Exam. Code : 103206
Subject Code : 7031

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

MATHEMATICS

Paper—I (Dynamics)

Time Allowed—Three Hours] [Maximum Marks—50

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

SECTION—A

I. (a) Define dynamics. Explain, when a body is said to in rest and in motion.

(b) What are the units of force in CGS and MKS system ?

(c) Let F be a force acting on a body of mass m, prove that F = ma, where a is the acceleration. 3,2,5

II. 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. If the tension in the string is equal to the weight of mass M, prove that M is the harmonic mean between m_1 and m_2.

III. Two smooth inclined planes of inclination 30 degree and 60 degree respectively are placed 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.

IV. Define escape velocity. Find the escape velocity of a particle projected from the surface of earth, where $g = 9.8$ m/sec^2 and $R = 6370$ km, R being the radius of earth.

V. Two light strings are fastened to a particle of mass m and their other ends to fixed points so that the strings are taut. The modulus of each is λ, the tension T and length a and b. Show that period of oscillation along the line of string is $2\pi\sqrt{\frac{m\,a\,b}{(T+\lambda)(a+b)}}$.

SECTION—B

VI. (a) If R is the range of a projectile on a horizontal plane and h be its maximum height for a given angle of projection, show that the maximum horizontal range with the same velocity of projection is $2h + \frac{R^2}{8h}$.

(b) A body is projected at an elevation α with a velocity of 9.8 m/sec. In what time will the direction of motion be $\frac{1}{3}\alpha$. 6,4

VII. A particle is projected along a smooth curve, 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 :

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

VIII. (a) State Kepler's laws of planetary motion.

(b) Prove that the time taken by the earth to travel over half its orbit, remote from the sun, separated by the minor axis is about 2 days more than half year. The eccentricity of the orbit is $\frac{1}{60}$. 3,7

IX. Differentiate between kinetic energy and potential energy. A bullet passes through two planks in succession, its original velocity is 120 m/sec and it loses a velocity of 20 m/sec in penetrating each plank. Find ratio of thickness of the two planks, assuming that they offer the same average resistance.

X. State and prove principle of conservation of energy.