



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 Ingeniería de Telecomunicacion

ACADEMIC YEAR & SEMESTER

2017/18 - Semester 2

Index

Learning guide

1. Description.....	1
2. Faculty.....	1
3. Skills and learning outcomes	2
4. Brief description of the subject and syllabus.....	4
5. Schedule.....	5
6. Activities and assessment criteria.....	8
7. Teaching resources.....	11

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	Escuela Tecnica Superior de Ingenieros de Telecomunicacion
Academic year	2017-18

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Enrique Iborra Grau	B- 312	enrique.iborra@upm.es	Sin horario. Las tutorías se concertarán por correo electrónico.
Jimena Olivares Roza (Subject coordinator)	B-307	jimena.olivares@upm.es	Sin horario. Las tutorías se concertarán por correo electrónico.

Marta Clement Lorenzo	B-307	marta.clement@upm.es	Sin horario. Las tutorías se concertarán por correo electrónico.
Jesus Sangrador Garcia	B-308	jesus.sangrador@upm.es	Sin horario. Las tutorías se concertarán por correo electrónico.

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

3. Skills and learning outcomes *

3.1. 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.

CG3 - Que los estudiantes sean capaces de integrar conocimientos y enfrentarse a la complejidad de formular juicios a partir de una información que, siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos y juicios.

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.

CT6 - Capacidad para emitir juicios sobre implicaciones económicas, administrativas, sociales, éticas y medioambientales ligadas a la aplicación de sus conocimientos.

CT7 - Capacidad para trabajar en contextos internacionales.

3.2. 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.

4. Brief description of the subject and syllabus

4.1. 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 that the students become familiar with processes involved in the microfabrication of ICs and with the fabrication technologies used currently.

4.2. Syllabus

1. Introduction
2. Definition and characteristics of a microelectronic technology
3. Technological processes I: Materials and thermal oxidation
4. Technological processes II: Ion implantation
5. Technological processes III: Lithography and etching
6. Vacuum technologies
7. Deposition techniques I: Thermal evaporation
8. Deposition techniques II: Sputtering
9. Deposition techniques III: Thermal vapour deposition

5. Schedule

5.1. Subject schedule*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Other face-to-face activities	Assessment activities
1	Introduction Duration: 02:00 Lecture			
2	Topic 1 Duration: 02:00 Lecture			
3	Topic 2 Duration: 02:00 Lecture	Practical session 1: Simulation on the technology Duration: 04:00 Laboratory assignments		Writing of a lab notebook to summarize the processes undertaken during each session. The grade of this activity will be obtained as an average of the whole module. Individual work Continuous assessment Duration: 00:00
4	Topic 3 Duration: 02:00 Lecture	Practical session 2 Duration: 04:00 Laboratory assignments		Writing of a lab notebook to summarize the processes undertaken during each session. The grade of this activity will be obtained as an average of the whole module. Individual work Continuous assessment Duration: 00:00
5	Topic 4 Duration: 02:00 Lecture	Practical session 3 Duration: 04:00 Laboratory assignments		Writing of a lab notebook to summarize the processes undertaken during each session. The grade of this activity will be obtained as an average of the whole module. Individual work Continuous assessment Duration: 00:00
6	Tema 5 Duration: 02:00 Lecture	Practical session 4 Duration: 03:00 Laboratory assignments		Writing of a lab notebook to summarize the processes undertaken during each session. The grade of this activity will be obtained as an average of the whole module. Individual work Continuous assessment Duration: 00:00
7	Topic 6 Duration: 02:00 Lecture	Practical session 5 Duration: 04:00 Laboratory assignments		Writing of a lab notebook to summarize the processes undertaken during each session. The grade of this activity will be obtained as an average of the whole module. Individual work Continuous assessment Duration: 00:00

8			Visit to the ion implanter at CAI de Técnica Físicas of UCM Duration: 03:00 Additional activities	Test 1 Written test Continuous assessment Duration: 01:00
9	Topic 7 Duration: 02:00 Lecture	Practical session 6 Duration: 04:00 Laboratory assignments		Writing of a lab notebook to summarize the processes undertaken during each session. The grade of this activity will be obtained as an average of the whole module. Individual work Continuous assessment Duration: 00:00
10	Topic 8 Duration: 02:00 Lecture	Sesión práctica 7 Duration: 04:00 Laboratory assignments		Writing of a lab notebook to summarize the processes undertaken during each session. The grade of this activity will be obtained as an average of the whole module. Individual work Continuous assessment Duration: 00:00
11	Topic 9 Duration: 02:00 Lecture	Practical session 8 Duration: 04:00 Laboratory assignments		Writing of a lab notebook to summarize the processes undertaken during each session. The grade of this activity will be obtained as an average of the whole module. Individual work Continuous assessment Duration: 00:00
12		Practical session 9 Duration: 04:00 Laboratory assignments		Writing of a lab notebook to summarize the processes undertaken during each session. The grade of this activity will be obtained as an average of the whole module. Individual work Continuous assessment Duration: 00:00
13			Assistance to the oral presentation session Duration: 04:00 Additional activities	Oral presentation Individual presentation Final examination Duration: 00:30 Oral presentation Individual presentation Continuous assessment Duration: 00:20
14				
15				Test 2 Written test Continuous assessment Duration: 02:00
16				
17				Test Written test Final examination Duration: 03:00

The independent study hours are training activities during which students should spend time on individual study or individual assignments.

