INTERNATIONAL
CAMPUS OF
EXCELLENCE

POLITÉCNICA

ETSIT UPM

E.T.S. de Ingenieros de
Telecomunicacion

ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

93000925 - Design Of Communication Systems And Equipment

DEGREE PROGRAMME

09AT - Master Universitario En Teoria De La Señal Y Comunicaciones

ACADEMIC YEAR & SEMESTER

2023/24 - Semester 1

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Learning guide

1. Description

1.1. Subject details

Name of the subject	93000925 - Design Of Communication Systems And Equipment
No of credits	6 ECTS
Type	Optional
Academic year ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	09AT - Master Universitario en Teoria de la Señal y Comunicaciones
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 *
Fco. Javier Casajus De Quiros (Subject coordinator)	C-328	javier.casajus@upm.es	Sin horario. Use e-mail for an appointment
Jose Parera Bermudez	B-405	jose.parera@upm.es	Sin horario. Use e-mail for an appointment

Miguel Angel Garcia Izquierdo	B-408	miguelangel.garcia.izquierdo @upm.es	Sin horario. Use e-mail for an appointment

* 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

- Working knowledge of a computation environment (MATLAB, Octave, Python,?)

- Probability and Stochastic Processes for Engineers

- Radio Communications

- Digital Communication fundamentals

4. Skills and learning outcomes *

4.1. Skills to be learned

CB06 - 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

CB07 - 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

CB08 - 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

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CB09 - 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

CB10 - 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

CE01 - Analizar y aplicar técnicas para el diseño y desarrollo avanzado de equipos y sistemas, basándose en la teoría de la señal y las comunicaciones, en un entorno internacional

CE02 - Evaluar y sintetizar los resultados de un trabajo en equipo en proyectos relacionados con la teoría de la señal y las comunicaciones, en un entorno internacional.

CE03 - Valorar y contrastar la utilización de las diferentes técnicas disponibles para la resolución de problemas reales dentro del área de teoría de la señal y comunicaciones.

CT01 - Capacidad para comprender los contenidos de clases magistrales, conferencias y seminarios en lengua inglesa

CT03 - Capacidad para adoptar soluciones creativas que satisfagan adecuadamente las diferentes necesidades planteadas

CT04 - Capacidad para trabajar de forma efectiva como individuo, organizando y planificando su propio trabajo, de forma independiente o como miembro de un equipo

CT05 - Capacidad para gestionar la información, identificando las fuentes necesarias, los principales tipos de documentos técnicos y científicos, de una manera adecuada y eficiente

CT06 - Capacidad para emitir juicios sobre implicaciones económicas, administrativas, sociales, éticas y medioambientales ligadas a la aplicación de sus conocimientos

4.2. Learning outcomes

RA3 - Conocer técnicas avanzadas de optimización para equipos y dispositivos de RF.

RA10 - Capability to design systems and equipments for multimedia generation and distribution

RA9 - To evaluate and to implement RF systems and equipments.

* 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

This course is focused on those elements and techniques that are needed in order to built intelligent radios based on digital technology. This implies adequate coverage of software defined radio, cognitive radio and intelligent radio.

All this from the point of view of both the digital hardware and the signal processing software required for their full implementation plus the cognitive techniques layered on top of the physical system.

The starting point is a review of digital communications fundamentals. New advanced topics are then added that cover performance degradation due to: subsystems impairments, channel time-variability or non linearity. Digital signal processing techniques are introduced so as to reduce real-world system degradation to acceptable levels.

Additional topics present technology and architectures intended to interface all-digital equipment to the physical world, for both wired or wireless communication channels.

Moreover, there is also an analysis of digital technology available for implementation on actual equipment of signal processing and interface functionality. This includes programmable logic (FPGAs, for instance) and general purpose processors. To this, a description of development methodology for these technologies, is added; including signal processing techniques specifically intended for each of them.

