BSP503					Classical Mechanics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To revise Newtonian mechanics and introduce Lagrangian formulation of mechanics.
- To emphasis the understanding of Classical Mechanics using Lagrangian and Hamiltonian Approach.
- To realize the reduction of a two-body problem to a one-body problem in a central force system.
- To appreciate the theory of relativity for particles having relativistic speeds.

UNIT 1 LAGRANGIAN DYNAMICS 16 Hrs.

Review of Newtonian Mechanics – Conservation laws – Inertial frames – Mechanics of a system of particles, Coordinate System – Degrees of freedom – Constraints – Generalized coordinates – Principle of Virtual work – D' Alembert's principle – Lagrangian and Lagrange's equations of motion – Generalized potential – Superiority of Lagrangian mechanics over Newtonian – Gauge Invariance of the Lagrangian – Symmetry property of Space and Time and conservation laws.

UNIT 2 HAMILTONIAN DYNAMICS 12 Hrs.

Generalized momentum - Cyclic coordinates – Conservation Theorems and symmetry properties, energy function and the conservation energy - Hamiltonian's Principle - Derivation of Lagrange's equations from Hamilton's Principle - Advantage of a Variational Principle formulation and examples.

UNIT 3 CENTRAL FORCE PROBLEM 14 Hrs.

Reduction of two-body to equivalent one-body problem – Central force equation and motion in a plane - differential equation for an orbit - Kepler's laws – Stability of orbits under central force – Artificial satellites – Virial Theorem - Scattering in the central field – Rutherford scattering cross section.

UNIT 4 SPECIAL THEORY OF RELATIVITY 18 Hrs.

Galiliean transformation – Principle of relativity – Transformation of force from one inertial system to another – Covariance of Physical laws – Principle of relativity and theory of light – Michelson-Morley Experiment – Ether hypothesis – Postulates of special theory of relativity – Lorentz transformations - Minkowski space – Time dilation – Length contraction - simultaniety – Four Vectors: Four momentum and energy-momentum relation – Conservation of four-momentum - Relativistic Doppler's effect.

Max. 60 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Identify the motion of a mechanical system using Lagrange-Hamilton formalism.
CO2 - Apply the formalism of Lagrangian and Hamiltonian in generating equations of motion for complicated mechanical systems of classical mechanics.
CO3 – Determine the differential equation of orbit, stability of orbit under central force, scattering cross section, scattering angle, impact factor.
CO4 – Compare Lagrangian and Hamiltonian formalism, Galiliean and Lorentz transformation and various reference frames.
CO5 – Apply theory of relativity to determine time dilation, length contraction and simultaneity,
CO6 – Determine the various Four vectors: position, velocity, acceleration, momentum, Force etc.

TEXT/REFERENCE BOOKS

1. Classical Mechanics, H. Goldstein, C.P. Poole, J. L. Safko, 3rd Edn. 2002, Pearson Education.
2. Mechanics, L. D. Landau and E. M. Lifshitz, 1976, Pergamon.
3. Classical Mechanics, P.S. Joag, N.C. Rana, 1st Edn., McGraw Hall.
4. Classical Mechanics, R. Douglas Gregory, 2015, Cambridge University Press.
5. Solved Problems in classical Mechanics, O. L. Delange and J. Pierrus, 2010, Oxford Press.