



POLITÉCNICA

INTERNATIONAL
CAMPUS OF
EXCELLENCE

COORDINATION PROCESS OF
LEARNING ACTIVITIES
PR/CL/001



E.T.S. de Ingeniería y Sistemas
de Telecomunicación

ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

593000412 - Rf Electronic Design

DEGREE PROGRAMME

59AF - Master Univ. Ing. Sistemas y Servicios para la Sociedad de la Información

ACADEMIC YEAR & SEMESTER

2020/21 - Semester 2

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1. Description

1.1. Subject details

Name of the subject	593000412 - Rf Electronic Design
No of credits	5 ECTS
Type	Optional
Academic year of the programme	First year
Semester of tuition	Semester 2
Tuition period	February-June
Tuition languages	English
Degree programme	59AF - Master Univ. Ing. Sistemas y Servicios para la Sociedad de la Informacion
Centre	59 - Escuela Tecnica Superior de Ingenieria y Sistemas de Telecomunicacion
Academic year	2020-21

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Fco. Javier Ortega Gonzalez (Subject coordinator)	A8412	franciscojavier.ortega@upm.es	Tu - 18:00 - 20:00 Th - 18:00 - 20:00
Jose Manuel Pardo Martin	A8414	josemanuel.pardo@upm.es	M - 18:00 - 20:00 W - 18:00 - 20:00

* 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

CEI.2 - Capacidad de interpretar y evaluar de forma crítica documentos científicos en el área de las Tecnologías de la Información y las Comunicaciones.

CGEN.6 - Capacidad para proyectar, calcular y diseñar sistemas y servicios para la Sociedad de la Información

3.2. Learning outcomes

RA38 - Using specific test instruments for measuring radiocommunication systems

RA40 - Choosing active and passive components.

RA42 - Design, analyze and measure electronic circuits for R.F. systems

RA43 - Specify characteristics of wireless communication systems

RA39 - Designing software defined radio communication systems

RA37 - Analyzing wireless communications subsystems

RA44 - Designing wireless communication systems

RA41 - Using specific test measurement equipment for RF electronic components

* 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 "RF electronic design" teaches how to design circuits and systems for advanced high frequency and microwave systems.

This course pays special attention to signal source circuits such as oscillators and direct digital synthesizers besides advanced PLLs (phase locked loop) systems. The course also covers small signal and power amplification topics including some state of the art technologies such as new linearization techniques for power amplifiers and high-efficiency power amplifiers.

4.2. Syllabus

1. Radio receiver architectures
 - 1.1. Superheterodyne architecture
 - 1.2. Direct conversion architecture
 - 1.3. Low IF (intermediate frequency) architecture
2. Frequency synthesizers
 - 2.1. Oscillators
 - 2.2. Phase locked loop frequency synthesizer
 - 2.3. Direct digital synthesizers (DDS)
3. Frequency Mixers
 - 3.1. Modulators
 - 3.2. Demodulators
4. Small signal amplifiers
 - 4.1. Stability
 - 4.2. Gain
 - 4.3. Noise
5. High efficiency power amplifiers
 - 5.1. Doherty techniques and LINC amplifiers

5.2. Predistortion

5.3. Envelope Tracking (ET) and Envelope Elimination & Restoration (EER) techniques

5. Schedule

5.1. Subject schedule*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Distant / On-line	Assessment activities
1			Lesson 1: Transmitters and receivers architectures Duration: 04:00	
2			Lesson 2: PLL frequency synthesizers, and DDS Direct Digital Synthesizers. Duration: 04:00	
3			Lesson 2: PLL frequency synthesizers, and DDS Direct Digital Synthesizers. Duration: 04:00	
4			Lesson 2: PLL frequency synthesizers, and DDS Direct Digital Synthesizers. Duration: 04:00	
5			Lesson 3: Frequency Mixers. Duration: 04:00	
6			Lesson 4: Small signal amplifiers: stability, gain, noise. Duration: 04:00	
7			Lesson 4: Small signal amplifiers: stability, gain, noise. Duration: 04:00	
8			Lesson 4: Small signal amplifiers: stability, gain, noise. Duration: 04:00	
9			Lesson 5: High efficiency power amplification and and linearization. Duration: 04:00	
10			Tema 5: Amplificadores de alto rendimiento y linealización Duration: 04:00	
11			Lesson 5: High efficiency power amplification and and linearization. Duration: 04:00	

12		Laboratory: Design, building and measuring a radio transmitter or receiver. Duration: 04:00	Laboratory: Design, building and measuring a radio transmitter or receiver. Duration: 04:00	Laboratory practice exam. Continuous assessment Presential Duration: 02:00
13		Laboratory: Design, building and measuring a radio transmitter or receiver. Duration: 04:00	Laboratory: Design, building and measuring a radio transmitter or receiver. Duration: 04:00	
14		Laboratory: Design, building and measuring a radio transmitter or receiver. Duration: 04:00	Laboratory: Design, building and measuring a radio transmitter or receiver. Duration: 04:00	
15		Laboratory: Design, building and measuring a radio transmitter or receiver. Duration: 04:00	Laboratory: Design, building and measuring a radio transmitter or receiver. Duration: 04:00	
16		Laboratory: Design, building and measuring a radio transmitter or receiver.. Duration: 04:00	Laboratory: Design, building and measuring a radio transmitter or receiver.. Duration: 04:00	Laboratory practice exam. Continuous assessment Presential Duration: 02:00
17				Laboratory practice exam. Final examination Not Presential Duration: 02:00

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.

6. Activities and assessment criteria

6.1. Assessment activities

6.1.1. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
12	Laboratory practice exam.		Face-to-face	02:00	70%	5 / 10	CEI.2 CGEN.6
16	Laboratory practice exam.		Face-to-face	02:00	30%	5 / 10	CEI.2 CGEN.6

6.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Laboratory practice exam.		No Presential	02:00	100%	5 / 10	CEI.2 CGEN.6

6.1.3. Referred (re-sit) examination

No se ha definido la evaluación extraordinaria.

6.2. Assessment criteria

This course is evaluated by means of two exams:

- Theory exam: A written exam about the matters covered by the course.
- Laboratory exam: A presentation of one or more deliverables about the practical designs built and measured in the laboratory.

7. Teaching resources

7.1. Teaching resources for the subject

Name	Type	Notes
Recommended book 1.	Bibliography	"RF/microwave circuit design for wireless applications", Ulrich L. Rohde (Wiley) ISBN: 978-0-470-90181-6
Recommended book 2.	Bibliography	RF Power Amplifiers for Wireless Communications, Second Edition (Artech House Microwave Library) Steve C. Cripps, May 30, 2006, ISBN-13: 978-1596930186
Recommended book 3.	Bibliography	Switchmode RF and Microwave Power Amplifiers, Second Edition ? July 3, 2012, Andrei Grebennikov, Nathan O. Sokal, Marc J Franco, ISBN-13: 978-0124159075
Laboratory test and measurement instruments.	Equipment	R.F. Signal source, R.F. spectrum analyzer, R.F. network analyzer, digital oscilloscope, power supply.