Roll No. : .....

Total No. of Questions : **16**] [Total No. of Printed Pages : **3**

PHYSSEM–114

M.Sc. (Ist Semester) Examination, Dec., 2022

PHYSICS

Paper – CC–102

(Classical Mechanics)

*Time : **3** Hours*] [*Maximum Marks : **40***

The question paper contains three Sections.

Section–A **(Marks : 1 × 10 = 10)**

Note :– The candidate is required to answer all the *ten* questions carries **1** mark each. The answer should not exceed **50** words.

Section–B **(Marks : 3 × 5 = 15)**

Note :– The candidate is required to answer *five* questions by selecting at least *one* question from each Unit. Each question carries **3** marks. Answer should not exceed **200** words.

Section–C **(Marks : 5 × 3 = 15)**

Note :– The candidate is required to answer *three* questions by selecting at least *one* question from each Unit. Each question carries **5** marks. The answer should not exceed **500** words.

Section–A

1. (i) What do you mean by constrained motion ? Give one example.

   (ii) Define generalized momentum and cyclic coordinates.

   (iii) Define Jacobi Integral. Under what condition it becomes Hamiltonian of a system.

   (iv) State principle of least action.

   (v) Write Hamilton-Jacobi equation. What is Hamilton-Jacobi function ?

   (vi) Define canonical transformation with the help of one example.

   (vii) What is Poisson breacket ? Write any *two* of its properties.

   (viii) What are rotating frames ?

   (ix) Write Kepler's second law of planetary motion.

   (x) Write down the formula for Rutherford-Scattering cross-section.

Section–B

Unit–I

2. State and derive D'Alembert's principle.

3. Find equation of motion for one-dimensional linear harmonic oscillator using Lagrangian method.

4. Describe various types of constraints in brief with one example of each.

Unit–II

5. Derive Hamilton's equations of motion.

6. Find equation of motion for a particle in central field of force using Hamilton's equation of motion.

7. Deduce bilinear invariant condition for a transformation to be canonical.

Unit–III

8. If potential is $V(r) = kr^{n+1}$, then derive the condition for stability and closure for the orbits.

9. Discuss any *one* application of Coriolis force briefly.

10. Discuss general features of the centre force motion.

Section–C

Unit–I

11. Derive Lagrangian equation of motion for a conservative system.

12. Prove that law of conservation of energy, linear momentum and angular momentum are direct consequence of homogeneity of time and space and isotropy respectively.

Unit–II

13. What is generating function ? Show that the following transformation is canonical :

$$q = \sqrt{2p}\sin\phi$$

$$q = \sqrt{2p}\cos\phi$$

14. Show that the Poisson Bracket of any two functions is invariant under canonical transformation.

Unit–III

15. Explain how the problem of two bodies moving under the influence of a mutual central force can be reduced a one body problem.

16. Write short notes on the following :

    (a) Artificial satellites

    (b) Rutherford scattering