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E.T.S. de Ingeniería y Sist. de
Telecom.

ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

593000614 - Wireless Systems Manufacturing

DEGREE PROGRAMME

59AJ - Master Universitario En Comunicaciones Inalámbricas

ACADEMIC YEAR & SEMESTER

2025/26 - 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.....	6
6. Activities and assessment criteria.....	8
7. Teaching resources.....	11
8. Other information.....	13

1. Description

1.1. Subject details

Name of the subject	593000614 - Wireless Systems Manufacturing
No of credits	4.5 ECTS
Type	Optional/elective
Academic year of the programme	First year
Semester of tuition	Semester 2
Tuition period	February-June
Tuition languages	English
Degree programme	59AJ - Master Universitario en Comunicaciones Inalámbricas
Centre	59 - E.T.S. De Ingeniería Y Sist. De Telecom.
Academic year	2025-26

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Neftali Nuñez Mendoza (Subject coordinator)	A4205	neftali.nunez@upm.es	Sin horario. Ver en la Web https://intra.etsist.upm.es /

* 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

CB6 - Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación/ Students have demonstrated knowledge and understanding providing the groundwork or opportunity for innovation in developing and/or applying ideas, often within a research context

CB7 - 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/Students are capable of applying their knowledge, understanding, and problem-solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study

CB8 - 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/Students are capable of integrating knowledge and making complex decisions, which, although based on incomplete or limited information, require reflection on social and ethical responsibilities linked to the application of their knowledge and opinions

CGI02 - Comprender el procedimiento, valor y límites del método científico, siendo capaz de identificar, localizar y obtener datos requeridos en un trabajo de investigación, de diseñar y guiar investigaciones analíticas, de modelado y experimentales, así como de evaluar datos de una manera crítica y extraer conclusiones. / Understand the procedure, value, and limits of the scientific method, being able to identify, locate and obtain data required in a research work, to design and guide analytical, modeling, and experimental investigations, as well as to critically evaluate data and extract conclusions.

CGI03 - Valorar la importancia de las fuentes documentales, manejarlas y buscar la información para el desarrollo de cualquier trabajo de investigación. / Assess the importance of documentary sources, manage them and search for information for the development of any research work.

CGI04 - Leer y comprender publicaciones dentro de su ámbito de estudio/investigación, así como su catalogación y valor científico. / Read and understand publications within their field of study / research, as well as their cataloging and scientific value.

UPM1 - Uso de la lengua inglesa / Use of the English language

UPM4 - Organización y planificación / Planning and organization

3.2. Learning outcomes

RA35 - Enumerar y describir los componentes de un equipo de usuario para comunicaciones inalámbricas/ List and describe the components of a user equipment for wireless communications

RA36 - Elegir los métodos y herramientas informáticas necesarias para abordar la solución de un problema/ Choose the computer methods and tools necessary to tackle the solution of a problem

RA37 - Diseñar y fabricar la PCB necesaria de un equipo de usuario para comunicaciones inalámbricas/ Design and manufacture the PCB necessary of a user equipment for wireless communications

RA38 - Montar e integrar los subsistemas sobre una PCB real/ Assemble and integrate the subsystems on a real PCB

RA63 - Interpretar los datos derivados de observaciones y mediciones empíricas en términos de su importancia y relacionarlos. / Interpret data derived from empirical observations and measurements in terms of their importance and relate them.

* 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

The course covering this topic is aimed to address to design and develop wireless communications systems, by the interconnection of the different building blocks of a wireless communication system in the context of modern wireless devices (components, integrated circuits and systems-on-a-chip). The main technology applied for design and development will be printed circuit board (PCB), but the used of emerging PCB substrates materials and other technologies for manufacturing of wireless circuits will also be reviewed.

4.2. Syllabus

1. Introduction to PCB design for wireless systems
 - 1.1. Introduction
 - 1.2. PCB design software applications
 - 1.3. Component types and design rules
 - 1.4. Board technology and manufacturing
 - 1.5. Project management
2. PCB project of a wireless system, part 1
 - 2.1. Definition of wireless system design, part 1
 - 2.2. Signal and power integrity on a system
 - 2.3. Transmissions lines and control impedance
 - 2.4. High-frequency PCB design
3. Wireless system peripherals
 - 3.1. Introduction
 - 3.2. Communicating on-board and out-board data with peripherals
 - 3.3. Wireless system peripherals
4. Industrial developing of PCB project of a wireless system, part 2

