PPH445: PLASMA PHYSICS AND FUSION REACTOR

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Course Objective: To expose the students to theory related to motion of charge particle in inhomogeneous field, production of plasma and usage of plasma.

Introduction: Plasma state, plasma parameters, applications of plasmas.

Single Particle Orbit Theory: Drift of charge particle under different combinations of electric and magnetic field, crossed electric and magnetic fields, homogenous electric and magnetic fields, spatially and time varying electric and magnetic fields,

The Boltzmann Equation - Simplified magneto-hydrodynamic equations - Electron plasma oscillations, Debye shielding phenomenon and criteria for plasma, Electric field drift, curvature drift, adiabatic invariants; fundamental equations of magneto-hydrodynamics(MHD), magnetic confinement.

Production of Plasma in Laboratory: Physics of glow discharge, electron emission, ionization breakdown of gases, Paschen's law and different regimes of E/ρ in a discharge.

Plasma Diagnostic: Probes, energy analysers and optical diagnostics.

Fusion Reactor: Potential of fusion energy, controlled thermonuclear reactions, fusion power generation, energy balance for fusion systems, ignition criterion, gain factor, plasma heating, inertial confinement fusion.

Course Learning Outcomes (CLO):
Students will have understanding of:

1. what are theoretical method to study the charge particle motion
2. how to generate plasma in the laboratory?
3. how plasma production is helpful to make fusion reactors

Recommended Books:

1. *Chen, F.F., Introduction to Plasma Physics, Springer, (1984).*
2. *Sturrock, P.A., Plasma Astrophysics, Cambridge University Press, (1994)*
3. *Choudhuri, A.R., The Physics of Fluids and Plasmas, Cambridge University Press, (1998).*
4. *Nicholson, D. R., Introduction to Plasma theory, Wiley, (1983).*