Course Title: Introduction to Relativistic Mechanics
Course Code: PHYS 312
Level: B.Sc. (Applied Physics)
Year: III
Semester: II

Course Objectives: This is the basic course on relativistic mechanics. It provides the details of classical theory of relativity to the special theory of relativity. At the end of this course students will know the basic ideas form relativistic kinematics to Minkowski space and relativistic Hamilton’s principle.


2. Einstein’s special theory of relativity: Relativistic kinematics: The relativity of simultaneity: The relativistic concept of space and time, Attempts to locate the absolute frame: Michelson-Morley experiment, Postulates of special theory of relativity, Lorentz transformation equation, Consequences of Lorentz transformation equations: Relativity of simultaneity, Einstein time dilation (Apparent retardation of clocks), Relativity of space (Length contraction), Relativity of time, Transformation of acceleration, Phenomenon of aberration (Relativistic). [12 Hrs.]

3. Relativistic mechanics: Introduction (mass and momentum), Variation of mass with velocity, Equivalence of mass and energy, Transformation of mass, Relation between momentum and energy, Transformation of momentum and energy, Lorentz transformation of force, Relativistic Lagrangian and Hamiltonian. [9 Hrs.]

4. Minkowski space: Geometrical interpretation of Lorentz transformations: Introduction, Geometrical interpretation of Lorentz transformations of space and time, Geometrical representation of simultaneity, contraction and dilation, Space like and time like intervals, Four vectors, Minkowski equation of motion, Relativistic classification of particles. [9 Hrs.]

5. Relativistic Hamilton’s principle and covariant equations of motion: Modified Hamilton’s principle, Derivation of Hamilton’s equations from modified Hamilton’s principle (Variational principle), Hamilton’s principle in relativity, Derivation of relativistic Lagrange’s equation, Derivation of Hamilton’s canonical equations in covariant form. [10 Hrs.]

References