(i) Printed Pages : 3 Roll No. .....

(ii) Questions : 9 Sub. Code : 3 2 2 3

Exam. Code : 4 7 2

**M.Sc. 1st Semester**

**1125**

**PHYSICS**

**Paper—Phy-6002 : Classical Mechanics**

**Time Allowed : Three Hours]** **[Maximum Marks : 60**

**Note :—** Attempt **five** questions in all selecting **one** each from Units I–IV. Q. 9, Unit-V is compulsory. All questions carry equal marks.

## UNIT—I

1. (a) A particle of mass m moves in one dimension such that it has the Lagrangian $L = \frac{m^2\dot{x}^4}{12} + m\dot{x}^2 V(x) - V^2(x)$, where V is differentiable function. Find the equation of motion for x(t) and discuss the result. 6

   (b) Derive Lagrange's Equations from Variational Principle. 6

2. (a) Show that the Lagrangian of a system is indefinite to the extent of total time derivatives of a function of coordinates and time. 6

   (b) Derive Lagrange's Equations from D'Alembert's Principle. 6

## UNIT—II

3. (a) What is the Coriolis effect ? Find an expression for the deviation of a falling body from the vertical. 6

(b) What is Inertia tensor ? Define Moment of Inertia and thus find Inertia tensor for a homogeneous cube of density $\rho$ and mass M. Choose the origin to be at one corner of the cube and axes along the edges. 6

4. Describe in detail the motion of a heavy symmetrical top. 12

## UNIT—III

5. (a) A dynamical system has the Lagrangian $L = \dot{q}_1^2 + \frac{\dot{q}_2^2}{a + pq_1^2} + cq_1^2 + d\,\dot{q}_1\dot{q}_2$, where a, b, c and d are constants. Find equations of motion in the Hamiltonian formulation. 6

(b) State and prove the principle of least action. 6

6. (a) Find the frequency and the normal coordinates of vibration of a linear triatomic molecule considering small displacement from the mean position. 7

(b) Derive Hamilton equations from variational principle. 5

## UNIT—IV

7. (a) Use Hamilton–Jacobi method to solve one dimensional Harmonic Oscillator problem. 6

(b) Discuss active and passive view of the canonical transformations. Endorse the statemment *the constants of the motion are the generating functions of those infinitesimal canonical transformations that leave the Hamiltonian invariant.* 6

8. (a) Show that Symplectic condition implies the existence of a generating function. 6

(b) Show that the transformation $p = m\omega q \cot Q$ and $P = \frac{m\omega q^2}{2 \sin^2 Q}$ is canonical. 6

## UNIT—V

9. (a) What are normal coordinates ?

(b) Briefly explain inertial ellipsoid. What would be the shape of inertial ellipsoid of a cube ?

(c) Distinguish between Libration and rotation.

(d) Write equations of motion in terms of Poisson bracket.

(e) Find expression for angular momentum of a system of particles.

(f) What is Legendre transformation ? Give two examples.

$6 \times 2 = 12$