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

Code No. : 10429 E **Sub. Code : CMMA 64**

B.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2024.

Sixth Semester

Mathematics – Core

DYNAMICS

(For those who joined in July 2021-2022)

Time : Three hours Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer:

1. Maximal horizontal range of projectile is ————.

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

(c) $\frac{u \sin 2\alpha}{g}$ (d) $\frac{2u \sin \alpha}{g}$

2. The greatest height attained by a projectile is ————.

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

(c) $\frac{2u \sin \alpha}{g}$ (d) $\frac{u^2 \sin 2\alpha}{g}$

3. For a perfectly elastic particle $e =$ ————.

(a) 0 (b) 1

(c) 2 (d) 1/2

4. If two spheres are perfectly elastic and of equal mass than ————.

(a) $m_1 > m_2$ (b) $m_1 = m_2$

(c) $m_1 < m_2$ (d) $m_1 \neq m_2$

5. The fundamental equation of S.H.M. is $\frac{d^2x}{dt^2} =$ ————.

(a) μx (b) $-\mu x$

(c) $\mu^2 x$ (d) $\sqrt{\mu}$

6. The period of S.H.M. is ————.

(a) $\frac{1}{\sqrt{\pi}}$ (b) $\frac{2}{\sqrt{\mu}}$

(c) $\frac{2\pi}{\sqrt{\mu}}$ (d) $\frac{\pi^2}{\sqrt{\mu}}$

7. $(p-r)$ equation to the spiral is ————.

(a) $p = r\sin\alpha$

(b) $p = r\sin\beta$

(c) $p = r + \sin\alpha$

(d) $p = \sin\beta$

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

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

(c) $\dot{r}$ (d) $\dot{r}\dot{\theta}$

9. $p-r$ equation of ellipse is ————.

(a) $\frac{b^2}{p^2} = \frac{2a}{r} + 1$ (b) $p^2 = ar$

(c) $p^2 = -ar$ (d) none

10. The differential equation of a central orbit is ————.

(a) $u + \frac{d^2u}{d\theta^2} = \frac{p}{h^2u^2}$

(b) $\frac{d^2u}{d\theta^2} + u = \frac{1}{h^2u^2}$

(c) $u + \frac{d^2u}{d\theta^2} = \frac{p}{hu}$

(d) $\frac{d^2u}{d\theta^2} + \frac{1}{u^2} = \frac{1}{h^2}$

PART B — (5 × 5 = 25 marks)

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

11. (a) Find the time of flight of a projectile.

Or

(b) A particle is projected at an angle 'α' with a velocity 'u' and 'f' strikes up an inclined plane of inclination β at right angles to the plane prove that (i) $\cot\beta = 2\tan(\alpha - \beta)$, (ii) $\cot\beta = \tan\alpha - 2\tan\beta$.

12. (a) A ball dropped from a height 'h' on a horizontal plane bounces up and down. If the coefficient of restitution is e, prove that the whole distance covered before it comes to rest is $\frac{h(1+e^2)}{1-e^2}$.

Or

(b) A ball is thrown from a point on a smooth horizontal ground with a speed 'v' at an angle α to the horizontal. Show that the total time for which the ball rebounds on the ground is $\frac{2v\sin\alpha}{g(1-e)}$.

13. (a) Prove that the path of a particle which possess 25 HMS – simple harmonic motions in perpendicular directions and of the same period is an ellipse.

Or

(b) A particle moves in a straight line and of v be the velocity at a distance x from a fixed point in the line $v^2 = \alpha - \beta x^2$ where α and β are constant. Show that the motion is simple harmonics and determine its period and amplitude.

14. (a) Find the radial and transverse components of velocity and acceleration.

Or

(b) Find the polar equation of the spiral.

15. (a) Derive the differential equation of the central orbit.

Or

(b) Find the law of force towards the pole for the orbit $r^n = a^n \cos n\theta$.

PART C — (5 × 8 = 40 marks)

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

16. (a) A particle is thrown over a triangle from one end of a horizontal base and gracing the vertex falls on the other end of the base. If A, B are the base angles and α the angle if projection show that $\tan\alpha = \tan A + \tan B$.

Or

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

17. (a) Explain fundamental law of impact.

Or

(b) Find the loss of kinetic energy due to oblique impact of two smooth spheres.

18. (a) Obtain the differential equation of simple harmonic motion, and its displacement.

Or

(b) Find the resultant of two simple harmonic motion of the same period in the same straight line.

19. (a) The velocities of a particle along and perpendicular to a radius vector from a fixed origin and λr^2 and $\mu\theta^2$ where μ and λ are constant. Show that the equation to the path of the particle is $\frac{\lambda}{\theta}+c=\frac{\mu}{2r^2}$ where c is constant.

Or

(b) 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 draw from a fixed point O, is a conic whose focus is O and whose eccentricity is $\frac{U}{V}$.

20. (a) Derive the pedal equation of a central orbit.

Or

(b) Find the pedal equation of

(i) circle pole at any point

(ii) parabola-pole at focus.
