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

Code No. : 20348 E **Sub. Code : EMPH 31/ FCPH 31**

B.Sc. (CBCS) DEGREE EXAMINATION, NOVEMBER 2025.

Third Semester

Physics — Core

MECHANICS

(For those who joined in July 2023 onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL the questions.

Choose the correct answer :

1. A body travelling with uniform velocity has ———— acceleration.

   (a) Unit (b) Zero

   (c) Small (d) Negative

2. Force is measured in ————.

   (a) Newton

   (b) Kilogram

   (c) Meter

   (d) Kilogram Meter

3. Which of the following quantity remains conserved when the moon revolves around the earth?

   (a) Velocity

   (b) Angular momentum

   (c) Linear momentum

   (d) None

4. Which one of the following is not a conservative force?

   (a) Frictional force

   (b) Electrical force

   (c) Gravitational force

   (d) Spring force

5. The total energy of the system is ————————.

(a) not a constant

(b) constant

(c) a positive quantity

(d) a negative quantity

6. Power is expressed in ————————.

(a) Watt

(b) Joule per second

(c) Both (a) and (b)

(d) Joule

7. $(r \times p)$ is

(a) Torque

(b) Force

(c) Angular momentum

(d) None

8. Radian is a ————————.

(a) Pure number

(b) Dimensionless quantity

(c) Both (a) and (b)

(d) Dimension quantity

9. Configuration space of n particles with k constraints would have the following number of dimensions

(a) $(n-k)$ (b) $3n$

(c) $(3n+k)$ (d) $(3n-k)$

10. The motion of rigid bodies is always such that the distance between any two particles in it ————————.

(a) remains constant

(b) changes

(c) is arbitrarily

(d) is restricted

PART B — ($5 \times 5 = 25$ marks)

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

Each answer should not exceed 250 words.

11. (a) Explain Newton's Law of Gravitation.

Or

(b) State Kepler's Laws of Planetary motion.

12. (a) Define center of mass and deduce expression for center of mass of a system.

Or

(b) State the fundamental principles of impact and define coefficient of restitution.

13. (a) Describe the conservation of energy in gravitational field.

Or

(b) Define work, power and energy.

14. (a) State and prove parallel axes theorem.

Or

(b) Obtain an expression for rotational kinetic energy of a rotating body.

15. (a) Setup Lagrange's equation of motion for a simple pendulum and obtain an expression for its period.

Or

(b) State and explain d'Alembert's principle.

PART C — (5 × 8 = 40 marks)

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

Each answer should not exceed 600 words.

16. (a) Derive an expression for time of flight of a projectile and its range on a horizontal plane under the action of uniform gravitational field.

Or

(b) Describe the Boy's method for determination of gravitational constant.

17. (a) Deduce the loss of kinetic energy due to direct collision of two smooth spheres.

Or

(b) What is a rocket? Considering rocket and the ejected burnt fuel during rocket motion as a single closed and isolated system, derive an expression for thrust of the rocket engine. Also calculate the increase of speed of rocket due to change of its mass from M_i to M_f.

18. (a) Derive Work-Energy theorem.

Or

(b) Explain Conservative Force. Prove Conservative Force Property. Deduce Potential Energy Function.

19. (a) Obtain an expression for total kinetic energy of a body rolling on a smooth horizontal plane.

Or

(b) Derive an expression for acceleration of uniform body rolling down an inclined plane. Discuss the special case for a circular ring.

20. (a) Explain generalized co-ordinates. Write down the equations of constraints and identify the generalized co-ordinates in the following cases.

(i) a simple pendulum bob oscillating in vertical plane.

(ii) a particle moving along a circle in XY plane.

(iii) a particle moving over a surface of a sphere.

Or

(b) Setup Lagrange's equation for Atwood's machine and obtain the equation of motion of the system.
