

Course Title	Course Code	Number of Study Hours			Year	Level	Prerequisites
		Theoretical	Laboratory	Credit			
Plasma Physics	452PHYS	3	---	3	4 th	8 th	353PHYS

(1) **Brief Course Description**

Plasma is the fourth state of matter that incredibly important in basics sciences and technology. This course is an introductory course to plasma physics in which the plasma state and the basics plasma parameters and conditions are defined. Also in this course, the plasma models, the plasma oscillation, and waves phenomena in plasma are explained, in addition. The theory of gas discharge and the breakdown mechanism in plasma are illustrated, as well as the thermonuclear fusion reactions and criteria are given.

(2) **Course Objectives**

This course is designed to provide students with:

- The definition of plasma state and its main behavior and characteristics.
- The basic plasma parameters and some examples of plasma state in nature.
- The plasma conditions and the relation between these conditions and the plasma behavior.
- The single particle model and the motion of the charged particle in uniform electric and magnetic field.
- The fluid plasma model, the plasma frequency, and waves in plasma.
- The theory gas discharge and the breakdown mechanism in plasma experiments.
- the thermonuclear fusion criteria and its roles in the fusion experiments.

(3) **Course Contents**

- **Plasma State:** Plasma in Nature, Definition of Plasma , Concept of Temperature, Debye Shielding, Plasma parameters and conditions.
- **Plasma models:** The single particle mode, and Motion of single particle in uniform E and B .
- **Waves in plasma:** The wave definition and representation, The phase and group velocity , The plasma oscillation, Electron plasma wave, Ion plasma (sound) waves.
- **Gas discharge and breakdown:** Background (The gas discharge and its classifications), The Direct current (DC) discharge, Breakdown condition, The Townsend, Glow and Arc discharges.
- **Plasma experiments and diagnostics:** Introduction to controlled fusion (Fusion reaction and Lawson criterion), The Magnetic Confinement, The Inertial Confinement
- **Plasma Diagnostics and plasma application** (elective)

(4) **Assessment Criteria**

- Periodic Exams: 30%
- Oral, Student Activity and Essay: 20%
- Final Exam: 50%

(5) **Course Teaching Strategies**

- Lectures, Reports and Essay Assignments, Homeworks, and Web-based assignments.

(6) **Text Book**

- Introduction to Plasma Physics and Controlled Fusion; F. F. Chen, Plenum Press, 2006.
- Fusion Research Principles, Experiments, and Technology, T. Dolan, Pergamum Press 2000.

(7) **Reference Books**

- Fundamentals of Plasma physics; Paul M. Bellan, Cambridge University Press, 2006.
- Introduction to Plasma Physics; R.J. Goldston, P.H. Rutherford, Institute of Physics Publishing, London, 1997.