

A-0429

Total Pages : 3

Roll No.

MSCPH-502

Master of Science (MSC)

Classical Mechanics

Examination, June 2025

Time : 2:00 Hrs.

Max. Marks : 70

Note :- This paper is of Seventy (70) marks divided into Two (02) Sections 'A' and 'B'. Attempt the questions contained in these Sections according to the detailed instructions given therein. *Candidates should limit their answers to the questions on the given answer sheet. No additional (B) answer sheet will be issued.*

Section-A

Long Answer Type Questions 2×19=38

Note :- Section 'A' contains Five (05) Long-answer type questions of Nineteen (19) marks each. Learners are required to answer any *two* (02) questions only.

1. Write down the Lagrange's equation of motion for a particle of mass m falling freely under gravity near the surface of earth. Also deduce Newton's equation of motion from Lagrange's equations.

2. Discuss the Hamiltonian Formalism and obtain Hamiltonian equation of motion for a classical system.
3. Derive Hamilton's Equations from the variational principle. Deduce Hamilton's principle. How can this principle be used to find the equation of one-dimensional harmonic oscillator.
4. Discuss in detail the Euler angles and obtain an expression for the complete transformation matrix.
5. Discuss the scattering of α -particles under a central force field and hence obtain the expression for Rutherford scattering cross-section.

Section–B

Short Answer Type Questions 4×8=32

Note :– Section ‘B’ contains Eight (08) Short-answer type questions of Eight (08) marks each. Learners are required to answer any *four* (04) questions only.

1. What are constraints ? Explain the various types of constraints. Give their significance.
2. Deduce the Lagrangian expression for a charged particle in an electromagnetic field.
3. Deduce the Hamiltonian function and equation of motion for a Compound pendulum. Also evaluate the value of periodic time.

4. What is inverse square law force ? Derive Kepler's law with its help.
5. How many generalized coordinates are needed to specify the motion of a rigid body ? Discuss it in detail.
6. State and prove the virial theorem.
7. Show that the transformation :

$$Q = \log(1 + \sqrt{q} \cos p)$$

$$P = 2\sqrt{q}(1 + \sqrt{q} \cos p) \sin p$$

is canonical. Find the generating function $F(p, Q)$.

8. What are the Poisson and Lagrange bracket's ? Show that the Lagrange's bracket is invariant under canonical transformation.
