Universitat Autònoma de Barcelona

2023/2024

Electrical Characterisation and Reliability

Code: 43431
ECTS Credits: 6

Degree	Type	Year	Semester
4314939 Advanced Nanoscience and Nanotechnology	OT	0	A

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

No prerequisites are required for students accepted to the program. It is advisable to have knowledge in electronic devices and their applications.

Objectives and Contextualisation

This module aims to address the electrical characterization in nanoelectronic devices to assess their performance and reliability.

Competences

- Communicate and justify conclusions clearly and unambiguously to both specialised and non-specialised audiences.
- Continue the learning process, to a large extent autonomously
- Identify the characterisation and analysis techniques typically adopted in nanotechnology and know the principles behind these, within one's specialisation.
- Show expertise in using scientific terminology and explaining research results in the context of scientific production, in order to understand and interact effectively with other professionals.
- Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.

Learning Outcomes

1. Communicate and justify conclusions clearly and unambiguously to both specialised and non-specialised audiences.

2. Continue the learning process, to a large extent autonomously
3. Describe the principles and identify the possibilities of electric characterisation techniques at the nanoscale.
4. Design accelerated reliability tests in nanoelectronics.
5. Know the mechanisms of variability and malfunction in nanodevices.
6. Show expertise in using scientific terminology and explaining research results in the context of scientific production, in order to understand and interact effectively with other professionals.
7. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
8. Use device-level instruments and characterisation methods in nanoelectronic devices.

Content

The course is structured into 4 blocks:

1.- Devices at the nanoscale. Device characterization methods. Advanced Instrumentation.

2.- Failure mechanisms in nanodevices: Dielectric breakdown, Hot Carrier injection (HCI) and BTI. Resistive switching phenomenon in dielectrics and applications. Characterization of Random Telegraph Noise (RTN) in nanodevices.

3.- Effects of variability at the nanoscale. Process variability and time dependent variability. Modeling and simulation of variability in nanodevices and circuits.

4.- Advanced electrical characterization at the nanoscale. Operating principles and application to nanoelectronics probes for atomic force conductivity (C-AFM), capacitance (SCM) and contact potential (KPFM). Spreading resistance (SSRM). Other techniques.

Methodology

Students must attend lectures, problem solving classes / cases / exercises and problem-based learning, with an active participation of students in the classroom. They must also make the presentation and defense of planned activities about specific topics and participate in the practical activities in the lab.

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			
Classes to solve problems / cases / exercises and problem-based learning	10	0.4	5, 3, 4, 6, 7, 1
Lectures	12	0.48	6
Oral presentation and discussion of works	6	0.24	6, 1
Practical activities	8	0.32	5, 3, 4, 6, 7, 8

Type: Supervised			
Tutorials	8	0.32	6
Type: Autonomous			
Personal study, reading articles and reports of interest	60	2.4	6
Preparation of works	46	1.84	6, 1, 2

Assessment

Continuous evaluation

A separate evaluation will be made for each of the four blocks into which the course is divided. The final mark will be the average of the marks obtained in each of the blocks.

For each of the blocks, the evaluation of the level of skills acquisition by the students is made taking into account the activities indicated in the table above, with their weights.

To pass the course, a minimum of 5 as final average mark is needed, as well as minimum of 3 in each of the activities.

Final evaluation

In case the student fails during the continuous evaluation, but he/she has been evaluated of at least 60% of the proposed activities, specific tests will be planned for the final evaluation, which can be theoretical and / or practical, to retake the failed block(s).

Remarks

Any situation not specified in this document will be analyzed individually.

Assessment procedures may be adjusted, in case that the course development advices to do so.

For each of the blocks, a place, date and hour will be indicated, so that the student can review the evaluation of that block. In case of no-show at the indicated place/date, no other evaluation review will be allowed afterwards.

Final remarks

Without prejudice to other disciplinary action deemed appropriate and in accordance with current academic regulations, any irregularities committed by the student that may lead to a change in the qualification of an act of assessment will be qualified with a zero. Therefore, copying or allowing copying any evaluation activity will involve failing it with a zero as mark. In case it was needed to be passed to pass the course, the entire course would be failed, without the opportunity to retake them in the same academic year.

The dates of assessment and delivery of works will be published inthe campusvirtual, and may be subject to changes, for reasons of better programming. Always the information about these changes will be announced in campus virtual, as it is understood that this is the common platform for information exchange between professors and students.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes

Attendance and active classroom participation	30%	0	0	5, 3, 4, 6, 7, 1, 8
Delivery of reports / works	40%	0	0	5, 3, 4, 6, 1, 2, 8
Oral defense of works	30%	0	0	6, 1

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Software

MATLAB