

Code No.: 5374

Sub. Code: ZMAE 21

M.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2023.

Second Semester

Mathematics

CLASSICAL MECHANICS – Elective

(For those who joined in July 2021 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

- If the force acting on a particle are conservative then $T + V$ is conserved. The name of the theorem is
 - Energy conservation theorem for a particle
 - Conservation theorem for linear momentum of a particle
 - Conservation theorem for the angular momentum of a particle
 - Conservation theorem for angular momentum
- Let f be a function of n independent variable y_i and their derivatives \dot{y}_i . The equations $\frac{\partial f}{\partial y_i} - \frac{d}{dx} \left(\frac{\partial f}{\partial \dot{y}_i} \right) = 0, i = 1, 2, 3, \dots, n$ is called _____
 - Lagrange's equations
 - Hamilton's equations
 - Euler's Lagrange's equation
 - Newton's equation of motion
- If $e < 1$ and $E < 0$ then the orbit is _____
 - Circle
 - Ellipse
 - Parabola
 - Hyperbolic
- The equation $\omega t = \psi - e \sin \psi$ is known as _____
 - Lagrange's equations
 - Newton's equations
 - Hamilton's equations
 - Kepler's equation
- $\frac{1}{2} r^2 \dot{\theta}$ is called _____
 - linear velocity
 - angular velocity
 - areal velocity
 - relative velocity

- A particle is constrained to move along any curve on a given surface is _____ constraint.
 - holonomic
 - non-holonomic
 - rheonomous
 - scleronomous
- U in the equation $L = T - U$ is called _____
 - kinetic energy
 - momentum
 - generalized potential
 - torque
- $Q_j = \sum_i \bar{F}_i \frac{\partial r_i}{\partial q_j}$ is called _____
 - electromagnetic force
 - frictional force
 - impulsive force
 - generalized force
- The shortest distance between two points on a given surface is called _____ of the surface.
 - radius
 - diameter
 - geodesic
 - straight line

- Which of the following theorem is used in deriving Boyle's law for perfect gas?
 - Conservation theorem for linear momentum
 - Bertrand's theorem
 - Virial theorem
 - Cartheodory theorem

PART B — (5 × 5 = 25 marks)

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

- (a) Show that $\frac{dT}{dt} = F \cdot v$ and if the mass varies with time $\frac{d(mT)}{dt} = F \cdot p$

Or

 (b) Prove that $M^2 R^2 = M \sum_i m_i r_i^2 - \frac{1}{2} \sum_{i,j} m_i m_j r_{ij}^2$
- (a) Discuss the motion of a bead sliding on a uniformly rotating wire in a force-free space.

Or

 (b) Explain Dissipation function.

13. (a) Explain the minimum surface of revolution.

Or

(b) Find the shortest distance between two points in a plane.

14. (a) Prove that the central force motion is always motion in a plane.

Or

(b) State and prove Virial theorem.

15. (a) Prove that $\tau = 2\pi\sqrt{m/k} a^{3/2}$.

Or

(b) Derive Kepler's equation.

PART C — (5 × 8 = 40 marks)

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

16. (a) Explain Constraints.

Or

(b) State and prove energy conservation theorem of a particle.

17. (a) Discuss Maxwell equations in connection with Lagrange's equation.

Or

(b) Derive Lagrange's equation of motion for Atwood machine.

18. (a) Discuss the problem of finding out the curve for which any line integral has a stationary value.

Or

(b) Explain Brachistochrone problem.

19. (a) Derive the four integral.

Or

(b) Discuss orbits by inverse square law.

20. (a) Define Laplace-Runge-Lenz vector and discuss their properties.

Or

(b) State and prove Kepler's third law of planetary motion.