Universidad Zaragoza

Academic Year/course: 2023/24

60040 - Radiation detection systems

Syllabus Information

Academic year: 2023/24
Subject: 60040 - Radiation detection systems
Faculty / School: 100 - Facultad de Ciencias
Degree: 538 - Master's in Physics and Physical Technologies
589 - Master's in Physics and Physical Technologies
ECTS: 5.0
Year: 1
Semester: Second semester
Subject type: Optional
Module:

1. General information

In this subject students will learn the physics and electronics necessary to understand the functioning and operation of the main types of radiation detectors and to be able to design, assemble, set up and perform experiments in a scientific laboratory. Students will also learn the characteristics of the electrical signals produced and some signal processing techniques.

Its approaches and objectives are aligned with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/es/):

- SDG 4 (Quality education)
- SDG 9 (Industry, innovation and infrastructure)

There are no specific prerequisites for this subject although it is advisable to have a degree in physics or engineering, or at least a basic knowledge of electronics and radiation.

2. Learning results

- The student will be able to describe the energy spectrum of different radiation sources and distinguish the signals left by the interaction of radiation in materials commonly used as detectors.
- The student will be able to identify the most suitable detector for each type of radiation, energy range or purpose.
- The student will know how the electric charge, heat or light produced in a detector by radiation is converted into an electric pulse.
- The student will be able to calculate the effect of electronic noise on time and amplitude measurements.
- The student will be able to analyse and design an analogue pulse shaping electronic circuit for amplitude and time measurements.
- The student will be able to design pulse digitizing systems.
- The student will be able to set up a complete ionizing radiation measurement system.
- The student will be able to calculate the effects of radiation on semiconductor devices.
- The student will be able to use different detection equipment in the laboratory and interpret the results.

3. Syllabus

1. Radiation sources and interactions
2. Physical fundamentals and general properties of radiation detectors
3. Gas detectors, scintillation detectors, semiconductor detectors, bolometers and hybrid detectors
4. Radiation spectroscopy
5. Detection system applications
6. Introduction to sensing electronics
7. Signal acquisition
8. Analog pulse processing
9. Digital pulse processing

10. Effect of radiation on circuits
11. Radiation detector architectures

4. Academic activities

The subject is organized in three activities:

- theoretical classes (3 ECTS)
- interactive problem-solving classes (1 ECTS)
- work in the laboratory (1 ECTS)

The theoretical classes in the classroom will serve to introduce the basic knowledge of the subject. Interactive problem-solving lectures and laboratory work sessions will be interspersed throughout the course. In the latter, students will perform experiments and write reports with the results obtained. Likewise, throughout the course, students will solve problems, questions and other activities proposed by the professors that will be used for their continuous assessment.

5. Assessment system

- Continuous assessment through the solving of problems, questions and other proposed activities: it will represent 50% of the final grade.
- Written reports of the work done in the laboratory: it will account for 50% of the final grade.

Passing the subject by means of a single global test.

Students will be able to pass the subject by means of a single global test divided into two parts:

1. A theoretical-practical test with problems and questions related to the main concepts discussed in the subject. The student will have 90 minutes to write the test and it will account for 50% of the final grade.
2. A practical exercise in which the student will be asked to describe the elements and configuration of an experimental setup used in the subject and then to assemble and set it up in the laboratory. The student will have 90 minutes to write the test and it will account for 50% of the final grade.

"Outstanding" grade or "Matricula de Honor" may be awarded, according to the current regulations, among the students who have obtained the highest "outstanding" and, in case of doubt, a specific optional work will be proposed.