(b) A car weighing 300kg is accelerating at 6m/sec^2 up an incline of 1 in 100, the resistance being 10gm-weight per kg-wt. Find the power exerted by the engine when the speed is 65m/sec. 5,5

8. Define conservative forces. If a particle is moving under a system of conservative forces, then prove that the sum of its kinetic and potential energies at any instant remains constant throughout the motion. 10

Exam. Code : 103205
Subject Code : 1190

B.A./B.Sc. 5th Semester

MATHEMATICS

Paper—I

(Dynamics)

Time Allowed—3 Hours] [Maximum Marks—50

Note :— Attempt ***five*** questions in all, selecting at least ***one*** question from each section. The **fifth** question may be attempted from any section. All questions carry equal marks.

SECTION—A

1. (a) Two particles 100m apart are approaching each other. Particle A has velocity of 5m/sec and acceleration at 2m/sec^2. Particle B has a velocity of 20m/sec and decelerating at 2m/sec^2. At the instant they meet, how far will each have travelled from its initial position ?

   (b) A particle is projected vertically upwards with velocity u. Find the maximum height attained by the particle and the time to reach the highest point. 5,5

2. A body moves down a smooth inclined plane under the action of gravity alone, discuss its motion. Also find the time to reach the highest point and the time of flight. 10

SECTION—B

3. (a) A particle moves in a straight line under retardation kv^2. If its initial velocity is u, show that the space described in time t is $\frac{1}{k}\log(1+kut)$.

   (b) 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 $\frac{\pi}{4\sqrt{\mu}}$. 5,5

4. (a) A light elastic string with modulus of elasticity λ is stretched to double its length and is tied to two fixed points distant 2a apart. A particle of mass m, tied to its middle point, is displaced along the line of string through a distance equal to half of its distance from the fixed point and released. Prove that the time of complete oscillation is $\pi\sqrt{\frac{am}{\lambda}}$ and maximum velocity acquired is $\sqrt{\frac{a\lambda}{m}}$.

   (b) A particle is performing SHM between two points A and B. If the period of oscillation is 2π, show that the velocity at any point P is mean proportional between AP and BP. 6,4

SECTION—C

5. (a) The velocity of a particle when at its greatest height is $\sqrt{\frac{2}{5}}$ of its velocity when at half of its greatest height. Show that the angle of projection is 60°.

   (b) A particle is projected from a point on the ground so as to pass over a vertical wall of height h at a horizontal distance 'a' from the point of projection. Show that it strikes the ground at a distance $\frac{2u^2h}{ga}$ beyond the wall, u being the horizontal component of velocity. 5,5

6. (a) Find expressions for tangential and normal accelerations of a particle moving along a circle.

   (b) In an oscillatory pendulum, the tension in the string when the bob is in its lowest position is n times the weight of the bob. Prove that the angle of the swing on each side of the vertical is $\cos^{-1}\left(\frac{3-n}{2}\right)$. 5,5

SECTION—D

7. (a) A particle of mass m is moving with S.H.M. of period T and amplitude a. Find the work done by the force of attraction when the particle moves from the mean position to an extreme position.