Universidad Zaragoza

Academic Year/course: 2023/24

26911 - Physical Techniques I

Syllabus Information

Academic year: 2023/24
Subject: 26911 - Physical Techniques I
Faculty / School: 100 - Facultad de Ciencias
Degree: 447 - Degree in Physics
ECTS: 8.0
Year: 2
Semester: Annual
Subject type: Compulsory
Module:

1. General information

Modern experimental physics makes use of information processing systems based on the manipulation of electronic signals. For a proper understanding of the measurement acquisition process of a physical system, as well as the estimation of its degree of reliability, it is necessary to know the basic fundamentals of basic electronic instrumentation, as well as its essential characteristics, calibration techniques and determination of the accuracy of the measurements. This subject will provide the theoretical and practical knowledge and skills necessary to determine the characteristics that an electronic measurement system should have according to a series of specific properties of the physical system under study, as well as to design and use a conditioning, measurement acquisition and actuation stage, data processing and extraction of results and to estimate the accuracy of the measurement process and its results. The theoretical knowledge of Statistics that the student receives in other subjects (Mathematical Methods for Physics is here used and applied to real laboratory situations. These approaches and objectives are aligned with the following Sustainable Development Goals (SDGs) of the United Nations Agenda 2030 in such a way that the acquisition of the learning results of the subject provides training and competence to contribute to some extent to their achievement:

- SDG 4 (Quality education)

- SDG 9 (Industry, Innovation and Infrastructure)

2. Learning results

The skills acquired in this subject enable the student to select the most appropriate type of instrumentation depending on the quantities to be measured, as well as the physical characteristics of the system under study. The subject provides the necessary knowledge to carry out the analysis and design of the corresponding electronic circuits, as well as to establish the processes of calibration and determination of the reliability of the measurements of according to the characteristics and conditions of the measurement system used. The student will be able to perform adequately all the necessary steps to design a basic measurement and actuation system according to a set of requirements: electrical simulation, selection of the basic electronic conditioning blocks, performing the measurements with the corresponding instruments and determining the reliability of the measurements, making use of the basic statistical methodology of experimental data processing, estimation of physical parameters from them and their uncertainty . The transversality of its contents makes the subject especially relevant for any student of the Physics degree, regardless of their preferences.

On the other hand, this subject will allow students to develop their critical and analytical skills so that they will be able to make well-reasoned decisions.

3. Syllabus

Block I. Basic Concepts

- Physical sensors: fundamentals and modelling. Applications.
- Basic components.
- Signals and physical variables.
- Fundamental laws and equivalences.

Block II. Transformed field

- Circuits in the transformed field.
- Network function.
- Permanent sinusoidal regime.

Block III. Systematic methods of analysis

- Analysis by nodes.
- Analysis by meshes.
- Generalization.

Block IV. Circuits and equivalent systems

- Thévenin and Norton.
- Quadrupoles.
- Characterization of an electronic system.

Block V. Basic instrumentation

- Measurement system.
- Generating instruments.
- Measuring instruments.

Block VI. Basic measurement characteristics

- Laboratory.
- Measurement errors.
- Electrical noise.
- Criteria for selecting a measurement system.

Block VII. Metrology

- Basic concepts of metrology.
- Quality in metrology.
- Introduction to units and patterns.

LABORATORY SESSIONS:

P1. Measurement of physical-electrical variables.
P2. Time and frequency analysis of circuits.
P3. Electrical signal processing.
P4. Signal filtering and conditioning.
P5. Radiation metrology with a Geiger counter.
P6. Application of statistical tools in the measurement of physical quantities.

PROJECT: Radiation detection system and actuation circuit

4. Academic activities

The learning activities of this subject include theory classes, problem classes, laboratory classes, proposed thematic works, seminars and projects. Simulation tools and instrumentation will be used to address the design and verification. Both the evaluable teaching assignments and the preparation of the laboratory practice reports are included. Practical classes will begin in the second semester

- Participative master class: 40 hours
- Problem solving and case studies: 10 hours
- Laboratory practices: 30 hours
- Teaching assignments: 24 hours
- Study and personal work: 60 hours
- Assessment tests. 6 hours

The distribution, according to credits, of the different programmed activities is as follows:

- Theory classes, problems and evaluative tests: 5 ECTS
- Practical classes: 3 ECTS

5. Assessment system

It will consist of two options:

I. Mixed system, which is composed of the following assessment activities:

a) Evaluation of activities developed during the term, which will be based on the qualification of learning activities such as problems solved and delivered on the indicated date, exposition of the solution of problems in class and performance of other assessment tests. The overall result of these will be weighted by 20% in the final grade.

b) Passing the laboratory practices The evaluation of this part will be based on the qualification of the questionnaires corresponding to each practical session, the submitted reports and the laboratory rubric. This part will be weighted at 30% in the final grade.

c) Theoretical-practical written test. This test will be weighted 50% of the final grade.

The final grade will be obtained through the weighted average of the grades of the evaluation activities of the sections (a), (b) and (c), being necessary that the result of the weighted average is 5.0 points or higher. However, the students will not pass the subject if they do not achieve a minimum grade of 5 out of 10 points in the evaluation activity of section (b) as well as a minimum grade of 5 out of 10 points in the evaluation activity of section (c).

II. Simple system. The student who has not passed the subject by the previous proposed activities, or who wishes to raise the grade may choose to take a global final exam, on a date established by the official calendar of exams, which will consist of two parts:

a) the completion of the same final written test consisting of the resolution of a theoretical-practical case, just like the one that the students who have opted for the mixed system will take and

b) the realization of an additional exercise consisting of a questionnaire and an experimental characterization in the laboratory of one of the blocks contained in the program of the subject.

The final grade of the overall test will be obtained from the weighted average of the grades of the written test, 60%, and of the above mentioned exercise, in 40 %, being necessary that the result of the weighted average is 5.0 points or higher.

However, students will not pass the subject if they do not achieve a minimum grade of 5 out of 10 points in the total of the written test, as well as a minimum grade of 5 out of 10 points in the experimental exercise.