INTERNATIONAL
CAMPUS OF
EXCELLENCE

POLITÉCNICA

E.T.S. de Ingenieria y Sistemas
de Telecomunicacion

ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

593000603 - Rf Wireless Technology

DEGREE PROGRAMME

59AJ - Master Universitario En Comunicaciones Inalámbricas

ACADEMIC YEAR & SEMESTER

2024/25 - Semester 1

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1. Description

1.1. Subject details

Name of the subject	593000603 - Rf Wireless Technology
No of credits	6 ECTS
Type	Compulsory
Academic year ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	59AJ - Master Universitario en Comunicaciones Inalámbricas
Centre	59 - Escuela Tecnica Superior De Ingenieria Y Sistemas De Telecomunicacion
Academic year	2024-25

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Alejandro Garcia Lamperez (Subject coordinator)		alejandro.garcia.lamperez@upm.es	- -

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

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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

- Electromagnetism and electromagnetic waves

- Solid State technology

- Electronic components

- Communication Circuits and Systems

- Circuit Theroy

- Analog Electronics

4. Skills and learning outcomes *

4.1. 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

CEM05 - Realizar la integración de los módulos de radiofrecuencia que intervienen en un sistema de comunicaciones inalámbrico y su medida./ Perform the integration of the radio frequency modules involved in a wireless communications system and their measurement.

CGI02 - Comprender el procedimiento, valor y límites del método científico, siendo capaz de identificar, localizar y obtenerdatos 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

UPM5 - Gestión de la Información / Information management

4.2. Learning outcomes

RA57 - Capacity to design and execute research, development and innovation projects.

RA56 - Ability to demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to Wireless Communications.

RA58 - Identify and describe the applied electronics principles used to develop circuitry and circuit-systems used in wireless user equipment, radio access networks and core networks.

RA59 - Identify the basic tools and test equipment used to construct, troubleshoot, and maintain standard Wireless Communications circuits and systems.

RA55 - Competence in the planning, design, and execution of research investigations, from the problem recognition stage through to the evaluation and appraisal of results and findings; this to include the ability to select appropriate techniques and procedures.

* 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

The course covering this topic is aimed to learn about innovations on the latest and most significant contents in the area of circuit design of RF devices for wireless communications systems, both in wireless infrastructure and user equipment.

Wireless systems are based on the interaction of different electronic circuits specially designed to work at high frequencies. In turn, these circuits are based on the use of electronic components specially adapted to work at high frequencies. In this course the main circuits and technology used at high frequencies are studied.

In RF and microwave frequencies the length of the waves to be worked with is comparable to the dimensions of the electronic circuits used for their control. That is why different effects appear that are necessary to know and therefore it is necessary to use special techniques that minimize the effects derived from this fact.

In the course RF Wireless Technology (RWT) the main architectures, technologies and circuits used in radio transmitters and receivers are studied, from the system to the component point of view.

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5.2. Syllabus

1. Wireless networks and devices.

    1.1. Wireless networks infrastructure.

    1.2. Wireless devices and terminals.

2. Wireless transceiver architectures.

    2.1. Radio transmitter architectures.

    2.2. Radio receiver architectures.

    2.3. RFIC technology.

3. Wireless transceivers circuits and systems.

    3.1. Low noise front ends.

    3.2. High efficiency power amplifiers.

    3.3. Advanced clock and timing circuits.

    3.4. Data converters.

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6. Schedule

6.1. Subject schedule*

Week	Type 1 activities	Type 2 activities	Distant / On-line	Assessment activities
1	**Lesson 1.1. Wireless networks infrastructure.** Duration: 04:00 **Lesson 1.2. Wireless devices and terminals.** Duration: 04:00			**Wireless networks and devices.** Progressive assessment and Global Examination Presential Duration: 01:00
2	**Lesson 2.1 Radio transmitter architectures.** Duration: 06:00	**Laboratory practice 1:Radio transmitter and receiver architectures.** Duration: 02:00		**Wireless transceiver architectures.** Progressive assessment and Global Examination Presential Duration: 02:00
3	**Lesson 2.2. Radio receiver architectures.** Duration: 06:00	**Laboratory practice 1: Radio transmitter and receiver architectures.** Duration: 02:00		**Wireless transceiver architectures.** Progressive assessment and Global Examination Presential Duration: 02:00
4	**Lesson 2.3. RFIC technology.** Duration: 03:00 **Lesson 3.1. Low noise front ends.** Duration: 03:00	**Laboratory practice 1: High efficiency radio transmitter and / or receiver.** Duration: 02:00		**Wireless transceiver architectures.** Progressive assessment and Global Examination Presential Duration: 02:00
5	**Lesson 3.2. High efficiency power amplifiers.** Duration: 06:00	**Laboratory practice 2: High efficiency radio transmitter and / or receiver.** Duration: 02:00		**Wireless transceivers circuits and systems.** Progressive assessment and Global Examination Presential Duration: 02:00
6	**Lesson 3.2. High efficiency power ampliffers.** Duration: 03:00 **Lesson 3.3. Advanced clock and timing circuits.** Duration: 03:00	**Laboratory practice 2: High efficiency radio transmitter and / or receiver.** Duration: 02:00		**Wireless transceivers circuits and systems.** Progressive assessment and Global Examination Presential Duration: 02:00

