Exam. Code : 209001
Subject Code : 3752

M.Sc. Physics 1st Semester

PHY–403 : CLASSICAL MECHANICS

Time Allowed—3 Hours] [Maximum Marks—100

Note :— Attempt **FIVE** questions. Select at least **one** question from each section. The **fifth** question may be attempted from any section.

SECTION—A

I. Using Newton's laws of motion, deduce the conservation theorems for linear momentum, angular momentum and energy for the motion of a system of particles. 20

II. (a) State Hamilton's principles and hence derive Lagrange's equations of motion using this variational principle. 14

(b) Obtain Lagrangian and equations of motion for the harmonic motion of a particle on the surface of a cone. 6

SECTION—B

III. (a) Derive differential equation for the orbit of a particle moving under the influence of a central force field. 10

(b) A particle describes a conic $r = \frac{a}{1+b\cos\theta}$. where a and b are constant. Show that the force under which particle is moving is a central force. Deduce the force law and energy of the particle. 10

IV. What do you mean by differential and total scattering cross-sections ? Discuss the problem of scattering in a central force field and hence obtain Rutherford's scattering formula. 20

SECTION—C

V. Discuss in brief the role of orthogonal transformation matrix in rigid body kinematics. Hence state and prove the various properties of orthogonal transformation matrix. 20

VI. A rigid body is rotating about an axis through the origin. Obtain angular momentum and kinetic energy in terms of inertia tensor. How do these expressions get modified in the coordinate system in which the body axes coincide with the principle axes ? 20

SECTION–D

VII. (a) Define Hamiltonian of a system and hence deduce Hamilton's equations of motion from it. Discuss the various features of these equations. 12

(b) Write Hamiltonian and equations of motion for a compound pendulum. 6

(c) Is Hamiltonian more basic or Lagrangian ? Give arguments in support of your answer. 2

VIII. (a) What is an infinitesimal canonical transformation ? Obtain its relation with Poisson bracket. Hence deduce the conservation of linear and angular momenta of a given mechanical system. 16

(b) Derive Hamilton's equations of motion in terms of Poisson bracket form. 4