Plasma Diagnostics and Technology of Materials

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

Department assigned to the subject: Physics Department

Coordinating teacher: SANCHEZ FERNANDEZ, LUIS RAUL

Type: Electives ECTS Credits : 6.0

Year : 2 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Basic knowledge of plasma physics and solid state physics including optical, electrical, and dielectric properties.

OBJECTIVES

The purpose of this course is to introduce the students to the problem of nuclear fusion plasma diagnosis and the main issues for insulators operating in future fusion reactors, including the experimental procedures to simulate radiation damage due to fusion environment. The course includes the experimental techniques to measure optical, electrical and dielectric properties during irradiation of advanced insulators for fusion.

The course will provide the student with a basic knowledge of plasma diagnostics, radiation damage processes in solids, experimental techniques to measure optical, electrical and dielectric properties during irradiation and the experimental procedures to simulate radiation damage due to fusion radiation environment.

DESCRIPTION OF CONTENTS: PROGRAMME

1. The plasma diagnostic problem. MAGNETIC MEASUREMENTS: Rogowski probes, multipolar probes, plasma resistivity measurement, diamagnetic measurements and their interpretation. Measurement of magnetic surfaces on plasma without current (stellarators). MICROWAVE AND INFRARED SYSTEMS: Interferometry, tomography and Abel inversion, Polarimetry, ¿scattering¿. Reflectometry. THOMSON SCATTERING: temperature and electronic density measurement based on Thomson Scattering: fundamentals, technologies, LIDAR. SPECTROSCOPY IN PLASMAS: X-rays, estimation of the effective plasma ion charge, visible and UV spectroscopy. Doppler-broadening and sliding measurement. Intensities of lines and their relationship to impurity content. Charge-exchange spectroscopy. PARTICLE DIAGNOSTICS: Charge exchange, neutral beam for active charge exchange, heavy ion beam probe, Langmuir probes. ELECTRICAL FIELD MEASUREMENT: Doppler spectroscopy, ¿Motional Stark effect¿, heavy ion beam probe. MEASUREMENT OF FUSION PRODUCTS: neutron spectroscopy, alpha particles that escape from the plasma, gamma emissions.

2. Materials technology. General introduction (Operating Environment. Radiation Damage). Electrical Properties (Electrical Degradation, insulating gases, Measurement systems). Dielectric Properties. Optical Properties (Problems for windows and fibres, in-situ techniques).

LEARNING ACTIVITIES AND METHODOLOGY

* Teaching methods:

Classroom lectures and classroom problem solving sessions. Homework assignments.

* Course Material:

Lecture notes. Virtual facilities (a dedicated web page) will be also provided with the aim of improving the interaction with the lecturers and the learning of the subject.

ASSESSMENT SYSTEM

Evaluation shall take into account attendance and class participation, including practical classes and the solution of questionnaries periodically proposed by the lecturers along the course (30% of the final mark). A written-closed book exam will take place at the end of the semester (70% of the final mark).

% end-of-term-examination:	70
% of continuous assessment (assigments, laboratory, practicals…):	30

BASIC BIBLIOGRAPHY

- C. Kittel INTRODUCTION TO SOLID STATE PHYSICS, John Wiley and sons, New York, 1967

- F. Agulló-López, C.R.A. Catlow and P.D. Townsend POINT DEFECFS IN MATERIALS, Academic Press, London, 1988

- I. Hutchinson Principles of Plasma Diagnostics, Cambridge University Press , 2002

ADDITIONAL BIBLIOGRAPHY

- F. Chen Introduction to plasma physics and controlled fusion, Plenum Press, 1988

- P. E. Stott (editor) Advanced Diagnostics for Magnetic and Inertial Fusion, Kluwer/plenum publishers, 2002