



POLITÉCNICA

INTERNATIONAL
CAMPUS OF
EXCELLENCE

COORDINATION PROCESS OF
LEARNING ACTIVITIES
PR/CL/001



E.T.S. de Ingenieros de
Telecomunicacion

ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

93000836 - Microelectronic Technology

DEGREE PROGRAMME

09AQ - Master Universitario En Ingenieria De Telecomunicacion

ACADEMIC YEAR & SEMESTER

2023/24 - Semester 2

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1. Description

1.1. Subject details

Name of the subject	93000836 - Microelectronic Technology
No of credits	6 ECTS
Type	Optional
Academic year of the programme	Second year
Semester of tuition	Semester 4
Tuition period	February-June
Tuition languages	English
Degree programme	09AQ - Master Universitario en Ingenieria de Telecomunicacion
Centre	09 - Escuela Tecnica Superior De Ingenieros De Telecomunicacion
Academic year	2023-24

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Jimena Olivares Roza (Subject coordinator)	B-307	jimena.olivares@upm.es	Sin horario. Tutorial appointments will be fixed by e-mail
Marta Clement Lorenzo	B-307	marta.clement@upm.es	Sin horario. Tutorial appointments will be fixed by e-mail

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

The subject - recommended (passed), are not defined.

3.2. Other recommended learning outcomes

- Basic physics and thermodynamics. Basic electricity and magnetism
- Basic knowledge of semiconductors and device physics

4. Skills and learning outcomes *

4.1. Skills to be learned

CE10 - Capacidad para diseñar y fabricar circuitos integrados.

CE15 - Capacidad para la integración de tecnologías y sistemas propios de la Ingeniería de Telecomunicación, con carácter generalista, y en contextos más amplios y multidisciplinares como por ejemplo en bioingeniería, conversión fotovoltaica, nanotecnología, telemedicina.

CG2 - Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio.

CG4 - Que los estudiantes sepan comunicar sus conclusiones y los conocimientos y razones últimas que las sustentan a públicos especializados y no especializados de un modo claro y sin ambigüedades.

CG5 - Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.

CT1 - Capacidad para comprender los contenidos de clases magistrales, conferencias y seminarios en lengua inglesa.

CT3 - Capacidad para adoptar soluciones creativas que satisfagan adecuadamente las diferentes necesidades planteadas.

CT4 - Capacidad para trabajar de forma efectiva como individuo, organizando y planificando su propio trabajo, de forma independiente o como miembro de un equipo.

CT5 - Capacidad para gestionar la información, identificando las fuentes necesarias, los principales tipos de documentos técnicos y científicos, de una manera adecuada y eficiente.

4.2. Learning outcomes

RA122 - Conocer a nivel básico los procesos tecnológicos que se usan en la fabricación de circuitos integrados

RA125 - Conocer las aplicaciones de las tecnologías microelectrónicas a dispositivos electrónicos particulares como dispositivos pasivos de alta frecuencia, sensores, MEMS, etc.

RA124 - Conocer el concepto de tecnología de fabricación microelectrónica y saber diseñar esquemáticamente una ruta de fabricación de CI

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

In the subject Microelectronic Technology the students will deal with technologies currently used in the microfabrication of integrated circuits. The concept of technology is introduced as a concatenation of technological processes. Each individual process is described together with concepts about integration by highlighting the importance of their interrelation to build a complete technology.

The main objective is students becoming familiar with processes involved in the microfabrication of ICs and the fabrication technologies used currently.

5.2. Syllabus

1. Schedule and module rules
2. Introduction
3. Technological processes I (Lithography and etching)
4. Device fabrication technology
5. Technological processes II (Materials, thermal oxidation, ion implantation)
6. Vacuum technologies
7. Deposition techniques I (Thermal evaporation)
8. Deposition techniques II (Sputtering)
9. Deposition techniques III (CVD)

6. Schedule

6.1. Subject schedule*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1	Introduction Duration: 02:00 Lecture			
2	Topics 1-2 Duration: 02:00 Lecture			
3	Intro lab Duration: 02:00 Lecture	Practical session 1: Simulation of the technology Duration: 03:00 Laboratory assignments		Deliverable related with the lab sessions Group work Continuous assessment Not Presential Duration: 00:00
4	Topic 3 Duration: 02:00 Lecture	Practical session 2 Duration: 03:00 Laboratory assignments		Online quizz Online test Continuous assessment Presential Duration: 00:15 Deliverable related with the lab sessions Group work Continuous assessment Not Presential Duration: 00:00
5	Topic 4 Duration: 02:00 Lecture			Online quizz Online test Continuous assessment Presential Duration: 00:15
6	Tema 5 Duration: 02:00 Lecture	Practical session 3 Duration: 03:00 Laboratory assignments		Online quizz Online test Continuous assessment Presential Duration: 00:15 Deliverable related with the lab sessions Group work Continuous assessment Not Presential Duration: 00:00
7	Topic 6 Duration: 02:00 Lecture			Online quizz Online test Continuous assessment Presential Duration: 00:15