- 4.1. Outsourcing PCB projects
- 4.2. Definition of wireless system design, part 2
- 4.3. Hardware platforms and embedded systems. - Examples
- 4.4. Thermal issues on a system
- 4.5. Reliability of electronics systems
- 4.6. EMI/EMC issues on a system
5. Laboratory activity: individual work in PCB design, manufacturing and test a wireless system, part 1
6. Laboratory activity: group work in outsourcing PCB project of a wireless system, part 2

5. Schedule

5.1. Subject schedule*

Week	Type 1 activities	Type 2 activities	Distant / On-line	Assessment activities
1	Lecture activity.. Sections; 1.1 Introduction 1.2 PCB design software applications 1.3 Component types and design rules Duration: 03:00	Laboratory activity. EMC PCB CAD-CAM software introduction. Duration: 01:00		
2	Lecture activity.. Sections; 1.4 Board technology and manufacturing 1.5 Project management Duration: 02:00	Laboratory activity. EMC PCB CAD-CAM software introduction. Duration: 02:00		
3	2.1 Definition of wireless system design, part 1 2.2 Signal and power integrity on a system Duration: 02:00	Laboratory activity.: EMC PCB CAD-CAM design, part 1. Duration: 02:00		
4	Lecture activity.. Sections; 2.2 Signal and power integrity on a system 2.3 Transmissions lines and control impedance Duration: 02:00	Laboratory activity.: EMC PCB CAD-CAM design, part 1. Duration: 02:00		
5	Lecture activity.. Section; 2.4 High-frequency PCB design. 3.1 Introduction Duration: 02:00	Laboratory activity.: EMC PCB CAD-CAM design, part 1. Duration: 02:00		
6	Lecture activity.. 3.1 Introduction, 3.2 Communications on-board and out-board data with peripherals Duration: 02:00	Laboratory activity.: EMC PCB CAD-CAM design, part 1. Note: This week. Delivery of individual work design project, part 1 Duration: 02:00		
7	Lecture activity.. Sections; 3.3 Wireless system peripherals- 4.1 Outsourcing PCB projects Duration: 02:00	PCB assembly and test , part 1 Duration: 02:00		
8	Lecture activity.. Sections; 4.1 outsourcing PCB projects Duration: 00:30			1º Theoretical Partial Exam 15%. Two parts. Exam type quiz in Moodle (Units 1,2,3), and evaluation of PCB design parameters with a software Progressive assessment and Global Examination Presential Duration: 01:30

9	Lecture activity.. 4.2 Definition of wireless system design part 2. 4.3 Hardware platforms and embedded system - Examples Duration: 01:00	Laboratory activity.: PCB CAD-CAM project, part 2. Duration: 01:00		
10	Lecture activity.. Sections; 4.4. Thermal issues on a system Duration: 01:00	Laboratory activity.: PCB CAD-CAM project, part 2. Duration: 01:00		Laboratory evaluation of individual work, project part 1. 45% Progressive assessment and Global Examination Not Presential Duration: 00:00
11	Lecture activity: 4.4 Thermal issues on a system Duration: 01:00	Laboratory activity.: PCB CAD-CAM project, part 2. Duration: 01:00		
12	Lecture activity: 4.5 Reliability of electronics systems Duration: 01:00	Laboratory activity.:PCB CAD-CAM project, part 2. Duration: 01:00		
13	Lecture activity: 4.6 EMI-EMC issues on a system Duration: 01:00	Laboratory activity.: PCB CAD-CAM project, part 2. Duration: 01:00		
14	Lecture activity: 4.6 EMI-EMC issues on a system Duration: 00:30			2º Partial Theoretical Exam 10%. Two parts; Two parts. Exam type quiz in Moodle (Unit 4), and evaluation of PCB thermal problems with a software Progressive assessment and Global Examination Presential Duration: 01:30 Laboratory evaluation of individual or group work, project part 2.30% Progressive assessment and Global Examination Not Presential Duration: 00:00
15				
16				
17				

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.

