SHRIMATHI DEVKUNVAR NANALAL BHATT VAISHNAV COLLEGE FOR WOMEN
(AUTONOMOUS)
(Affiliated to the University of Madras and Re-accredited with 'A+' Grade by NAAC)
Chromepet, Chennai — 600 044.
B.Sc.(Maths) END SEMESTER EXAMINATIONS NOVEMBER - 2023
SEMESTER - V
20UMACT5011 - Dynamics

Total Duration : 2 Hrs 30 Mins. Total Marks : 60

Section B

Answer any **SIX** questions $(6 \times 5 = 30$ Marks)

1. Find the magnitude and direction of the resultant velocities $\overline{v_1}$ and $\overline{v_2}$.
2. If a point moves in a straight line with uniform acceleration and covers successive equal distances in times t_1,t_2, t_3, then show that $\frac{1}{t_1} - \frac{1}{t_2} + \frac{1}{t_3} = \frac{3}{t_1 + t_2 + t_3}$
3. Show that the resultant of two simple harmonic motions of same period along the same straight line is also simple harmonic with the same period.
4. Show that the path of a projectile is a parabola.
5. A particle is projected over a triangle from one end of its horizontal base to graze the vertex and fall at the other end of the base. If B and C are the base angles and α, the angle of projection, show that tan α = tan B + tan C .
6. A shell of mass m is moving with velocity v. An internal explosion generates an energy E and breaks the shell into two portions whose masses are in the ratio a : b. They continue to move in the original line of motion. Show that their velocities after explosion are $v + \sqrt{\frac{2bE}{am}}$,$v - \sqrt{\frac{2aE}{bm}}$
7. A ball dropped from a height h on a horizontal plane bounces up and down . If the coefficient of restitution is e, prove that

   (i) The whole distance H covered before its comes to rest is $h\frac{1+e^2}{1-e^2}$

   (ii) The total time T taken is $\frac{1+e}{1-e}\sqrt{\frac{2h}{g}}$
8. Show that the moment of inertia of the circular lamina is $\frac{1}{2}a^2$

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Section C

Answer any **THREE** questions $(3 \times 10 = 30$ Marks)

9. The wind is blowing due east with a speed u. An aeroplane which has a constant speed v in still air flies at a constant height to a point at a distance x in the east and a distance y in the north form the starting point in time t and flies back to the starting point in time t' .
   Show that tt' $= \dfrac{x^2 + y^2}{v^2 - u^2}$
   and that on each journey the plane must be steered in a direction inclined to the line of flight at an angle $\sin^{-1}\dfrac{uy}{v\sqrt{x^2 + y^2}}$.

10. Show that two bodies of masses m and are attached to the lower end of an elastic string whose upper end is fixed and hang at rest , falls off. Show that the distance of m from the upper end of the string at time t is a+b+c cos$\sqrt{\frac{g}{b}}t$ where a is the unstretched length of the string and b and c are the distances by which it would be stretched when supporting m and .

11. Prove that a ball is projected so as to just clear two parallel walls, the first of height a at a distance b from the point of projection and the second of height b at a distance a from the point of projection. Supposing the path of the ball to lie in a plane perpendicular to the walls, find the range on the horizontal plane and show that the angle of projection exceeds $\tan^{-1}3$

12. Find the impulse imparted to each sphere and change in the kinetic energy of the spheres when two smooth spheres collide directly.

13. State and prove parallel axis theorem.

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