2316 220

Class –BA/B.Sc. III Sem VI

Subject – Mathematics

Paper– I (Dynamics)

Time Allowed : 3 Hours **Maximum Marks : 50**

Note: Attempt any five questions selecting atleast two from each section.

Section–A

1. (a) A bus is beginning to move with an acceleration of 1 m/sec^2. A man who is 40 m behind the bus starts running at 9 m/sec to catch the bus. After how many seconds will the man be able to catch the bus?

(b) Two scale pans each of mass 4 kg are connected by a light string passing over a pulley. Show how to divide a mass of 10 kg in two scale pans so as to produce an acceleration of g/9. (5,5)

2. (a) A body is projected up a smooth inclined plane of length 20m and inclination 30° with a velocity just sufficient for it to reach the top. Divide the whole length into three parts, so that each part is covered in the same time.

(b) Two smooth inclined planes of inclination 30° and 60° respectively are placed back to back and a string, passing over a smooth pulley at the top, joins masses of 0.3 kg and 0.5 kg lying on the planes. Find the acceleration of either mass, the tension in the string and the reactions of the planes. (5,5)

3. (a) A particle moves in a straight line, starting from rest from a distance c to a centre of attraction towards which force per unit mass is $\frac{\mu}{x^3}$, where x is measured from the centre. Show that the time required to reach the centre is $\frac{c^2}{\sqrt{u}}$.

(b) A particle moving with S.H.M. of period 30 sec travels 15 cm from the position of rest in 5 sec. Find the amplitude, maximum velocity and velocity at the end of 5 seconds. (5,5)

4. (a) A particle is projected upwards with a velocity of 4m/sec and after t seconds another particle is projected upwards from the same point and with the same velocity. Prove that the particles meet at height $\frac{4u^2 - g^2t^2}{8g}$ metres after a time $\left(\frac{t}{2} + \frac{u}{g}\right)$ seconds.

(b) A particle is executing S.H.M. A and B are the points at which its velocity is zero. It passes through a certain point P at intervals of 0.5 and 1.5 seconds with a speed of 3m/sec. Determine the Maximum speed and also the ratio $\frac{AP}{PB}$. (5,5)

Section–B

5. (a) An elastic string of natural length *l* is extended by an amount a, when it supports a mass M at rest, and is extended by an amount b when it is rotating as a conical pendulum, carrying a particle of the same mass, with angular velocity w, prove that $gb = w^2a(l + b)$

(b) Define conical pendulum. Show that the time of revolution varies directly as the square root of the depth of the particle below the fixed point.

(5,5)

6. (a) A gun is fired from the sea level. It is then taken to a height h metre above the sea level and fired making the same angle α with the horizon. Show that its range is increased by the fraction $\frac{1}{2}\left[\left(1+\frac{2gh}{u^2\sin^2\alpha}\right)^{1/2}-1\right]$ of itself, u being the velocity of projection.

(b) A pendulum which beats seconds at the surface of the earth is carried to the top of a mountain 5 km high, how many seconds will it loss or gain per day? What correction in its present length be made so that it may beat seconds at the top of the mountain? (5,5)

7. (a) Two bodies are projected from the same point in directions making angles α_1 and α_2 with the horizontal and strike at the same point on the

horizontal plane through the point of projection. If t_1 and t_2 be their time of flight, show that

$$\frac{t_1^2 - t_2^2}{t_1^2 + t_2^2} = \frac{\text{Sin}(\alpha_1 - \alpha_2)}{\text{Sin}(\alpha_1 + \alpha_2)}$$

(b) If α be the angle between the tangents at the extremities of any arc of a parabolic path and v, v_1 the velocities at these extremities and u be their horizontal component, show that the time of describing the arc is $\frac{vv_1 \text{Sin}\alpha}{gu}$. (5,5)

8. (a) A particle is projected up an inclined plane of inclination β at an elevation α to the horizon. Show that $\tan \alpha = \cot \beta + 2 \tan \beta$, if the particle strikes the plane at right angles.

(b) A particle is projected with velocity $2\sqrt{ag}$ so that it just clears two walls of equal heights 'a' which are at a distance 2a from each other. Show that the latus rectum of the path is 2a and that the time of passing between the walls is $2\sqrt{a/g}$ (5,5)

****