# Plasma Physics

**Academic Year: ( 2023 / 2024 )** **Review date: 09-06-2021**

**Department assigned to the subject: Physics Department**

**Coordinating teacher: GARCIA GONZALO, LUIS**

**Type: Compulsory ECTS Credits : 6.0**

**Year : 1 Semester : 1**

## REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Basic knowledge of electromagnetic theory (graduate level)

## OBJECTIVES

The student will acquire during this course the knowledge of basic physical phenomena related to plasma confinement. At the end of the course, the student will be able to understand the mathematical models involved in plasma physics.

## DESCRIPTION OF CONTENTS: PROGRAMME

1. PLASMA. Debye shielding. Plasma frequency. Gas discharges. Fusion plasmas.
2. FLUIDS AND PLASMAS. Different levels of theory.
3. THE NEED OF ENERGY: The role of Nuclear Fusion. Magnetic confinement fusion and inertial confinement.
4. SINGLE PARTICLE MOTION. Electric and magnetic drifts. Adiabatic invariants. Trapped particles.
5. DESCRIPTION OF PLASMAS AS FLUIDS. Multi-fluid theory. Equation of state. One fluid theory. Diffusion. Collisions and conductivity. Magnetohydrodynamics equations. Equilibrium.
6. EQUILIBRIUM AND STABILITY. Hydromagnetic equilibrium. Linear stability. Ideal modes. Resistive modes. Plasma instabilities.
7. FUNDAMENTALS OF PLASMA TRANSPORT MECHANISMS. Classical, neoclassical and turbulent Transport.
8. WAVES IN PLASMAS. Electrostatic waves. Electromagnetic waves. Alfvén waves. Magnetosonic waves.
9. KINETIC THEORY. Distribution function. Boltzmann equation. Vlasov equation. Macroscopic variables. Landau damping. Wave kinetic theory.
10. FUNDAMENTALS OF PLASMA HEATING. Ohmic heating: Plasma resistivity. Neutral beam injection. Electron-ion cyclotron frequency heating.

## LEARNING ACTIVITIES AND METHODOLOGY

Lectures where the theoretical concepts are explained
- The lecturer will provide a file with the following information (1 week in advance)
- Lecture notes of main topics to be discussed during the session
- Chapters/sections in each of the text books provided in the bibliography were the student can read about these topics

## ASSESSMENT SYSTEM

Assessment during the course. Evaluation based on 3 midterm exams.

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| **% end-of-term-examination:** | 0 |
| **% of continuous assessment (assigments, laboratory, practicals…):** | 100 |

## BASIC BIBLIOGRAPHY

- R.J. Goldston and P.H. Rutherford Introduction to Plasma Physics, Institute of Physics Publishing, 1995