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7	**Lesson 3.3. Advanced clock and timing circuits.** Duration: 03:00 **Lesson 3.4. Data converters.** Duration: 03:00	**Laboratory practice 2: High efficiency radio transmitter and / or receiver.** Duration: 02:00		**Wireless transceivers circuits and systems.** Progressive assessment and Global Examination Presential Duration: 01:00
8				
9				
10				
11				
12				
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14				
15				
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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.

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7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
1	Wireless networks and devices.		Face-to-face	01:00	10%	5 / 10	CB6 CEM05 CGI02 CB7 UPM1 CGI04
2	Wireless transceiver architectures.		Face-to-face	02:00	10%	5 / 10	CB6 CEM05 CGI02 CB7 UPM1 CGI04
3	Wireless transceiver architectures.		Face-to-face	02:00	10%	5 / 10	CB6 CEM05 CGI02 CB7 UPM1 CGI04
4	Wireless transceiver architectures.		Face-to-face	02:00	25%	5 / 10	CB6 CEM05 CGI02 CB7 UPM1 CGI04
5	Wireless transceivers circuits and systems.		Face-to-face	02:00	10%	5 / 10	CB6 CEM05 CGI02 CB7 UPM1 CGI04
6	Wireless transceivers circuits and systems.		Face-to-face	02:00	10%	5 / 10	CB6 CEM05 CGI02 CB7 UPM1 CGI04

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| 7 | Wireless transceivers circuits and systems. | | Face-to-face | 01:00 | 25% | 5 / 10 | CB6 CEM05 CGI02 CB7 UPM1 CGI04 |

7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
1	Wireless networks and devices.		Face-to-face	01:00	10%	5 / 10	CB6 CEM05 CGI02 CB7 UPM1 CGI04
2	Wireless transceiver architectures.		Face-to-face	02:00	10%	5 / 10	CB6 CEM05 CGI02 CB7 UPM1 CGI04
3	Wireless transceiver architectures.		Face-to-face	02:00	10%	5 / 10	CB6 CEM05 CGI02 CB7 UPM1 CGI04
4	Wireless transceiver architectures.		Face-to-face	02:00	25%	5 / 10	CB6 CEM05 CGI02 CB7 UPM1 CGI04
5	Wireless transceivers circuits and systems.		Face-to-face	02:00	10%	5 / 10	CB6 CEM05 CGI02 CB7 UPM1 CGI04
6	Wireless transceivers circuits and systems.		Face-to-face	02:00	10%	5 / 10	CB6 CEM05 CGI02 CB7 UPM1 CGI04

7	Wireless transceivers circuits and systems.		Face-to-face	01:00	25%	5 / 10	CB6 CEM05 CGI02 CB7 UPM1 CGI04

7.1.3. Referred (re-sit) examination

No se ha definido la evaluación extraordinaria.

7.2. 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 continuous evaluation methodology is here proposed for this course, based on a set of short quizzes, or on a short project, or on both. This way, main concepts could be properly set up while the attractive of the contents are increased.

In the evaluation, an important weight has been given to laboratory practices, since this is considered a fundamental and distinct aspect of training in this type of discipline.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Slide shows	Web resource	Moodle LMS
Lab scripts	Web resource	Moodle LMS
R. Rhea, Oscillator Design and Computer Simulation, McGraw- Hill, 1995	Bibliography	Book on oscillators

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Rohde, Microwave and Wireless Synthesizers Analysis and Design, Wiley, 1997	Bibliography	Book on Synthesizers
J. Smith, Modern Communication Circuits, Mc Graw Hill 1998	Bibliography	Classic Book on wireless systems and circuits
Herbert L. Krauss, Charles W. Bostian, Frederick H. Raab, Solid state Radio Engineering, Wiley, 1980, ISBN: 978-0-471-03018-8	Bibliography	Classic book on wireless systems and circuits
Andrei Grebennikov, Nathan O. Sokal, Marc J. Franco, Switchmode RF and Microwave Power Amplifiers, 2nd edition, Academic Press (Eselvier) 2012, ISBN: 978-0-12-415907-5	Bibliography	Book on RF and microwave power amplifiers