Universitat Autònoma de Barcelona

2023/2024

Electronic Instrumentation

Code: 103308
ECTS Credits: 6

Degree	Type	Year	Semester
2501922 Nanoscience and Nanotechnology	OB	2	2

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

Prerequisites

It is recommended that you have passed the subjects of the first course of mathematics and the one of Electricity, Magnetism and Optics and simultaneously study the subject Mathematics Tools of second.

Objectives and Contextualisation

The main objective is to provide the basic concepts, with special emphasis on the practical aspects, for the implementation of electronic instrumentation systems for the conditioning and processing of electrical signals. This includes the ability to be autonomous in the handling of the main electronic instrumentation equipment, in the assembly of amplifiers and basic filters as well as in the simulation of the behavior of electronic circuits

Competences

- Adapt to new situations.
- Apply the concepts, principles, theories and fundamental facts of nanoscience and nanotechnology to solve problems of a quantitative or qualitative nature in the field of nanoscience and nanotechnology.
- Be ethically committed.
- Communicate orally and in writing in one's own language.
- Demonstrate knowledge of the concepts, principles, theories and fundamental facts related with nanoscience and nanotechnology.
- Handle the standard instruments and materials of physical, chemical and biological testing laboratories for the study and analysis of phenomena on a nanoscale.
- Interpret the data obtained by means of experimental measures, including the use of computer tools, identify and understand their meanings in relation to appropriate chemical, physical or biological theories.

- Lead and coordinate work groups.
- Learn autonomously.
- Manage the organisation and planning of tasks.
- Obtain, manage, analyse, synthesise and present information, including the use of digital and computerised media.
- Operate with a certain degree of autonomy.
- Propose creative ideas and solutions.
- Reason in a critical manner
- Recognise and analyse physical, chemical and biological problems in the field of nanoscience and nanotechnology and propose answers or suitable studies for their resolution, including when necessary the use of bibliographic sources.
- Recognise the terms used in the fields of physics, chemistry, biology, nanoscience and nanotechnology in the English language and use English effectively in writing and orally in all areas of work.
- Resolve problems and make decisions.
- Show motivation for quality.
- Show sensitivity for environmental issues.
- Work correctly with the formulas, chemical equations and magnitudes used in chemistry.
- Work on the synthesis, characterisation and study of the properties of materials on a nanoscale from previously established procedures.

Learning Outcomes

1. Adapt to new situations.
2. Apply the acquired theoretical contents to the explanation of experimental phenomena.
3. Be ethically committed.
4. Communicate orally and in writing in one's own language.
5. Correctly characterise specific properties of materials, devices and systems on a nanoscale using electrical methods
6. Critically evaluate experimental results and deduce their meaning.
7. Describe the general concepts of circuit theory.
8. Describe transitory and permanent behaviours in first and second order electrical circuits.
9. Design electronic instrumentation systems for the determination of specific physical and chemical characteristics
10. Distinguish the main causes of electromagnetic interferences and electrical noise in electronic measurement systems and their possible solutions.
11. Handle the typical electronic instruments in a physical and chemical characterisation laboratory.
12. Identify the situations in which the different methodologies studied can help to resolve problematic situations and know how to select the best techniques.
13. Interpret and rationalise measurements obtained using electronic instrumentation.
14. Lead and coordinate work groups.
15. Learn autonomously.
16. Manage the organisation and planning of tasks.
17. Obtain, manage, analyse, synthesise and present information, including the use of digital and computerised media.
18. Operate with a certain degree of autonomy.
19. Perform bibliographic searches for scientific documents.
20. Propose creative ideas and solutions.
21. Propose electrical diagrams for the electrical measurement of small signals and in presence of noise
22. Propose electrical measurement methods to determine specific physical and chemical characteristics of nanoscale materials, devices and systems.
23. Reason in a critical manner
24. Recognise the basics of electrical signal processing: amplification, filtered and analog-digital and digital-analog filtered conversion.
25. Recognise the correct terms for topics related to methodologies and experimentation in nanoscience and nanotechnology.
26. Resolve problems and make decisions.
27. Resolve problems with the help of the provided complementary bibliography.
28. Show motivation for quality.

29. Show sensitivity for environmental issues.
30. Specify and use electronic instrumentation, measuring systems and instruments and data acquisition systems.
31. Specify the characteristics of current-voltage and properties of passive elements in electrical circuits.
32. Understand texts and bibliographies in English on each of the techniques, methodologies, tools and instruments in the subject area.
33. Work correctly with the formulas, chemical equations and magnitudes used in chemistry.

Content

1. Circuits Theory. Elements, variables and equations of electrical circuits. Theorems of circuit theory. Properties, characteristics and dynamic behavior of circuits with passive electrical components.

2. Basic instruments for electrical measures. Osciloscope. Multimeters. Power supplies and waveform generators. Passive and active probes. Reduction of noise and electromagnetic interference in measuring systems.

3. Circuits and systems for signal processing. Amplification, Filtering and analog-digital and digital-analog converters.

