Phys 3101	CLASSICAL MECHANICS	(CR3)
Preq.	Phys 1001	

Objectives

To introduce students with the basic concepts of dynamical systems and to develop Lagrangian and Hamiltonian formulation of mechanics.

Syllabus

Kinematics, description of motion, space, time and coordinate systems, displacement, velocity and acceleration, Newtonian mechanics, laws of motion, inertial and noninertial frames, work, energy and conservation theorems, system of particles and conservation theorems for system of particles. Lagrangian formulation in generalized coordinates, constraints, principle of virtual work, D'Alembert's principle, Lagrange equations of motion, cyclic coordinates, Routhian function and noncyclic coordinates, forces of constraints and Lagrange multipliers, velocity dependent potentials, charged particle in an electromagnetic field. Central force problem, reduction of two-body problem, reduced mass, conservation in central force field, Kepler laws, properties of motion in central force field, effective potential, calculations of orbits of planets, derivation of Kepler's laws, stability of circular orbits, Rutherford scattering, impact parameter and scattering angle, scattering cross section, derivation of Rutherford scattering formula. Methods in calculus of variations, Euler's equations, second form of Euler's equations, Beltrami identity, some examples of calculus of variations, Hamilton's principle of least action, Lagrange equations. Space time symmetries and conservation laws, homogeneity and isotropy, cyclic coordinates, integrals of motion, Noether's Theorem, Legendre's transformation, Hamiltonian and Hamilton's equations of motion, Poisson brackets and their properties, phase space and phase portrate. Canonical transformations and their properties, canonical transformation of the free particle Hamiltonian, invariance of Poisson's brackets under canonical transformations.

Recommended Books

1. *Classical Mechanics by H. Goldstein, C. P. Poole and J. L. Safko, Pearson New International Edition, (2014)*
2. *Classical Dynamics of Particles and Systems, S. T. Thornton and J. B. Marion, Cengage Learning, 5th Edition, (2012)*
3. *Classical Mechanics by T. L. Chow (2nd Edition), CRC Press (2013)*
4. *Classical Mechanics, D. Strauch, Springer (2009)*
5. *Classical Mechanics, M. J. Benacquista and J. D. Romano, Springer (2018)*