SS861 CLASSICAL FIELD THEORY 3-1-0-4

Course objectives:

The course introduces the concepts and calculations involved in classical field theory. It extensively explains the theory of hydrodynamics and classical field theory of Gravitation.

UNIT 1: Continuum Mechanics

Review of Classical Mechanics:Lagrangian and Hamiltonian formalisms, Liouville's theorem,Transformation theory, Action-Angle variables, Hamilton-Jacobi equations.Lagrangian and symmetries: Energy-Momentum tensor, Noether's theorem and applications

UNIT 2: Hydrodynamics

The velocity and density fields. Continuity equation, Pascal's Law and the stress tensor, Bernoullis principle, Euler equations. Gravity waves, Viscosity, Navier-Stokes equations. Boundary conditions, examples of flow, low Reynolds number flows, Stokes limit. Relativistic Hydrodynamics.

UNIT 3: Maxwell's theory as a Classical Field Theory

Lorentz transformation,The electromagnetic field tensor, covariant charge density and current, action formalism for electrodynamics, Maxwell's equations and relativistic covariance, Lagrangian and Hamiltonian formalism, Symmetries and covariance, Gauge invariance.

UNIT 4: Classical Field Theory of Gravitation

Principle of equivalence, curvilinear coordinates, metric, connection, curvature tensor, energy-momentum tensor, Einstein field equations and its Newtonian limit.

Reference Books:

1. L. D. Landau and E. M. Lifshitz, *The Classical Theory of Fields*, Pergamon Press, 4^{th} Edition, 1980.

2. G. Giachetta, L. Mangiarotti and G. Sardanashvily, *Advanced Classical Field Theory*, World Scientific, 2009.

3. Florian Scheck, *Classical FieldTheory- On Electrodynamics, Non-Abelian Gauge Theories and Gravitation*, Springer, 2012.

Course Outcomes:

After the completion of the course student is expected to:

CO1. Have a deep understanding of the concepts and physical ideas of classical field theory and perform calculations in field theory, with special application to electromagnetism.

CO2. Study and analyse classical theory of hydrodynamics in depth

CO3. Understand the Electromagnetism and Gravitation as a classical relativistic field theory

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