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 subject schedule is based on a previous theoretical planning of the subject plan and might go to through experience some unexpected changes along throughout the academic year.

6. Activities and assessment criteria

6.1. Assessment activities

6.1.1. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
3	Writing of a lab notebook to summarize the processes undertaken during each session. The grade of this activity will be obtained as an average of the whole module.	Individual work	No Presential	00:00	10%	4 / 10	CT4 CE15 CG5 CT1 CG3 CG4 CE10 CT3 CG2 CT6 CT7 CT5
4	Writing of a lab notebook to summarize the processes undertaken during each session. The grade of this activity will be obtained as an average of the whole module.	Individual work	No Presential	00:00	0%	4 / 10	
5	Writing of a lab notebook to summarize the processes undertaken during each session. The grade of this activity will be obtained as an average of the whole module.	Individual work	No Presential	00:00	0%	4 / 10	
6	Writing of a lab notebook to summarize the processes undertaken during each session. The grade of this activity will be obtained as an average of the whole module.	Individual work	No Presential	00:00	0%	4 / 10	
7	Writing of a lab notebook to summarize the processes undertaken during each session. The grade of this activity will be obtained as an average of the whole module.	Individual work	No Presential	00:00	0%	4 / 10	

8	Test 1	Written test	Face-to-face	01:00	30%	4 / 10	CE10 CT1 CT3
9	Writing of a lab notebook to summarize the processes undertaken during each session. The grade of this activity will be obtained as an average of the whole module.	Individual work	No Presential	00:00	0%	4 / 10	
10	Writing of a lab notebook to summarize the processes undertaken during each session. The grade of this activity will be obtained as an average of the whole module.	Individual work	No Presential	00:00	0%	4 / 10	
11	Writing of a lab notebook to summarize the processes undertaken during each session. The grade of this activity will be obtained as an average of the whole module.	Individual work	No Presential	00:00	0%	4 / 10	
12	Writing of a lab notebook to summarize the processes undertaken during each session. The grade of this activity will be obtained as an average of the whole module.	Individual work	No Presential	00:00	0%	4 / 10	
13	Oral presentation	Individual presentation	Face-to-face	00:20	20%	4 / 10	CE15 CT3 CT7
15	Test 2	Written test	Face-to-face	02:00	40%	4 / 10	CE15 CT3 CT7

6.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
13	Oral presentation	Individual presentation	Face-to-face	00:30	20%	4 / 10	CE15 CG4 CT3 CT7
17	Test	Written test	Face-to-face	03:00	80%	4 / 10	CT1 CG3 CE10 CG2 CT6 CT5 CT4 CG5

6.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Exam	Written test	Face-to-face	02:00	100%	5 / 10	CT4 CE15 CG5 CT1 CG3 CG4 CE10 CT3 CG2 CT6 CT7 CT5

6.2. Assessment criteria

Continuous evaluation

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

1. March exam: 30%
2. May exam: 40%
3. Deliverables: 10%
4. Oral presentation: 20%

* Attendance to lab sessions is mandatory. Absences (if any) must be duly justified.

Final exam

Students who choose the final exam option (or fail the continuous evaluation) must sit an exam (80% of the final mark) and give an oral presentation (20%) to pass the course.

Mark required in the final exam to pass the course: > 5/10 (Minimum mark in each part: 4/10)

* Attendance to lab sessions is mandatory. Absences (if any) must be duly justified.

Continuous evaluation is the default option.

For taking the final exam option, students must inform the coordinator in writing by the end of the third week of the module.

Extraordinary exam

Students who fail the continuous evaluation or the final exam must sit an exam to pass the course.

Mark required in the final exam to pass the course: > 5/10

7. Teaching resources

7.1. Teaching resources for the subject

Name	Type	Notes
Página Moodle de la asignatura	Web resource	Página Moodle de la asignatura donde se alojará toda la información necesaria para su seguimiento
Laboratorios de fabricación y caracterización de materiales y dispositivos	Equipment	Laboratorios de investigación parcialmente acondicionados para su uso docente con capacidad de fabricación y caracterización de materiales y dispositivos de película delgada como los propuestos en el temario

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	