4. Automation of measurement equipment. Main features and limitations. Acquisition Cards. Virtual instrumentation: hardware and software.

Methodology

Theoretical classes Explanation by the teacher of the fundamental concepts of each of the topics. Part of the concepts will be introduced as a resolution of specific cases.

Problem classes Resolution and discussion by the teacher from the exercises and problems given to students.

Laboratory: Completion of practices in the electronic laboratory. Part of the practices will require a previous resolution based on mathematical calculations or by using an electric simulation tool. The last two practical sessions will include designs proposed by students to solve a practical case that will be considered during the course.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Problems	10	0.4	4, 9, 19, 16, 12, 21, 20, 22, 23, 27, 26, 33
Theoretical classes	15	0.6	15, 32, 4, 28, 8, 7, 10, 31, 29, 17, 18, 20, 22, 23, 24, 25
laboratory work	28	1.12	1, 2, 6, 5, 32, 4, 9, 19, 12, 13, 14, 11, 29, 17, 21,

			22, 23
Type: Supervised			
Mentoring	15	0.6	2, 6, 10, 30, 12, 23, 24
Type: Autonomous			
Problems	15	0.6	4, 9, 12, 21, 20, 22, 23, 27, 26, 33
Reading, resolution and writing of the laboratory reports	39	1.56	2, 15, 6, 4, 8, 9, 10, 30, 31, 19, 16, 12, 3, 29, 17, 21, 22, 23, 24
Study for the assimilation of concepts	20	0.8	2, 15, 6, 32, 8, 7, 10, 30, 31, 19, 16, 12, 17, 24, 25

Assessment

The evaluation of the subject will have 3 differentiated sections:

a) There will be compulsory two written exams of the concepts given in the classes of theory and problems. At the end of the course there will be a final final exam so that students can pass or improve their qualification. The weight of this written exam is 45%. A minimum score of 4.5 is required in this section to do the final weighting. Students are only allowed to attend this final exam if they have attended the two partial examinations. If a student does not attend one of the partial examinations, it will be considered "non-evaluable".

b) In each problem session, a problem will be raised that students will have to solve at the following session. These delivered problems will have a weight of 15% to the final grade. This is an activity that is not recoverable.

c) Practices, which are compulsory and not recoverable, will have a final weight of 40%. The evaluation of the same will be done with 2 grades:

· Written document with the experimental results of the practices, evaluating in particular the interpretation and discussion of the results compared with the theoretically expected and / or previously simulated, 90%;

· Active participation in the laboratory sessions (with the possibility of an oral examination for an individual assessment of the students), 10%.

To obtain a qualification of Matrícula d'Honor (which is possible to qualify the 5% of the enrolled students), grades above 9 to all the above items are needed and with a final average of 9.3

Single assessment:

The students who have joined the single assessment modality will have to carry out a final test that will consist of an exam of all the theoretical topics and problems of the subject. The students should also to delivery the reports of all the laboratory practices carried out.

This test is carried out on the day in which the students of the continuous assessment take the second partial exam. The qualification of the student will be:
Course grade = (Final test grade 60% + Laboratory grade 40%)/100
If the final grade does not reach 5, the student will have another opportunity to pass the subject by taking the recovery exam that will be held on the date set by the coordination of the degree. In this test you will be able to recover 60% of the note corresponding to the part of theory and problems. The laboratory part is not recoverable."

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Delivery of problems	15%	0	0	2, 6, 32, 4, 9, 12, 13, 21, 20, 22, 25, 27, 26
Laboratory evaluation	40%	2	0.08	1, 2, 15, 6, 5, 32, 4, 28, 9, 30, 19, 16, 12, 13, 14, 11, 3, 29, 17, 18, 21, 20, 22, 23, 25, 26, 33
Written exams	45%	6	0.24	2, 32, 4, 8, 7, 9, 10, 30, 31, 13, 21, 20, 22, 23, 24, 25

Bibliography

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D. Wobschall, "Circuit design for electronic instrumentation", McGraw-Hill (1987)

P. Horowitz and W. Hill,The Art of Electronics,Cambridge Univ. Press (1989)

J.Y. Beyon, "LabVIEW Programming, data adquisition and analysis", Prentice Hall (2001)

A.Bruce Carlson. Teoría de circuitos. Thomson-Paraninfo. 2002. (IBSB: 84-9732-066-2)

R. Pallás-Areny, "Instrumentos electrónicos básicos", Ed. Marcombo, 2006.

J.C. Alvarez et al., "Instrumentación electrónica", Thomson-Paraninfo, 2006

J.David Irwin. Análisis básico de circuitos en ingeniería , Limusa Wiley, cop. 2003
6ª ed.

Dorf, Richard C. Introduction to electric circuits Hoboken, N.J. : Wiley, cop. 2011
8th ed., International student ed.

Thomas L. Floyd. Principios de circuitos eléctricos / Pearson, 2007, 8ª ed.

Software

-Pspice de Orcad (student version)

-Labview (laboratory software and free trial version for the student at home)