Exam. Code : 103206
Subject Code : 1217

B.A./B.Sc. 6th Semester

MATHEMATICS (Dynamics)

PAPER–I

Time Allowed—3 Hours] [Maximum Marks—50

Note :– Attempt any **5** questions in all choosing at least **two** from each section. All questions carry equal marks.

SECTION—A

1. (a) What are the gravitational units of force in CGS and MKS system ?
   (b) State Newton's law of motion.
   (c) Let F be a force acting on a body of mass m, prove that $F = ma$, where a is the acceleration. 2,3,5

2. Two masses, m_1 and m_2 $(m_1 > m_2)$ are suspended by a light inextensible and flexible string over a smooth, fixed, small and light pulley. Find the tension in the string. Further show that the tension in the string is the H.M. between the weights of the two bodies. 10

3. A body sliding down a smooth inclined plane is observed to cover equal distances, each equal to l, in consecutive intervals of time t_1 and t_2. Show that inclination of the plane is $\sin^{-1}\left[\frac{2l(t_1 - t_2)}{gt_1t_2(t_1 + t_2)}\right]$. 10

4. A particle moves in a straight line, starting from rest from a distance c to a centre of attraction towards which the 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 $\frac{c^2}{\sqrt{\mu}}$. 10

5. A particle moves with S.H.M. in a straight line. In the first second after starting from the rest it travels a distance a and in the next second, it travels a distance b. Prove that the amplitude of the motion is $\frac{2a^2}{3a-b}$. 10

SECTION—B

6. 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 $2\sqrt{\frac{a}{g}}$. 10

7. A particle is projected along the inside of the arc of a smooth vertical circle from any point in it with velocity v_1. Prove that the velocity v_2 of the particle, after it has moved through a height h is given by.

$$v_2^2 = v_1^2 - 2gh.$$ 10

8. (a) Define power. What are the units of power in F.P.S. and M.K.S. system ? What is the relation between F.P.S. and M.K.S. units of power ?

   (b) A cycle being driven at 14 km/hr is bought to rest in 6 meters by using brakes. Find the work done by the resistance (assumed constant) if the weight of the cycle is 18 kg. 5,5

9. Differentiate between kinetic energy and potential energy. Show that the kinetic energy of a particle of mass m moving with a magnitude of velocity v is $\frac{1}{2}mv^2$. 10

10. Apply the principle of conservation of energy to find the magnitude of the velocity of a projectile at a height h above the point of projection, the velocity of projection being u. 10