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

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

Exam. Code : 0 0 0 4

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

1059

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) A lizard, at an initial distance of 21 cm behind and moving from rest with an acceleration of 2 cm/sec^2 pursues an insect which is crawling uniformly along a straight line at 20 cm/sec. Find when and where the lizard will catch the insect.

   (b) A ball is dropped from the roof of a tower. If the total distance covered by it in the last second of its motion is equal to the distance covered by it in first 3 seconds, then find the height of the tower.

2. (a) From an aeroplane rising vertically with uniform acceleration f, a ball is dropped. 4 seconds after it, another ball is dropped from the aeroplane. Show that the distance between the two balls 2 seconds after the second ball is dropped is $16(g + f)$.

(b) 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 wt is applied against the direction of motion. The force slows down the block to half of its original velocity while it moves 9 metres.

(i) What is u ?

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

3. (a) The force acting on a particle varies with time according to the law $F = 12\ mt^2$, where m is the mass of particle. If $x = 0$ and $v = -4$ m/sec when $t = 0$, find the velocity and the distance travelled after 2 sec.

(b) A particle starts from rest from origin and moves along y-axis. The acceleration f of particle at any time t is given by law $f = 2t - 16$, where f is in m/sec^2 and t in seconds. Find the location of particle when it comes to rest.

4. (a) A particle moving in straight line with S.H.M. has velocities u and v when its distances from centre are a and b. Prove that period of motion is $2\pi\sqrt{\frac{a^2 - b^2}{v^2 - u^2}}$.

(b) A particle is performing S.H.M. of period T about centre O and its passes through P (OP = b) with velocity v in the direction OP. Prove that the time which elapses before its return to P is $\frac{T}{\pi}\tan^{-1}\left(\frac{vT}{2\pi b}\right)$.

UNIT—II

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

   (b) Two balls are projected from the same point in directions inclined at 60° and 30° to the horizontal. If they attain the same height, find the ratio of their velocities of projection. What is the ratio if they have the same horizontal range ?

6. (a) The roadway of a bridge over a canal is in the form of a circular arc of radius 60.5 metres. What is the maximum velocity with which a motor-cyclist can cross the bridge without leaving the ground at the highest point ?

   (b) A train is moving with a speed of 44 km/hr when a stone hits it with a velocity of 33 km/hr in a direction perpendicular to the direction of motion of train. Find the velocity with which the stone appears to a passenger in the train to strike the train.

7. (a) A man is drawing water slowly from a well with a light bucket which leaks uniformly, the bucket when full weights 10 kg and when it arrives at the top, half the water remains. Find the work done if the depth of the wall is 20 metres.

   (b) In passing through a plank, the velocity of a rifle bullet changes in the ratio 10 : 9. How many such planks can it pass through before coming to rest, assuming resistance to motion to be uniform ?

8. (a) If masses of two balls are in the ratio 2 : 1 and their respective velocities before impact are in the ratio 1 : 2 and in opposite directions and $e = \frac{5}{6}$, show that after impact each ball will move back with $\frac{5}{6}$ of its original velocity.

(b) A bullet of mass 10 gm. is fired into a target with velocity 500 m/sec. The mass of the target is 15 kg and is free to move. Find the loss of kinetic energy by impact.