Roll No. ..... Total Page : 3

GSQ/M-21 1745

DYNAMICS

Paper–BM-363

Time Allowed : 3 Hours] [Maximum Marks : 40

Note : Attempt **five** questions in all, selecting **one** question from each Unit. Question No. **1** is compulsory.

Compulsory Question

1. (a) Define the radial and transverse acceleration and write down their expressions. 1

   (b) Define S.H.M and write the expression for velocity at any distance from centre. 1

   (c) A car weighing 200 kg travelling at 19.6 m/sec. is brought to set in 4.9 m by application of breakes. Find force of resistance of breakes. 2

   (d) Define trajectory and write down its equation. 2

   (e) Show that at an apse, particle moves at right angle to radius vector. 2

UNIT–I

2. (a) A particle describes an equiangular spiral $r = a\, e^{\theta}$ in such a manner that its acceleration has no radial component. Prove that its angular velocity is constant and magnitudes of velocity and acceleration are proportional to r. 4

   (b) To a person going on a bicycle at 10 km/hr due east wind seems to below from a direction 60° south of west at 6 km/hour. Find the actual direction and velocity of wind. 4

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

(b) Prove that work done against the tension in stretching a light elastic string is equal to the products of its extension and mean of the initial and final tensions. 4

UNIT–II

4. (a) Prove that the shortest time from rest to rest in which a steady load P tons can lift a weight W tons through a vertical distance h ft is $\sqrt{\frac{2\,hP}{g\,(P-W)}}$. 4

(b) If the string of an Atwood's machine can bear a strain of only $\frac{1}{8}$ of the sum of two weights. Show that least possible acceleration is $\frac{\sqrt{3}}{2}g$. 4

5. (a) State and prove the Principle of conservation of energy. 4

(b) Show that if a mass m is allowed to slide down a smooth inclined plane, the sum of potential and kinetic energies at every instant is the same. 4

UNIT–III

6. (a) A particle slides down the outside of a smooth vertical circle starting from rest at the highest point. Discuss the motion. 4

(b) A particle is projected from the lowest point inside a smooth sphere of radius 'a' with velocity $2\sqrt{ag}$. Find the point at which it will leave the sphere and equation to subsequent path of the particle. 4

7. (a) If R be the range of a projectile on a horigontal plane and h its maximum height for a given angle of projection. Show that the maximum range with the same velocity of projection is $2h+\frac{R^2}{8h}$. Also show that the velocity of projection is $\left[2g\left(h+\frac{R^2}{16h}\right)\right]^{\frac{1}{2}}$. 4

(b) If α, β be the two directions to hit a given point (a, b) with axes as usual, show that tan $(\alpha, \beta) = -\frac{a}{b}$. 4

UNIT–IV

8. (a) Obtain differential equation of central orbit in polar form. 4

(b) A particle is projected from an apse at a distance 'a' with a velocity from infinity under the action of central force $\frac{\mu}{r^{2n+3}}$. Prove that the equation of path is $r^n = a^n \cos n\theta$. 4

9. (a) A particle describes an ellipse under a force $\frac{\mu}{r^2}$ to the focus. Show that velocity at the end of minor axis is a geometric mean between the greatest and the least velocities. 4

(b) Find the acceleration of a particle in terms of spherical polar coordinates. 4