(8 Pages) **Reg. No. :** .....

Code No. : 30347 E **Sub. Code : SMMA 64**

B.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2022

Sixth Semester

Mathematics — Main

DYNAMICS

(For those who joined in July 2017 onwards)

Time : Three hours Maximum : 75 marks

PART A — ($10 \times 1 = 10$ marks)

Answer ALL questions.

Choose the correct answer :

1. The horizontal range R of a projectile is ————

(a) $\frac{u^2 \sin\alpha}{g}$ (b) $\frac{u^2}{g}$

(c) $\frac{u^2 \sin 2\alpha}{g}$ (d) None

2. A particle is projected with a velocity of 24 m/sec at an elevation of 30°. Then the time of flight is

(a) $\frac{12}{g}$ (b) $\frac{36}{g}$

(c) $\frac{24^2}{g}$ (d) $\frac{24}{g}$

3. When two equal sphere impinge directly, their velocities are inter changed. Then their elasticity is ————

(a) 0 (b) $\frac{1}{2}$

(c) $\frac{1}{4}$ (d) 1

4. When an elastic sphere strikes a plane normally with velocity u, it rebounds in the same direction with velocity ————

(a) u (b) eu

(c) u/e (d) e^2u

5. The period of SHM $x = a\cos 2t + b\sin 2t$ is ————

(a) 3π (b) 2π

(c) $\pi/2$ (d) π

6. In a simple Harmonic motion, the phase at time t is ————

(a) $t+\frac{E}{\sqrt{\mu}}$ (b) $t+\frac{1}{\sqrt{\mu}}$

(c) $t-\frac{E}{\sqrt{\mu}}$ (d) $t+\frac{1}{2E}$

7. The acceleration of a particle describing a circle of radius a has the component ———— along the radius to the center.

(a) $a\dot{\theta}^2$ (b) $a\theta$

(c) $a\ddot{\theta}$ (d) $a\ddot{\theta}^2$

8. The transverse component of velocity is ————

(a) $r\theta$ (b) $\dot{r}$

(c) $r\dot{\theta}$ (d) $\ddot{r}-r\dot{\theta}^2$

9. The pedal equation of the parabola – pole at focus is ————

(a) $r^2=2ap$ (b) $r^2=ap$

(c) $p^2=2ar$ (d) $p^2=ar$

10. The $(p-r)$ equation of the central orbit is ————

(a) $h\Big/p^2\frac{dp}{dr}=F$ (b) $h^2\Big/p\frac{dp}{dr}=F$

(c) $h^2\Big/p^2\frac{dp}{dr}=F$ (d) $h^2\Big/p^3\frac{dp}{dr}=F$

PART B — ($5\times5=25$ marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Find the range of a particle projected on an inclined plane.

Or

(b) A revolver can fire a bullet with a velocity of 63 m per sec. Is it possible to hit the top of a tower 400 m away its height being 30 m?

12. (a) Find the velocities of two smooth spheres after their direct impact.

Or

(b) A ball overtakes another ball of m times its mass, which is moving with $\frac{1}{n}$th of its velocity in the same direction. If the impact reduces the first ball to rest, prove that the coefficient of elasticity is $\frac{m+n}{m(n-1)}$.

13. (a) Find the composition of two simple harmonic motions of the same period in two perpendicular directions.

Or

(b) Show that the energy of a system executing SHM is proportional to the square of the amplitude and of the frequency.

14. (a) Find the velocity and acceleration in polar co-ordinates.

Or

(b) Find the polar equation of equiangular spiral.

15. (a) Find the law of force towards the pole under which the curve $r^n = a^n \cos n\theta$ can be obtained.

Or

(b) Derive the pedal equation for hyperbola – pole at focus.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Show that the greatest height which a particle with initial velocity v can reach on a vertical wall at a distance 'a' from the point of projection is $\frac{v^2}{2g} - \frac{ga^2}{2v^2}$.

Or

(b) Show that the path of projectile is parabola.

17. (a) Find the loss of kinetic energy due to direct impact between two smooth spheres.

Or

(b) A particle is projected from a point on an inclined plane and at the r^{th} impact it strikes the plane perpendicularly and at the n^{th} impact is at the point of projection. Show that $e^n - 2e^r + 1 = 0$.

18. (a) Write the fundamental differential equation of a particle in simple harmonic motion. Solve it completely.

Or

(b) If the displacement of a moving point at any time be given by an equation of the form $x = a\cos wt + b\sin wt$. Show that the motion is a simple harmonic motion. If $a = 3$, $b = 4$, $w = 2$, determine the period, amplitude, maximum velocity.

19. (a) Show that the path of a point P which possess two constant velocities u and v, the first of which is in a fixed direction and the second of which is perpendicular to the radius OP drawn from a fixed point O is a conic whose focus is O and eccentricity is u/v.

Or

(b) A point describes a curve with constant velocity and its angular velocity about the given fixed point O varies inversely as the distance from O, show that the curve is an equiangular spiral whole pole is O and that the acceleration of the point is along the normal at P and varies inversely as OP.

20. (a) Derive the differential equation of a central orbit in polar co-ordinates.

Or

(b) A particle moves in an ellipse under a force which is always directed towards its focus. Find the law of force, the velocity at any point of the path and its periodic time.

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