

Roll.No.

20PPHCT1002

SHRIMATHI DEVKUNVAR NANALAL BHATT VAISHNAV COLLEGE FOR WOMEN
(AUTONOMOUS)

(Affiliated to the University of Madras and Re-accredited with 'A+' Grade by NAAC)
Chromepet, Chennai - 600 044.

M.Sc.Physics - END SEMESTER EXAMINATIONS - NOVEMBER 2025
SEMESTER - I

20PPHCT1002 - Classical Mechanics and Relativity

Total Duration : 2 Hrs. 30 Mins.

Total Marks : 60

Section B

Answer any **SIX** questions ($6 \times 5 = 30$ Marks)

1. Explain the concept of cyclic coordinates and derive the condition for conservation of momentum.
2. Derive Lagrange's equations of motion from Hamilton's principle.
3. Explain infinitesimal rotations and derive how they are represented as vectors.
4. Show that Poisson brackets preserve the form of Hamilton's equations under canonical transformations.
5. Derive the equations of motion using Poisson bracket formalism.
6. Solve the differential equations for two identical coupled oscillators and obtain the normal mode frequencies.
7. Show that the scalar product of two four-vectors is Lorentz invariant.
8. Derive the relativistic Hamiltonian for a free particle from first principles.

Section C

I - Answer any **TWO** questions ($2 \times 10 = 20$ Marks)

9. Starting from Newton's law, derive Kepler's three laws of planetary motion using the conservation of angular momentum and energy.
10. Derive Euler's equations of motion for a torque-free rigid body and solve them for a symmetric top.
11. Derive the Hamilton-Jacobi equation. Solve the harmonic oscillator problem using Hamilton-Jacobi theory.
12. Discuss the Lorentz invariance of Maxwell's equations. Show how the electric and magnetic fields transform in to one another.

II - Compulsory question ($1 \times 10 = 10$ Marks)

13. Explain the concept of normal modes and normal coordinates. Apply this to solve the case of a linear triatomic molecule and find its vibrational frequencies.