5.2. Syllabus

1. Communication equipment concepts

2. System model

    2.1. Communication channel impairments

    2.2. Analogue modulation and demodulation

    2.3. Advanced sampling techniques

    2.4. Automatic gain control

    2.5. Digital filtering

3. Adaptive techniques

    3.1. Carrier recovery

    3.2. Transmit and receive filters

    3.3. Timing recovery

    3.4. Equalisation

4. Digital hardware

    4.1. General purpose processors

    4.2. Digital signal processors

    4.3. Field programmable gate arrays

5. Classroom project: QAM radio

6. Design project

6. Schedule

6.1. Subject schedule*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1	**Introduction** Duration: 02:00 Lecture **Section 2.1** Duration: 02:00 Lecture			
2	**Section 2.2** Duration: 02:00 Lecture	**Classroom project** Duration: 02:00 Laboratory assignments		
3	**Section 2.3** Duration: 02:00 Lecture **Section 2.4** Duration: 02:00 Lecture			
4	**Section 2.5a** Duration: 02:00 Lecture	**Classroom project** Duration: 02:00 Laboratory assignments		
5	**Section 2.5b** Duration: 02:00 Lecture **Section 3.1** Duration: 02:00 Lecture			
6	**Section 3.2** Duration: 02:00 Lecture	**Classroom project** Duration: 02:00 Laboratory assignments		
7	**Section 3.3** Duration: 02:00 Lecture **Section 3.4** Duration: 02:00 Lecture			
8	**Section 4.1** Duration: 02:00 Lecture	**Classroom project** Duration: 02:00 Laboratory assignments		
9	**Section 4.2** Duration: 02:00 Lecture **Section 4.3** Duration: 02:00 Lecture			

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10		**Design project** Duration: 04:00 Laboratory assignments		
11		**Design project** Duration: 04:00 Laboratory assignments		
12		**Design project** Duration: 04:00 Laboratory assignments		
13		**Design project** Duration: 04:00 Laboratory assignments		
14		**Design project** Duration: 04:00 Laboratory assignments		**Design project report** Group work Continuous assessment and final examination Not Presential Duration: 04:00
15				
16				
17				**Test of sections 1 to 4** Written test Continuous assessment Presential Duration: 02:00 **Classroom Exercises** Individual work Continuous assessment Not Presential Duration: 04:00 **Final exam** Written test Final examination 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.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
14	Design project report	Group work	No Presential	04:00	35%	5 / 10	CB09 CT01 CB07 CT03 CB06 CT04 CB08 CE01 CT06 CE03 CB10 CE02 CT05
17	Test of sections 1 to 4	Written test	Face-to-face	02:00	45%	3.5 / 10	CB08 CB09 CT01 CB07 CT03 CB06 CT04 CT06 CE03 CB10 CE02 CT05
17	Classroom Exercises	Individual work	No Presential	04:00	20%	5 / 10	CB08 CB09 CT01 CB07 CT03 CB06 CT04 CE01 CT06 CE03 CB10 CE02 CT05

7.1.2. Global examination

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Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
14	Design project report	Group work	No Presential	04:00	35%	5 / 10	CB09 CT01 CB07 CT03 CB06 CT04 CB08 CE01 CT06 CE03 CB10 CE02 CT05
17	Final exam	Written test	Face-to-face	02:00	65%	3.5 / 10	CB09 CT01 CB07 CT03 CB06 CT04 CE01 CT06 CE03 CB10 CE02 CT05

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Final Exam	Written test	Face-to-face	02:00	65%	5 / 10	CT03 CB06 CT04 CE01 CT06 CE03 CB10 CE02 CT05 CB08

						CB09
						CT01
						CB07
Design Project Report or Oral Exam on Project	Individual work	Face-to-face	02:00	35%	5 / 10	CB06 CT04 CE01 CT06 CE03 CB10 CE02 CT05 CB08 CB09 CT01 CB07 CT03

7.2. Assessment criteria

Evaluation will assess if students have acquired all the competences of the subject. Thus, evaluation through final assessment will be carried out considering all the evaluation techniques used in continuous evaluation (EX, ET, TG, etc.), and will be celebrated in the exam period approved by Junta de Escuela for the current academic semester and year. Evaluation activities that assess learning outcomes that cannot be evaluated through a single exam can be carried out along the semester.

Extraordinary examination will be carried out exclusively by the final assessment method.

The design project is an exercise on the design and simulation of a communication system starting from specifications provided in the course. A report about the design must be delivered and a practical exam of it will follow.

Classroom exercises will be proposed, solved and marked in classroom time.

A minimum of 3.5 points, out of 10, must be attained in every test so as to contribute to the final mark .

For evaluation by final examination only, students must deliver a report on the design project and attend a test on the theoretical matters as expounded on sections 1 through 4.

For the extraordinary examination, students will be allowed to choose between delivery of a report on the design project and attending an oral exam on the design project, thus assessing the level they have attained in the practical matters of the course.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Software Receiver Design de C. Richard Johnson y otros	Bibliography	Text book
http://proquest.safaribooksonline.com/book/electrical-engineering/communications-engineering/9781107386747	Web resource	Link to text book on-line version
Radio Engineering: From Software Radio to Cognitive Radio de Jacques Palicot	Bibliography	Reference book
http://proquest.safaribooksonline.com/book/electrical-engineering/communications-engineering/9781118602225	Web resource	Link to on-line version of the reference book
Computer	Equipment	The use of a laptop in class is strongly advised

9. Other information

9.1. Other information about the subject

Platforms: Moodle for evaluation, Teams for other activities

La asignatura se relaciona con el ODS4 a través de las metas 4.4, 4.7

La asignatura se relaciona con el ODS9 a través de la meta 9.5