

Course Structure: Mathematical Methods for Physicists (Offered in PhD Course, ISI)

1) Variational Principle and its applications:

Basics and simple applications

Fermat's Principle in Geometrical Optics

Action in Classical Mechanics: Lagrangian and Hamiltonian formalisms from VP

Electrodynamics: Boundary conditions and Maxwell's equations from VP

Lagrangian and Hamiltonian formalism of General Relativity (after 3)

2) The Quantum World from Variational Principle:

Hamiltonian and Lagrangian forms of Schroedinger equation

Relativistic Quantum Mechanics from Lagrangian formalism

Concept of Lagrangian density in Quantum Field Theory

Scalar and spinor fields

3) Tensors and Differential Geometry:

Basics of tensor algebra and tensor calculus

Applications to Relativistic Electrodynamics

Applications to General Relativity and comparison with variational principle

Differential Geometry formalism of General Relativity (Basics only)

Simple solutions of Astrophysical objects

4) Group Theory and applications:

Symmetry and Groups: Discrete and continuous groups

Generators of Continuous groups, Orbital angular momentum

Major groups in Particle Physics

Group Theory and Expanding universe

5) Statistical Methods in Physics:

Concept of prior and Maximum Likelihood Analysis

Basics of Bayesian Methods and Fisher Matrix Analysis

Simple applications to Cosmology/ Many body physics.

6) Path Integral and its applications:

Concept of functional

Reformulation of Quantum Mechanics and Quantum Field Theory

Simple applications

