(i) Printed Pages : 4 Roll No. .....

(ii) Questions : 8 Sub. Code : 0 3 4 3

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B.A./B.Sc. (General) 4th Semester

(2053)

MATHEMATICS

Paper : III Dynamics

Time Allowed : Three Hours] **[Maximum Marks : 30**

Note :—Attempt **FIVE** questions, selecting at least **TWO** questions from each unit. Each question will carry **6** marks.

UNIT—I

1. (a) If a particle moving with uniform acceleration in a straight line describes equal distances in time t_1, t_2, t_3. Show that $\frac{1}{t_1}-\frac{1}{t_2}+\frac{1}{t_3}=\frac{3}{t_1+t_2+t_3}$.

   (b) Two masses m_1 and m_2 ($m_1 > m_2$) are suspended by light inextensible string over a smooth pulley. Find the acceleration of masses, tension in the string and pressure on the pulley.

2. (a) A block of mass 3 kg is moving along a smooth horizontal surface with a velocity u at instant $t = 0$. A force of $\frac{160}{49}$ kg. w.t. is applied against the direction of motion. The force slows down the block to half of its original velocity while it moves 9 meters :

(i) What is u ?

(ii) How long does it take for this to occur ?

(b) A body falls freely from the top of a tower and during the last second of its flight it falls $\frac{16}{25}$th of the whole distance. Find the height of the tower.

3. (a) A particle having 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 origin, show that it will reach the origin after time $\frac{\pi}{4\sqrt{\mu}}$.

(b) A body is projected up a smooth inclined plane of length 100 meters and inclination $\sin^{-1}\left(\frac{3}{5}\right)$. Find the velocity of projection which is just sufficient to carry the body to the top.

4. (a) A particle moves with SHM in a straight line. In first second starting from rest, it travels a distance a and in the next second, it travels a distance b in the same direction. Prove that amplitude of the motion is $\frac{2a^2}{3a-b}$.

(b) If t_1 and t_2 be the periods corresponding to two different weights attached to a vertical elastic string and C_1 and C_2 be the statistical extensions due to these weights, prove that, $g(t_1^2 - t_2^2) = 4\pi^2(C_1 - C_2)$.

UNIT—II

5. (a) A particle moves along the curve $x = 4t$, $y = 6t - t^2$. Find tangential and normal acceleration when $t = 3$.

(b) A particle is projected with velocity 49 $msec^{-1}$ in a direction making an angle 45° with horizontal. Find :

(i) The time of flight

(ii) The horizontal range

(iii) The greatest height of projectile.

6. (a) The roadway of a bridge over a canal is in the form of a circular arc of radius 20 m. Find the greatest speed with which a motor-cyclist can cross the bridge without leaving the road at the heighest point.

(b) To a cyclist moving northeast at 16 km/hr, a west wind appears to blow from north. Find actual velocity of the wind.

7. (a) A stone of 3 kg falls vertically through a distance 40 m and comes to rest after penetrating 1 m into sand. What is the resistance offered by the sand ?

(b) An insect crawls at a constant speed u along the spoke of wheel of radius r which is rotating with constant angular velocity w about its center. Find actual acceleration of the insect as it reaches the rim of the wheel.

8. (a) A ball moving with velocity u impinges directly on an equally ball moving with velocity v in the opposite direction. It the first ball is brought to rest by impact, show that

$u : v = (1 + e) : (1 - e)$, e = coefficient of restitution.

(b) A shell of mass m is projected from a gun of mass M by an explosion which generates kinetic energy E. Prove that the initial velocity of the shell is $\sqrt{\frac{2EM}{m(M+m)}}$, assuming that the gun is free to recoil.