PHY7102: CLASSICAL MECHANICS I2(2-0)

1. Course Name: Classical Mechanics I

2. Course Code: PHY7102

3. Credit Units: 2

4. **Course Description:**

This course builds on the undergraduate Classical Mechanics by reviewing the Lagrangian and Hamiltonian formulations, before introducing the more complex transformations. These are then applied to continuous media and fields.

5. Course Objectives:

At the end of the course, the students should be able to:

- Apply Lagrange's equations to charged particles in electromagnetic fields.
- Apply small oscillations treatment to systems with a few degrees of freedom.
- Use canonical transformations when considering conservation laws.
- Apply Lagrangian and Hamiltonian formulations to continuous media and fields.

6. Course Outline:

Content	**Hours**
Brief review of Lagrangian formulation of mechanics: Lagrange's equations of motion derived from Hamilton's principle; Jacobian and Momentum Integrals; Extension of Hamilton's principle to non-conservative syatems. Application of Lagrange's equation to a charged particle in an electromagnetic field.	7
Small Oscillations: Orthogonal transformation and properties of the transformation matrix; Oscillations of a natural system: the eigen value equation and the principal axis transformation; eigen frequencies and eigen modes;	8

applications to systems with a few degrees of freedom; molecular vibrations.	
Special Relativity: Relativistic Covariants and tensor calculus; Relativistic kinematics and dynamics; Covariant Lagrangian and Hamiltonian formulations.	5
Hamiltonian formulation of Mechanics: Legendre transformations; Hamilton’s equations of motion; Conservation theorems; Principle of least action.	7
Canonical transformations: Generating functions; Lagrange and Poisson brackets; Jacob’s identity; Poisson brackets in quantum mechanics; Infinitesimal canonical transformations; Symmetries and Conservation laws.	10
Lagrangian and Hamiltonian formulation for continuous media and for fields: Continuous systems: Lagrangian and Hamiltonian densities; the tensor. Hamilton-Jacobi theory.	8
Total	**45**

7. Mode of Delivery:

This course will consist mainly of lecture sessions.

8. References:

1. Daniel Kleppner and Robrt J.Kolenkov. Introduction to Mechanics. McGraw Hill(1973).

2. John Taylor. Classical Mechanics. University Science Books(2005).