# Fusion Reactor Physics

**Academic Year: ( 2019 / 2020 )** **Review date: 28/03/2019 18:05:15**

**Department assigned to the subject:**

**Coordinating teacher: MARTIN SOLIS, JOSE RAMON**

**Type: Electives ECTS Credits : 6.0**

**Year : 2 Semester : 1**

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

Basic classical electrodynamics, fluid dynamics and plasma physics (at the level of the 1st year of the master)

## OBJECTIVES

The course is aimed to present the most relevant aspects of plasma physics in ignition conditions in tokamak and stellarator fusion reactors, which in large part determine the design of future magnetic confinement fusion devices such as the ITER (International Thermonuclear Experimental Reactor) tokamak. This course is of interest for the training of those students interested in the field of magnetic and inertial confinement fusion. The basic plasma physics learnt in other courses of the program will have one of its most important fields of application in both, theoretical and experimental analysis, of the plasma behaviour in ignition conditions in a fusion reactor.

After the course, the student should have learnt the basic physics underlying the behaviour of a plasma in ignition conditions in a (magnetically) fusion reactor which, to a great extent, determine its design. This will allow the student to identify the elements which are essential for a fusion reactor to work and the regimes under which it should operate.

## DESCRIPTION OF CONTENTS: PROGRAMME

1. Fusion power. The tokamak scheme
2. Tokamak reactors. Basic elements of tokamak physics
3. Stellarators. Stellarator reactors
4. Equilibrium and stability (tokamaks and stellarators)
5. Plasma confinement and transport in tokamaks
6. Plasma heating and current drive in tokamaks
7. Heating and confinement in stellarator plasmas
8. Plasma-wall interaction in tokamaks
9. Plasma operation and control in tokamak reactors
10. Plasma-wall interaction, plasma operation and control in stellarator reactors

## LEARNING ACTIVITIES AND METHODOLOGY

* Lectures where the theoretical concepts are explained:

The lecturers will provide to the students with a file including the material to be given (1 week in

advance) which constitutes the basis of the
theoretical lectures (lecture notes).

* Practical classes:

The exercises proposed by the lecturer are solved by the students during the practical classes, corrected and evaluated by the lecturer.

## ASSESSMENT SYSTEM

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

* Continuous evaluation (40% of final mark):

The evaluation will take into account attendance and student attitude, and the solution of proposed exercises in the practical classes. A proposed project in the field of nuclear reactor physics must be also prepared and completed by each student before the end of the course.

* Written exams (60% of final mark)

Three written exama will take place along the semester. Contents:

- Problems to be solved covering the main topics of the program.
- Short theoretical questions.

## BASIC BIBLIOGRAPHY


- J. P. Freidberg PLASMA PHYSICS AND FUSION, Cambridge University Press, 2007

- J. Wesson TOKAMAKS, Oxford University Press, 1997


## ADDITIONAL BIBLIOGRAPHY


- null ITER Physics basis, Nuclear Fusion, vol.39, pg. 2137, 1999

- D.E. Post and R. Behrisch PHYSICS OF PLASMA-WALL INTERACTIONS IN CONTROLLED FUSION, NATO ASI Series, Series B: Physics Vol.131, 1986

- P.C. Stangeby THE PLASMA BOUNDARY OF MAGNETIC FUSION DEVICES, Series in Plasma Physics, 2000