Plasma physics and technology

Academic Year: (2022 / 2023) **Review date: 14-06-2022**

Department assigned to the subject: Department of Physics

Coordinating teacher: SANCHEZ FERNANDEZ, LUIS RAUL

Type: Electives ECTS Credits : 6.0

Year : Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Physics I. Physics II. Calculus I. Calculus II. Differential equations and transforms. Electromagnetism and optics. Statistical Physics.

OBJECTIVES

To understand the basics of plasmas, the fourth state of matter.
To understand the behaviour of individual charged particles and fully ionized plasmas in the presence of magnetic and electric fields.
To be able to use the main mathematical models used to describe the behaviour of plasmas.
To be aware of the main technological applications of plasmas.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Basics of plasmas. Definition. Debye length. Plasma frequency. Types of plasmas.
2. Charge motion in an electromagnetic field. Cyclotron motion. Drifts. Magnetic momentum and trapping.
3. Collisions in a plasma. Coulomb binary collisions.
4. Fluid description of a plasma. Magneto-hydrodynamics. Equilibrium and stability.
5. Plasma waves. Waves in a cold magnetized plasma. Plasma dielectric tensor.
6. Kinetic description of a plasma. Vlasov equation. Landau damping. Fokker-Planck equation. Fluid limit
7. Introduction to magnetically confined plasma for fusion energy generation. Tokamaks and stellarators.
8. Introduction to inertial plasmas for fusion energy generation. Lasers and plasmas.
9. Other tecnological applications of plasmas. Plasma propulsion. Industrial plasmas

LEARNING ACTIVITIES AND METHODOLOGY

AF1. THEORETICAL-PRACTICAL CLASSES. Knowledge and concepts students mustacquire. Receive course notes and will have basic reference texts.Students partake in exercises to resolve practical problems
AF2. TUTORING SESSIONS. Individualized attendance (individual tutoring) or in-group (group tutoring) for students with a teacher.Subjects with 6 credits have 4 hours of tutoring/ 100% on- site attendance.
AF3. STUDENT INDIVIDUAL WORK OR GROUP WORK.Subjects with 6 credits have 98 hours/0% on-site.
AF8. WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.
AF9. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course. It entails 4 hours/100% on-site
AF8. WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.
MD1. THEORY CLASS. Classroom presentations by the teacher with IT and audiovisual support in which the subject`s main concepts are developed, while providing material and bibliography to complement student learning
MD2. PRACTICAL CLASS. Resolution of practical cases and problem, posed by the teacher, and carried out individually or in a group
MD3. TUTORING SESSIONS. Individualized attendance (individual tutoring sessions) or in-group (group tutoring sessions) for students with teacher as tutor. Subjects with 6 credits have 4 hours of tutoring/100% on-site.
MD6. LABORATORY PRACTICAL SESSIONS. Applied/experimental learning/teaching in workshops and laboratories under the tutor's supervision.

ASSESSMENT SYSTEM

SE1. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course.The percentage of the evaluation varies for each subject between 60% and 0%.
SE2. CONTINUOUS EVALUATION. Assesses papers, projects, class presentations, debates, exercises, internships and workshops throughout the course.The percentage of the evaluation varies for each subject between 40% and 100% of the final grade.

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- Francis F. Chen Introduction to Plasma Physics and Controlled Fusion, Springer, 2016

ADDITIONAL BIBLIOGRAPHY

- CM Braams and PE Stott Nuclear Fusion: half a century of magnetic confinement fusion research, Institute of Physics, 2002
- Dan Goebel and Ira Katz Fundamentals of electric propulsion: ion and hall thrusters, Wiley, 2008
- Robert Goldston and Paul Rutherford Introduction to Plasma Physics, Institute of Physics, 1995
- S Eliezer and Y Eliezer The fourth state of matter, Institute of Physics, 2001
- Susanne Pfalzner An introduction to inertial confinement fusion, Taylor & Frances, 2006