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**Reg. No. : .....**

**Name : .....**

**First Semester M.Sc. Degree Examination, May 2022**

**Physics**

**PH 211 : CLASSICAL MECHANICS**

**(2020 Admission Onwards)**

Time : 3 Hours Max. Marks : 75

PART – A

(Answer **any five** questions, **3** marks each)

1. When is a force field is said to be conservative?

2. How does the amplitude of oscillation vary around the resonant frequency?

3. What are cyclic coordinates? Show that the generalised momentum corresponding to a cyclic coordinate is a constant of motion.

4. What are Euler angles? Draw a neat diagram showing these angles. What will happen if their order is not maintained?

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

6. Speed of light is same for all observers regardless of the state of motion. Explain.

7. What is Hamilton's characteristic function? Give the physical significance of Hamilton's characteristic function.

8. Define Poisson's bracket and discuss their properties.

**(5 × 3 = 15 Marks)**

**P.T.O.**

## PART – B

(Answer **All** questions **15** marks each)

1. (A) (a) Explain Hamilton's principle.

(b) What are different symmetry properties and conservation laws in Lagrangian formulation?

OR

(B) Discuss the scattering of a particle in a central force field and derive Rutherford's scattering formula.

2. (A) (a) Explain canonical transformation.

(b) Obtain different transformation equations using generating functions of type $F_1$, $F_2$ and $F_3$

OR

(B) (a) Explain Hamilton-Jacobi equation.

(b) Obtain the solution of Harmonic oscillator using Hamilton-Jacobi equation.

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

OR

(B) (a) Explain the phase space diagram of linear oscillator and dissipative linear pendulum and obtain the condition for a conservative and dissipative system.

(b) What is fractal and its dimension?

**($3 \times 15 = 45$ Marks)**

## PART – C

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

1. A particle of mass m can move without friction on the surface of a paraboloid of revolution $\Phi = x^2 + y^2 - z = 0$ under the action of a uniform gravitational field in the negative Z direction. Obtain the equation of motion using D'Alembert's principle.

2. Show that the kinetic energy is a quadratic function of generalized velocities.

3. Obtain the Lagrange's equation of motion for a spherical pendulum, that is, a mass point suspended by a rigid weightless rod.

4. The Lagrangian for a simple harmonic oscillator is $L = \frac{1}{2}m\dot{q}^2 - \frac{1}{2}kq^2$. Obtain Hamiltonian and Hamilton's equations of motion.

5. A particle of mass 'm' moves along the axis under the influence of the potential energy $V(x) = -kxe^{-\beta x}$ where k, $\beta$ are constants. Find the equilibrium position.

6. Show that the curve of minimum length joining a pair of point in a plane is straight line.

**($3 \times 5 = 15$ Marks)**

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