6. Activities and assessment criteria

6.1. Assessment activities

6.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
8	1º Theoretical Partial Exam 15%. Two parts. Exam type quiz in Moodle (Units 1,2,3), and evaluation of PCB design parameters with a software		Face-to-face	01:30	15%	0 / 10	CB6 CB7 CB8 CGI02 CGI03 CGI04 UPM1 UPM4
10	Laboratory evaluation of individual work, project part 1. 45%		No Presential	00:00	45%	0 / 10	CB6 CB7 CB8 CGI02 CGI03 CGI04 UPM1 UPM4
14	2º Partial Theoretical Exam 10%. Two parts; Two parts. Exam type quiz in Moodle (Unit 4), and evaluation of PCB thermal problems with a software		Face-to-face	01:30	10%	0 / 10	CB6 CB7 CB8 CGI02 CGI03 CGI04 UPM1 UPM4
14	Laboratory evaluation of individual or group work, project part 2.30%		No Presential	00:00	30%	0 / 10	CB6 CB7 CB8 CGI02 CGI03 CGI04 UPM1 UPM4

6.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
8	1º Theoretical Partial Exam 15%. Two parts. Exam type quiz in Moodle (Units 1,2,3), and evaluation of PCB design parameters with a software		Face-to-face	01:30	15%	0 / 10	CB6 CB7 CB8 CGI02 CGI03 CGI04 UPM1 UPM4
10	Laboratory evaluation of individual work, project part 1. 45%		No Presential	00:00	45%	0 / 10	CB6 CB7 CB8 CGI02 CGI03 CGI04 UPM1 UPM4
14	2º Partial Theoretical Exam 10%. Two parts; Two parts. Exam type quiz in Moodle (Unit 4), and evaluation of PCB thermal problems with a software		Face-to-face	01:30	10%	0 / 10	CB6 CB7 CB8 CGI02 CGI03 CGI04 UPM1 UPM4
14	Laboratory evaluation of individual or group work, project part 2.30%		No Presential	00:00	30%	0 / 10	CB6 CB7 CB8 CGI02 CGI03 CGI04 UPM1 UPM4

6.1.3. Referred (re-sit) examination

No se ha definido la evaluación extraordinaria.

6.2. Assessment criteria

The type of course and the approach described above make more convenient to select an assessment mechanism different to the traditional final exam. A progressive evaluation methodology is here proposed for this course, based on a set of short quizzes and two lab practices with reports that will be also evaluated in order to get the final grade.

For progressive and global evaluation it is necessary to attend 80% of the laboratory classes, furthermore, there are four exams/works evaluated.

- The 1^o theoretical write exam, with two parts. Exam type quiz in Moodle (Units 1,2,3), and evaluation of PCB design parameters with a software. The weight of this exam is 15%. The duration is 90 min. and has been developed during the class.
- Laboratory evaluation of the Moodle delivered files of individual work, project part 1. The weight of this practical work is 45%.
- The 2^o theoretical write exam with two parts. Exam type quiz in Moodle (Unit 4), and evaluation of PCB thermal problems with a software. The weight of this exam is 10%. The duration is 90 min. and has been developed during the class.
- Laboratory evaluation of the Moodle delivered files of individual or group work, project part 2. The weight of this practical work is 30%.

Those students who do not meet the goals and do not pass the regular activities, will be able to attend an extraordinary exam organised on July.

After the overall assessment, Moodle will provide a timeframe for students to confirm by email to the professor that they will be taking the July exam. The exam will consist of two parts: the submission of an individual PCB project, which the professor will send to each student, with a deadline on the officially scheduled exam day, and on that day, a written exam that will include short questions, exercises, and various problems developed using PCB related software.

7. Teaching resources

7.1. Teaching resources for the subject

Name	Type	Notes
Moodle educational platform	Web resource	Slides, examples, reports, datasheets, laboratory information
High-Speed PCB Design Guide (Sierra Circuits)	Bibliography	Access by web.
Khater, M. A. (2020). High-speed printed circuit boards: A tutorial. IEEE Circuits and Systems Magazine, 20(3), 34-45.	Web resource	Accessed by IEEE Xplore
Wilson, P. (2017). The circuit designer's companion. Newnes. 4th edition.	Bibliography	Go to O _z Reilly.com/library, and login as "institution not listed", then it is needed to use academic email from a UPM network or VPN-UPM. Now you have in this book with access to online content.
Brooks, D. (2003). Signal integrity issues and printed circuit board design. Prentice Hall Professional.	Bibliography	Go to O _z Reilly.com/library, and login as "institution not listed", then it is needed to use academic email from a UPM network or VPN-UPM. Now you have in this book with access to online content.
- Video: PCB Signal Integrity LiveLessons (Video Training). By Douglas Brooks	Others	Go to O _z Reilly.com/library, and login as "institution not listed", then it is needed to use academic email from a UPM network or VPN-UPM. Now you have in this book with access to online content.
- Video : PCB Currents: How They Flow, How They React. By Douglas Brooks	Others	Go to O _z Reilly.com/library, and login as ?institution not listed??. then it is needed to use academic email from a UPM network or VPN-UPM. Now you have in this book with access to online content

<p>Bogatin, E. (2018). Signal and power integrity--simplified. Pearson Education</p>	<p>Bibliography</p>	<p>Go to OzReilly.com/library, and login as ?institution not listed??. then it is needed to use academic email from a UPM network or VPN-UPM. Now you have in this book with access to online content</p>
<p>Bowick, C. (2011). RF circuit design. Elsevier.</p>	<p>Bibliography</p>	<p>Go to OzReilly.com/library, and login as ?institution not listed??. then it is needed to use academic email from a UPM network or VPN-UPM. Now you have in this book with access to online content.</p>
<p>Williams, T. (2016). EMC for product designers. Newnes. Chapter 12</p>	<p>Bibliography</p>	<p>Go to OzReilly.com/library, and login as ?institution not listed??. then it is needed to use academic email from a UPM network or VPN-UPM. Now you have in this book with access to online content.</p>
<p>C. Tulkoff, G. Caswell (2021) Design for Excellence in Electronics Manufacturing. John Wiley & Sons</p>	<p>Bibliography</p>	<p>Go to OzReilly.com/library, and login as ?institution not listed??. then it is needed to use academic email from a UPM network or VPN-UPM. Now you have in this book with access to online content.</p>
<p>Electronics Projects with the ESP8266 and ESP32: Building Web Pages, Applications, and WiFi Enabled Devices</p>	<p>Bibliography</p>	<p>Go to OzReilly.com/library, and login as ?institution not listed??. then it is needed to use academic email from a UPM network or VPN-UPM. Now you have in this book with access to online content.</p>

8. Other information

8.1. Other information about the subject

INFORMACIÓN SOBRE ACTUACIONES EN CASO DE COPIA O PLAGIO

Los derechos y deberes de los estudiantes universitarios están desarrollados en el Estatuto del Estudiante Universitario (RD 1791/2010 de 30 de diciembre) y en el artículo 13 del referido estatuto en el punto d) especifica que es deber del estudiante universitario ***abstenerse de la utilización o cooperación en procedimientos fraudulentos en las pruebas de evaluación, en los trabajos que se realicen o en documentos oficiales de la universidad.***

En el caso de que en el desarrollo de las pruebas de evaluación se aprecie el incumplimiento de los deberes como estudiante universitario, el coordinador de la asignatura podrá ponerlo en conocimiento del Director o Decano del Centro, que de acuerdo con lo establecido en el artículo 77 (n) de los Estatutos de la UPM tiene competencias para proponer la iniciación del procedimiento disciplinario a cualquier miembro de la Escuela o Facultad, por propia iniciativa o a instancia de la Comisión de Gobierno al Rector, en los términos previstos en los estatutos y normas de aplicación.

Por lo tanto, ante tales hechos el Tribunal de la asignatura calificará con un 0 dicha prueba, al no poder determinar los conocimientos adquiridos por el alumno. Se informará a la dirección del departamento del hecho y a la Subdirección de Ordenación Académica para analizar los casos reincidentes y ponerlo en conocimiento del Director según el párrafo anterior.

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No se pueden utilizar dispositivos de comunicaciones durante la realización de las pruebas ni en clase.

English version:

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documents of the university.

In the event that, in the course of the evaluation tests, failure to fulfil the duties as a university student is assessed, the coordinator of the subject may bring it to the attention of the Director or Dean of the Centre, who in accordance with article 77 (n) of the Statutes of the UfM has the power to propose the initiation of disciplinary proceedings to any member of the School or Faculty, on his own initiative or at the request of the "Comisión de Gobierno al Rector", in the terms provided for in the statutes and implementing rules.

Therefore, in the event of such events, the subject court shall qualify with a 0 such test, because it is unable to determine the knowledge acquired by the student. The Department's management will be informed of the incident and the Subdirectorate of Academic Management to analyse the recurring cases and bring it to the attention of the Director according to the previous paragraph.

USE OF COMMUNICATIONS DEVICES

Communications devices may not be used during testing or in class.