

Roll.No.

20UMACT5011

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 Mathematics- END SEMESTER EXAMINATIONS - NOVEMBER 2025

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. In the simple harmonic motion whose equation is  $\ddot{x} = n^2x$ .  
Express i)  $x$  in  $t$  (ii)  $\dot{x}$  in  $t$  (iii)  $\dot{x}$  in  $x$ .
2. To a man walking along a level road at 5 km/h the rain appears to beat into his face at 8 km/h at an angle  $60^\circ$  with the vertical. Find the direction and magnitude of the true velocity of the rain.
3. 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 lie in a plane perpendicular to the walls, find the range on the horizontal plane and show that the angle of projection exceeds  $\tan^{-1} 3$ .
4. Two equal balls of mass  $m$  are in contact on a table. A third ball strikes both symmetrically and remains at rest after impact. Show that  $e = 2/3$ .
5. State and Prove Perpendicular axis theorem.
6. Two particles  $A_1, A_2$  describe concentric circles of radii  $a_1, a_2$  and centre  $O$  with speed  $v_1, v_2$ . Show that when the relative angular velocity on one particle about the other vanishes.
7. Show that the M.I of a rectangular lamina of mass  $M$  and sides  $2a$  and  $2b$  about a diagonal is  $M \frac{2a^2b^2}{3(a^2 + b^2)}$
8. The displacement  $x$  of a particle moving along a straight line is given by  $x = A \cos nt + B \sin nt$ , where  $A, B, n$  are constants. Show that its motion is S.H. If  $A = 3, B = 4, n = 2$ , find its period, amplitude, maximum velocity and maximum acceleration.

Condt...

## Section C

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

9. Derive the equations for rectilinear motion with a constant acceleration.
10. Two bodies of masses  $m$  and  $m'$  are attached to the lower end of an elastic string whose upper end is fixed and hang at rest  $m'$ , falls off. Show that the distance of  $m$  from the upper end of the string at time  $t$  is

$$a + b + c \cos \sqrt{\frac{g}{b}} t$$

11. To show that the path of a projectile is a parabola. Find also the maximum height and horizontal range.
12. 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 it comes to rest is

$$h \frac{1 + e^2}{1 - e^2}$$

- ii) The total time  $T$  taken is

$$\frac{1 + e}{1 - e} \sqrt{\frac{2h}{g}}$$

13. Define moment of inertia. Also derive the moment of inertia for the following cases:
- i) Circular lamina.
- ii) Solid sphere.

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