PPH101: CLASSICAL MECHANICS

L	T	P	Cr
3	1	0	3.5

Course Objectives: To apprise the students of Lagrangian and Hamiltonian formulations and their applications.

Newtonian Mechanics: One and many particle system; conservation of linear and angular momentum, work energy theorem,

System of Particles: Constraints, D'Alembert principle, Principle of virtual work, Degree of freedom, generalized coordinates and momenta, Lagrange's equation and application of linear harmonic oscillator, Simple pendulum and central force problems, Cyclic coordinate, Symmetries and conservation laws, Hamiltonian, Lagrange's equation from Hamilton's Principle, Principle of least action derivation of equation of motion; variation and end points.

Central Force: Reduction of two body problem into single body problem. Definition and characteristics of central force; Closure and stability of circular orbits. General analysis of orbits: bounded and unbounded orbits, Kepler's law of motion, Scattering in centre of mass and laboratory frame of reference, Rutherford scattering.

Rigid Body Dynamics: Euclerian angle, Inertia tensor, principal moment of inertia. Euler's equation of motion of a rigid body, Force free motion of a symmetrical top.

Canonical Transformation: Canonical transformation, Legendre Transformation, Generating functions. Conditions for a transformation to be canonical, Hamilton-Jacobi equation, Hamilton's principle and characteristics functions, Action and action angle variables

Wave Motion: Small oscillations, Normal modes and normal coordinates. Examples: Two coupled pendulums and Vibration of linear tri-atomic molecule, Dispersion relation.

Course Learning Outcomes (CLO):

Students will have understanding of

1. necessity of Lagrangian and Hamiltonian formulations.
2. essential features of a problem (like motion under central force, rigid body dynamics, periodic motions), use them to set up and solve the appropriate mathematical equations, and make quick and easy checks on the answer to catch simple mistakes.
3. theory of small oscillations which is important in several areas of physics e.g., molecular spectra, acoustics, vibrations of atoms in solids, coupled mechanical oscillators and electrical circuits.

Recommended Books:

1. *Rana, N.C. and Joag, P.S., Classical Mechanics, Tata McGraw-Hill, (1991).*
2. *Goldstein, H., Classical Mechanics, Pearson Education, (2007).*