine the natural circular frequency of the vibrating system as shown in **Fig. 4**

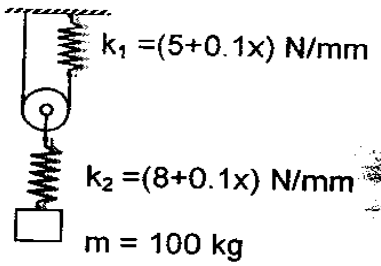

Fig. 4

Group – B (Answer any **Three**) [3x10=30]

3. A block of weight 50 N is placed on an inclined surface($\mu = 0.3$). The block is released at the position as shown in **Fig. 5** at a rest condition. What is the maximum compression of the spring? Take spring constant as 120 N/m.

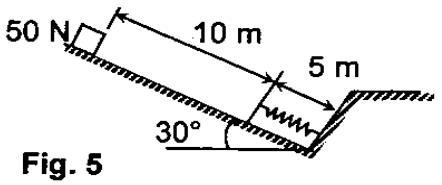

Fig. 5

4. A projectile was fired with a velocity of 75 m/s at an angle of 60° to the horizontal. Determine the radius of curvature of its path –
   (a) at the maximum height,
   (b) at the point of projection, and
   (c) at a position when it travelled a distance of 35 m from point of projection.

5. The most comfortable speed for a car entering a curve of radius 100 m is 40 km/hour. If the width of the pavement is 10 m, determine the super elevation necessary. If the coefficient of friction between the tyres and the pavement is 0.1 across the road, find the safe range of speed for the car during its travel along the curve.

6. A tennis ball is dropped vertically from rest in a height of 20 m on a horizontal floor. It rebounds to a height of 12 m. The ball falls down and rises again to an unknown height. What is the height of this second rebound?

7. A ball of weight w = 1 kg_f is resting in a trough as shown in **Fig. 6**. Determine the minimum acceleration with which the trough must move to the left so that the ball looses contact with the surface A.

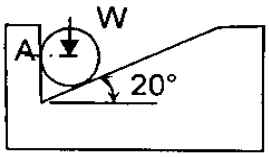

Fig. 6

Group – C (Answer any **Three**) [3x10=30]

8. Calculate the velocity of a spacecraft which orbits the moon in a circular path of 80-km altitude. Take the required data from the given table.

Sl No	Body	Mean diameter (km)	Surface gravitational acceleration (m/sec^2)	Escape velocity (km/sec)
1	Earth	12742	9.81	11.18
2	Moon	3476	1.62	2.37