8	Topic 7 Duration: 02:00 Lecture	Visit to the ion implanter at CAI de Técnica Físicas of UCM Duration: 03:00 Additional activities		Deliverable related with the lab sessions Group work Continuous assessment Not Presential Duration: 00:00
9	Topic 8 Duration: 02:00 Lecture			
10	Topic 9 Duration: 02:00 Lecture	Practical session 4 Duration: 03:00 Laboratory assignments		Online quizz Online test Continuous assessment Presential Duration: 00:15 Deliverable related with the lab sessions Group work Continuous assessment Not Presential Duration: 00:00
11	Topic 10 Duration: 02:00 Lecture			
12	Attendance to the oral presentation session Duration: 03:00 Additional activities	Practical session 5 Duration: 03:00 Laboratory assignments		Oral presentation Individual presentation Continuous assessment Presential Duration: 00:20 Deliverable related with the lab sessions Group work Continuous assessment Not Presential Duration: 00:00
13	Attendance to the oral presentation session Duration: 03:00 Additional activities	Practical session 6 Duration: 03:00 Laboratory assignments		Oral presentation Individual presentation Continuous assessment Presential Duration: 00:20
14		Practical session 7 Duration: 03:00 Laboratory assignments		Deliverable related with the lab sessions Group work Continuous assessment Not Presential Duration: 00:00
15				
16				
17				Exam Written test Continuous assessment Presential Duration: 03:00 Exam Written test Final examination Presential Duration: 03:00 Oral presentation Individual presentation Final examination Presential

Duration: 00:30

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

* The schedule is based on an a priori planning of the subject; it might be modified during the academic year, especially considering the COVID19 evolution.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
3	Deliverable related with the lab sessions	Group work	No Presential	00:00	4%	4 / 10	
4	Online quizz	Online test	Face-to-face	00:15	2%	4 / 10	
4	Deliverable related with the lab sessions	Group work	No Presential	00:00	4%	4 / 10	
5	Online quizz	Online test	Face-to-face	00:15	2%	4 / 10	
6	Online quizz	Online test	Face-to-face	00:15	2%	4 / 10	
6	Deliverable related with the lab sessions	Group work	No Presential	00:00	4%	4 / 10	
7	Online quizz	Online test	Face-to-face	00:15	2%	4 / 10	
8	Deliverable related with the lab sessions	Group work	No Presential	00:00	4%	4 / 10	
10	Online quizz	Online test	Face-to-face	00:15	2%	4 / 10	CG2 CT1 CT5
10	Deliverable related with the lab sessions	Group work	No Presential	00:00	4%	4 / 10	
12	Oral presentation	Individual presentation	Face-to-face	00:20	10%	4 / 10	
12	Deliverable related with the lab sessions	Group work	No Presential	00:00	4%	4 / 10	
13	Oral presentation	Individual presentation	Face-to-face	00:20	%	4 / 10	CG4 CT3 CE15
14	Deliverable related with the lab sessions	Group work	No Presential	00:00	6%	4 / 10	CG4 CT4 CT5
17	Exam	Written test	Face-to-face	03:00	50%	4 / 10	CG2 CG4 CG5 CT1 CT3 CT4 CT5 CE10 CE15

7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Exam	Written test	Face-to-face	03:00	65%	4 / 10	CG2 CG4 CG5 CT1 CT3 CT4 CT5 CE10 CE15
17	Oral presentation	Individual presentation	Face-to-face	00:30	15%	4 / 10	CG4 CT3 CE15

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Exam	Written test	Face-to-face	02:00	80%	4 / 10	CG2 CG4 CG5 CT1 CT3 CT4 CT5 CE10 CE15
Oral presentation	Individual presentation	Face-to-face	00:30	20%	4 / 10	CG4 CT3 CE15

7.2. Assessment criteria

Note

This subject involves mandatory practical activities that must be taken during the school period as they take place in research facilities with specific equipment. If they are not taken during the school period, the maximum grade in the global evaluation cannot be achieved.

Progressive assessment

Mark required to pass the course: > 5/10 (Minimum mark in each part: 4/10). The assessable items are:

Written exam: 50%

Oral presentation: 10%

Deliverables: 30%

Onlines quizzes: 10%

Overall assessment

Mark required to pass the course: > 5/10 (Minimum mark in each part: 4/10). The assessable items are:

Written exam: 65%

Oral presentation: 15%

Extraordinary exam

Mark required to pass the course: > 5/10 (Minimum mark in each part: 4/10). The assessable items are:

Written exam: 80%

Oral presentation: 20%

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Website of the module	Web resource	All relevant information of the module will be posted on its Moodle website.
Laboratorios de fabricación y caracterización de materiales y dispositivos	Equipment	Research lab conveniently adapted so that students can undertake the fabrication and characterization of MOS transistors with the supervision of a lecturer.
Handbook of Thin Film Technology. Frey, Hartmut, Khan, H. R. Springer (2015)	Bibliography	

Thin Films Material Technology: Sputtering of Compound Materials. Wasa, Kiyotaka, Kitabatake, Makoto, Adachi, Hideaki. Springer (2004)	Bibliography	
Sputtering Materials for VLSI and Thin Film Devices. Jaydeep Sarkar. Elsevier (2013)	Bibliography	
Thin Film Technology Handbook. Aicha Elshabini, Aicha Elshabini- Riad, Fred D. Barlow. McGraw Hill Professional, 1998	Bibliography	
Introduction to Surface and Thin Film Processes. John a. Venables. Cambridge U. Press. 2001	Bibliography	

9. Other information

9.1. Other information about the subject

* The schedule is based on an a priori planning of the subject; it might be modified during the academic year.

* This course invests a significant time and effort in laboratory activities. Since these activities take place in research facilities, small lab groups will be set at the beginning of the semester. Depending on the number of students some lab activities will take place in morning sessions,

Communication with students

* Communication between students and lectures will be through e-mail and Moodle. Any question or concern about the module should be sent to the coordinator. The lecturers will answer as soon as possible.

* Tutorials will take place face-to-face if possible or through Zoom.

Sustainable development goals

This module can contribute to Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all, in particular to targets 4.3 Ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university and 4.4 Substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.

As the module deals with microfabrication techniques for TIC components, we will have the opportunity to highlight Goal 9: Industry, Innovation and Infrastructure and its targets 9.5. Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending and 9.8 Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries.