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I Semester M.Sc. Degree Examination, March/April - 2025

PHYSICS**Classical Mechanics**

(CBCS New Scheme effective from 2019-2020 Freshers+Repeaters)

Paper : PHY 102

Time : 3 Hours

Maximum Marks : 70

(3×15=45)

1. a) What are generalized coordinates?
- b) Set up the Lagrangian for a simple pendulum and obtain the equation of motion.
- c) Explain how translational symmetry leads to conservation of linear momentum.

(3+8+4)

(OR)

2. a) What is a central force? Outline the general properties of central force motion.
- b) Discuss the motion of a particle under a central force that obeys the inverse square law.

(5+10)

3. a) Give the general description of scattering. Define scattering cross section and impact parameter.
- b) Obtain an expression for Rutherford scattering cross section.

(5+10)

(OR)

4. a) Discuss the motion of a particle in non-inertial frame of reference. Show that the resultant force is the sum of real and fictitious force.
- b) Show that the rotation of the plane of oscillation of Foucault's pendulum demonstrates the fact that the earth rotates about its axis.
- c) Show that for small displacements, the condition for stable equilibrium is that the potential energy is minimum at the equilibrium configuration.

(6+5+4)

[P.T.O.]



(2)

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5. a) Obtain the Euler's equations for the motion of a rigid body with one point fixed under the action of a torque.
- b) Show that under the torque free motion of a rigid body the total rotational kinetic energy and angular momentum is conserved.
- c) Write a note on the generalised momentum and cyclic coordinates.

(5+5+5)

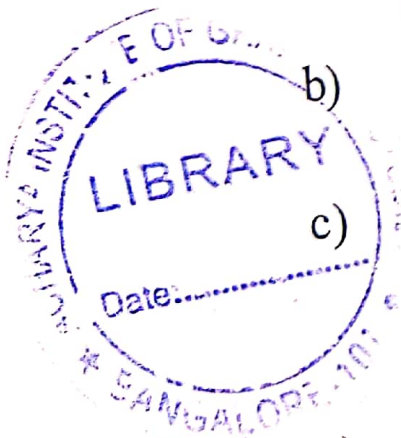
(OR)

6. a) Define Poisson bracket. Mention any three properties of the brackets.
- b) Obtain the differential equation in second order for a particle moving under central force using Hamiltonian formalism.

(5+10)

(5×5=25)

Answer any Five of the following:





7. Answer any **Five** of the following.

(5×5=25)

- Obtain the equation of motion of a system of two masses, connected by an inextensible string passing over a small smooth pulley.
- Equation of the orbit of a particle under the action of central force is given by $r = e^{b\theta}$. Find the corresponding force.
- Explain the advantages of centre of mass frame compared to the laboratory frame of reference in the scattering problem.
- The potential energy of a particle is given by the expression

$$V(x) = x^4 - 4x^3 - 8x^2 + 48x.$$

Find the points of stable and unstable equilibria.

- Derive the equation of motion of one-dimensional harmonic oscillator by using Hamilton's principle.
- If $[\phi, \Psi]$ be the Poisson bracket of ϕ and Ψ , then prove that

$$\frac{\partial}{\partial t} [\phi, \Psi] = \left[\frac{\partial \phi}{\partial t}, \Psi \right] + \left[\phi, \frac{\partial \Psi}{\partial t} \right]$$