

KAMARAJ COLLEGE (Autonomous)

Accredited with A+ Grade by NAAC

(Affiliated to Manonmaniam Sundaranar University, Tirunelveli)

THOOTHUKUDI – 628 003

5 Pages

Reg. No:

Question. Code No : 2400332

Sub Code : 24PMPH12

PG Degree - End Semester Examinations, November 2024

First Semester

M.Sc. Physics

Major - CLASSICAL MECHANICS AND RELATIVITY

(For those who joined in July 2024 onwards)

Time : 3 Hours

Maximum : 75 Marks

PART A – (10 × 1 = 10 Marks)

Answer ALL Questions

Choose the correct answer :

1. A non-holonomic constraint may be expressed in the form of
 - (a) equality
 - (b) inequality
 - (c) vector
 - (d) None of these
2. An example of a rheonomous constraint is

- (a) Bead rotating on a wire loop (b) Bead on a rotating wire loop
- (c) A simple Pendulum (d) A torsional Pendulum
3. Example of conservative force
- (a) Air resistance (b) Gravitational force
- (c) Frictional force (d) None of above
4. The lagrangian for a charged particle in electromagnetic field is
- (a) $L = T + q\phi + q(\mathbf{v} \cdot \mathbf{A})$ (b) $L = T - q\phi - q(\mathbf{v} \cdot \mathbf{A})$
- (c) $L = T - q\phi + q(\mathbf{v} \cdot \mathbf{A})$ (d) $L = T + q\phi - q(\mathbf{v} \cdot \mathbf{A})$
5. Hamilton's Canonical equations of motion are
- (a) $\dot{q}_i = \frac{\partial H}{\partial p_i}$ and $\dot{p}_i = \frac{\partial H}{\partial q_i}$ (b) $\dot{q}_i = \frac{\partial H}{\partial p_i}$ and $\dot{p}_i = - \frac{\partial H}{\partial q_i}$
- (c) $\dot{q}_i = \frac{\partial H}{\partial p_i}$ and $\dot{p}_i = \frac{\partial H}{\partial q_i}$ (d) $\dot{q}_i = \frac{\partial H}{\partial p_i}$ and $\dot{p}_i = - \frac{\partial H}{\partial q_i}$
6. For a charged particle in an electromagnetic field, the canonical momenta are
- (a) $m\mathbf{v} + \frac{q}{c} \mathbf{A}$ (b) $\frac{1}{2}m\mathbf{v}^2 + \frac{q}{c} \mathbf{A}$
- (c) $m\mathbf{v} - \frac{q}{c} \mathbf{A}$ (d) $\frac{1}{2}m\mathbf{v}^2 - \frac{q}{c} \mathbf{A}$
7. Stable equilibrium is characterised by
- (a) Minimum of potential energy (b) Maximum of kinetic energy
- (c) Maximum of total energy (d) None of above
8. Example of neutral equilibrium is
- (a) Pendulum at rest (b) Rod standing in one end

- (c) A book placed on a table (d) Egg standing on one end
9. Non inertial frame has.
- (a) Zero velocity (b) Non-zero acceleration
- (c) Zero acceleration (d) Both (A) and (c)
10. Minskowski space combines inertial space and time into.
- (a) one dimensional model (b) Three dimensional model
- (c) Two dimensional model (d) Four dimensional model

PART B – (5X5=25 Marks)

Answer ALL Questions choosing either (a) or (b).

(Answer should not exceed 250 words)

11. (a) Give a short note on generalized coordinates and configuration space.

(OR)

- (b) Derive principle of Virtual work.

12. (a) Derive the Lagrangian equation of motion for simple pendulum.

(OR)

- (b) Describe Atwood's Machine as an application of Lagrangian equation of motion.

13. (a) Show that the generalized momentum is conserved only when the generalized coordinate is cyclic.

(OR)

- (b) Derive Hamilton's canonical equation of motion and explain the physical significance of Hamiltonian.

14. (a) Write notes on Stable and Unstable equilibrium.

(OR)

- (b) Derive the Lagrangian formulation of small oscillations.

15. (a) Write briefly about Time dilation.

(OR)

- (b) Explain inertial and non-inertial frame with examples.

PART C – (5 × 8 = 40 Marks)

Answer ALL Questions choosing either (a) or (b).

(Answer should not exceed 600 words)

16. (a) What are constraints? Explain with examples Holonomic and Non- Holonomic constraints.

(OR)

- (b) Using Newton's law of motion derive conservation theorem for linear momentum, Angular momentum and energy for the motion of system of particles.

17. (a) Derive Lagrangian equation for non- conservative system.

(OR)

(b) Derive the Lagrangian for the particle moving in electromagnetic field.

18. (a) Obtain Hamilton function, equation for motion and expression for Harmonic oscillator.

(OR)

(b) Prove that the Hamiltonian H of the system is equal to the total energy of the system.

19. (a) Discuss the vibrations of linear triatomic molecule.

(OR)

(b) Give the properties of T , V , and W .

20. (a) Explain Minkowski space. Write about i) Velocity ii) momentum and iii) Acceleration.

(OR)

(b) Derive Einstein mass- energy relation.