Reg. No. : ....

Name : ....

First Semester M.Sc. Degree Examination, October 2023

Physics with Specialization in Nano Science/Physics with Specialization in Space Physics

PHNS 511/PHSP 511 – CLASSICAL MECHANICS

(2020 Admission Onwards)

Time : 3 Hours

Max. Marks : 75

SECTION – A

(Answer **any five** questions, Each carries **3** marks)

1. What is meant by an inertial mass and gravitational mass? Is there any difference between two?

2. Explain the term 'Resonance'. How is the resonant frequency affected by damping?

3. What is velocity dependent potential? Where do we come across such potential?

4. Distinguish between a symmetric top, spherical top and rotor.

5. Explain the meaning of generating function and give example of it.

6. What are proper length and proper time?

7. What is Hamilton's principal function? Explain the physical significance of Hamilton's principal function.

8. Show that the Poisson's bracket of two functions, F and G, does not obey the commutative law but obeys the distributive law.

(5 × 3 = 15 Marks)

P.T.O.

(Answer **All** questions, Each carries **15** marks)

9. (a) Explain the principle of virtual work and D'Alembert's principle.

    (b) Derive the Langrange's equations of motions from D'Alembert's principle.

OR

    (c) Briefly explain the general properties of central force motion and how the orbital motions are classified for different values of energy.

10. (a) Explain Action- angle variable formalism.

    (b) Obtain an expression for the frequency of 1D-harmonic oscillator using action-angle variable.

OR

    (c) What is velocity dependent potential?

    (d) Derive the Lagrangian type equation of a charged particle moving in an electromagnetic field.

11. (a) What is logistic equation and explain the formation of bifurcation and chaotic region?

    (b) Give the importance of Lyapunov exponent to explain the formation of normal and chaotic regions.

OR

    (c) State and prove force and energy equations in relativistic mechanics.

(3 × 15 = 45 Marks)

(Answer **any three** questions 5 marks each)

12. A particle is constrained to move in a circle in the vertical plane XY. Using D'Alembert's principle show that for equilibrium, $\ddot{x}y - \ddot{y}x - gx = 0$.

13. Show the equivalence of Lagrange's and Newton's equation.

14. A bead is sliding on a uniformly rotating wire in a force free space. Obtain Lagrangian and equation of motion.

15. Lagrangian is given by $L = T - e\phi + \dfrac{e}{c}$ A.V. If A and ϕ are independent of time 't'. Obtain the Hamiltonian.

16. The potential energy function between two atoms of a diatomic molecule is given by $V = ax^{-12} - bx^{-6}$. a, b are positive constants and x is the separation between atoms. Find the equilibrium position.

17. Show that the following transformations are canonical $Q = \dfrac{1}{p}, P = qp^2$.

(3 × 5 = 15 Marks)

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