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

Code No. : 30581 E **Sub. Code : SMMA 64**

B.Sc. (CBCS) DEGREE EXAMINATION,
APRIL 2020.

Sixth Semester

Mathematics — Core

DYNAMICS

(For those who joined in July 2017 onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. Time taken by the projectile to reach the greatest height is ————————

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

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

2. The acceleration of a particle moving up a smooth inclined plane of inclination α to the horizon is _____

(a) $g \sin\alpha$ (b) $g \cos\alpha$

(c) g (d) None of these

3. Which of the following material balls when impinge on each other has more elasticity?

(a) glass (b) ivory

(c) lead (d) iron

4. As per Newton's experimental law, the velocities after impact $v_2 - v_1$ = _____ [where u_1, u_2 - velocities before impact)

(a) $-(u_2 - u_1)$ (b) $-e(u_1 - u_2)$

(c) $e(u_1 - u_2)$ (d) $-(u_1 - u_2)$

5. The period of a simple Harmonic motion is

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

(c) π / μ (d) None of these

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

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

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

7. The radial component of acceleration is ———————

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

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

8. The differential equation of central orbit is ———————

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

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

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

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

9. The transverse component of velocity is _____

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

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

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

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

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

PART B — (5 × 5 = 25 marks)

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

Answer should not exceed 250 words.

11. (a) Show that for a given initial velocity, there are two possible directions of projections to obtain a given horizontal range.

Or

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

12. (a) Find the velocity and direction of motion of a smooth sphere after its impact on a fixed smooth plane.

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) A particle is moving with SHM and while making an oscillation from one extreme position to the other, its distances from the centre of oscillation at 3 consecutive seconds are x_1, x_2, x_3. Prove that period of oscillation is $\frac{2\pi}{\cos^{-1}\left(\frac{x_1+x_3}{2x_2}\right)}$.

14. (a) Find the polar equation of equiangular spiral.

Or

(b) Find the velocity and acceleration in polar Co-ordinates.

15. (a) Derive the pedal equation for hyperbola-pole at focus.

Or

(b) Find the law of force to an internal point under which a body will describe a circle.

PART C — (5 × 8 = 40 marks)

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

Answer should not exceed 600 words.

16. (a) Find the following

(i) The greatest height attained by a projectile

(ii) Time taken to reach the greatest height

(iii) Time of flight

(iv) Range of projectile.

Or

(b) The range of a rife bullet is 1000 m. When α is the angle of projection? Show that if the bullet is fired with the same elevation from a car travelling 36 km/hr towards the target, the range will be increased by $\frac{1000\sqrt{\tan\alpha}}{7}$ m.

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

Or

(b) A particle falls from a height h upon a fixed horizontal plane if e be the coefficient of restitution, show that the whole distance described before the particle has finished rebounding is $h\left(\frac{1+e^2}{1-e^2}\right)$. Show also that the whole time taken is $\frac{1+e}{1-e}\sqrt{\frac{2h}{g}}$.

18. (a) Describe the geometrical representation of simple harmonic motion.

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 simple harmonic. Also if $a=3$, $b=4$, $w=2$, then find period, amplitude, maximum velocity and maximum acceleration of the motion.

19. (a) Show that the path of a point P which possesses 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 $\frac{u}{v}$.

Or

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

20. (a) Find 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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