25/2392

M.Sc. (First Semester) Examination, 2025

PHYSICS

Paper : Second

(Classical Mechanics)

Time : Two Hours] *[Maximum Marks : 75*

Note : Attempt **all** sections as per instructions.

Section-A

(Very Short Answer Type Questions)

Note : Attempt all the **(05) five** questions. Each question carries **02 (two)** marks and answer of each question should not exceed **50** words. 5×2=10

1. (a) Define generalised coordinate.

   (b) What is Hamilton's principle?

P.T.O.

   (c) What are advantages of canonical transformation?

   (d) Explain Poisson bracket.

   (e) Define action angle variable.

Section-B

(Short Answer Type Questions)

Note : Attempt any **05 (Five)** questions out of Total **08 (Eight)** questions. Each question carries **05 (five)** marks and answer of each question should not exceed **100** words. 5×5=25

2. (a) Write the Lagrange's equation of motion for a particle of mass m falling under gravity.

   (b) Obtain Hamiltonian of a charged particle in an electromagnetic field.

   (c) Show that the transformation :

   $P = \frac{1}{2}(p^2 + q^2)$

   $Q = \tan^{-1}\left(\frac{q}{p}\right)$ is canonical.

(d) What is principle of least action?

(e) Deduce Hamilton-Jacobi Equation.

(f) Discuss the theory of spinning symmetrical top under gravity.

(g) Explain theory of small oscillation.

(h) Derive equation of motion in terms of Poisson's Bracket.

Section-C

(Long Answer Type Questions)

Note : Attempt any **02 (Two)** questions out of total **04 (four)** questions. Each question carries **20 (twenty)** marks and answer of each question should not exceed **400** words. 2×20=40

3. (a) Find the Lagrange's equation of motion using D' Alembert's principle for holonomic system. Show that if the Lagrangian does not depend explicitly on time, then the energy is conserved.

(b) Deduce the principle of least actions in the following form :

$$\delta \int_{t_1}^{t_2} T dt = 0$$

Where T is the kinetic energy.

(c) State and prove Liouville's theorem. Give the physical significance of this theorem.

(d) Discuss the vibrations of a linear symmetric triatomic molecule and calculate the eigen vectors for the three modes of vibrations for $\omega_1=0$, $\omega_2 = \sqrt{\frac{k}{m}}$, and $\omega_3 = \sqrt{\frac{k}{m}\left(1+\frac{2m}{M}\right)}$ where middle atom mass is M and atoms at end have mass m and k is the spring force constant.