Course title: Concepts of plasma physics

Course Instructor: Sudeep Bhattacharjee

Course No. : PHY682

Plasma physics is one of the most active research areas in modern physics. Most of the visible universe is in the plasma state and plasma phenomena are of major importance in space, solar and ionospheric physics. Here on earth one of the most ambitious scientific and technological undertakings of the second half of the twentieth century has been the quest for controlled thermonuclear fusion – for which plasma physics is the key underlying scientific discipline. Plasma physics forms the basis of many technologies that have revolutionized areas of physics research, such as gaseous ion sources, focused ion beams for plasma nanotechnology, generation of electromagnetic radiation, plasmas confined in multicusp and dipole magnetic fields, including dusty and laser produced plasmas. Several industrial applications rely on plasma physics, to name a few semiconductor processing, sputtering for thin film deposition, plasma display panels, plasma based lighting technologies, production of nanoparticles and nanostructuring, and more recently atmospheric pressure plasma jets and plasmas in liquids for biomedical applications, which has altogether opened a new field of plasma medicine. The objective of this course is to lay out the concepts of this exciting subject.

The course begins with a general introduction to plasma physics and is designed with the purpose of presenting a comprehensive, logical and unified treatment of the concepts of modern plasma physics. The course is primarily aimed for first year post graduate students and beyond or advanced undergraduate students meeting the subject of plasma physics for the first time and presupposes knowledge of vector analysis, differential equations, complex variables, as well as courses on classical mechanics and electromagnetic theory. To provide a flavor for experimental research to the students, time permitting, the students will be introduced to plasma experiments and may be asked to conduct measurements of laboratory plasma parameters.

Course Contents:

This course has been broadly divided into eight chapters.

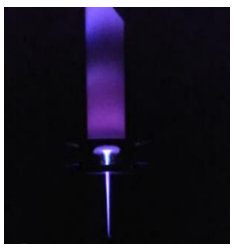
[1]. Introduction [2]. Charged particle motion in electromagnetic fields [3]. Some basic plasma phenomena [4]. Collisional processes in plasmas [5]. Fluid description of plasmas [6]. Diffusion and mobility [7]. Equilibrium and instabilities [8]. Introduction to waves in plasmas

Reference Text Books:

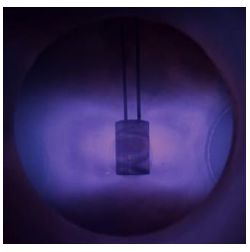
1. Introduction to plasma physics and controlled fusion (Vol. 1), F. F. Chen
2. Introduction to Plasma Physics, R. J. Goldston and P. H. Rutherford
3. Fundamentals of Plasma Physics, J. A. Bittencourt
4. Compact plasma and focused ion beams, Sudeep Bhattacharjee

Lightning

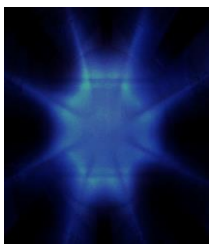
Nebula



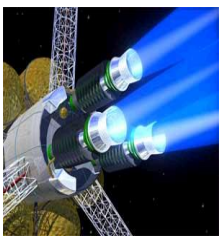
Plasma jet



Dipole plasma



Multicusp plasma



Plasma thruster