Exam. Code : 103206
Subject Code : 9051

B.A./B.Sc. 6th Semester (Old Syllabus 2017)

MATHEMATICS

Paper–I (Dynamics)

Time Allowed—3 Hours] [Maximum Marks—50

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

SECTION—A

1. A 100 kg man descends from a high tower with the help of a rope of breaking strength 90 kg. Find the maximum time that the man can use the rope if he has to cover 30 meter distance.

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 and pressure on the pulley.

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

4. A particle of mass m is acted upon by a force $m\mu\left(x+\frac{a^4}{x^3}\right)$ towards the origin. If it starts from rest at a distance 'a' from the origin, show that it will reach the origin after time $\frac{\pi}{4\sqrt{\mu}}$.

5. (a) Define SHM. Prove that simple harmonic motion is periodic and its period is independent of the amplitude.

   (b) A particle is moving between two points A and B in SHM. If the period of oscillation is 2π, show that the velocity at any point P is mean proportional between AP and BP.

SECTION—B

6. A particle is projected from a point A to pass through a point B. If t_1 and t_2 are two possible times of flight and θ is the inclination of AB to the horizontal plane. Prove that $t_1^2 + 2t_1t_2 \sin\theta + t_2^2$ is independent of θ.

7. If a particle starts from rest at a depth $\frac{1}{2}\gamma$ below the highest point of a smooth vertical circle of radius γ, show that it will leave the circle at a distance $\frac{1}{3}\gamma$ above the centre.

8. What is the work done in moving a mass of 2 kg from the surface of the earth to a point 10^7 km from the centre of the earth, radius of earth being 6.37×10^6 meters.

9. Define a conical pendulum. Show that the vertical depth of the particle in a conical pendulum, below the fixed point varies inversely as the square of the angular velocity and is independent of the length of the string.

10. (a) Discuss conservative and non-conservative forces.

(b) Using principle of work and energy, find the velocity of a particle moving in S.H.M. at any point of its line of motion.