ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

593000104 - Wireless communications

DEGREE PROGRAMME

59AC - Master Univ. en Sistemas y Servicios para la Sociedad de la Informacion

ACADEMIC YEAR & SEMESTER

2017/18 - Semester 1

Index

Learning guide

1. Description

1.1. Subjet details

Name of the subject	593000104 - Wireless communications
No of credits	5 ECTS
Type	Compulsory
Academic year ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	59AC - Master Univ. en Sistemas y Servicios para la Sociedad de la Informacion
Centre	Escuela Tecnica Superior de Ingenieria y Sistemas de Telecomunicacion
Academic year	2017-18

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Pedro Garcia Del Pino (Subject coordinator)	D8210	pedro.gdelpino@upm.es	Sin horario.
Jose Maria Rodriguez Martin	D8417	josemaria.rodriguez.martin@upm.es	Sin horario.
Antonio Perez Yuste	D8304	antonio.perez@upm.es	Sin horario.

* 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

El plan de estudios Master Univ. en Sistemas y Servicios para la Sociedad de la Informacion no tiene definidas asignaturas previas recomendadas para esta asignatura.

3.2. Other recommended learning outcomes

- Digital communications: modulation, noise, coding, equalization

- Radio communication systems, especially mobile communications

- Basic knowledge about antennas and radiowave propagation

4. Skills and learning outcomes *

4.1. Skills to be learned

CEI.1 - Capacidad de proponer, organizar y ejecutar trabajos de investigación en el ámbito de la ingeniería para la Sociedad de la Información.

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

CEI.3 - Capacidad de comunicación y difusión de los resultados de investigación.

CEI.4 - Habilidades de exposición pública de trabajos de investigación y defensa de las conclusiones.

CEP.1 - Capacidad de analizar, interpretar y aplicar estándares relacionados con las TIC.

CESI.1 - Capacidad de caracterizar, diseñar y desplegar sistemas y servicios de comunicaciones inalámbricas.

CGEN.2 - Poseer habilidades para el aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo

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

4.2. Learning outcomes

RA154 - Design radiating systems to deploy radio communication systems.

RA157 - Evaluate communication standards typically used in the deployment of wireless systems.

RA152 - Measure the main characteristics of wireless communications antennas.

RA158 - Manage simulation and planning tools for the design of mobile communications.

RA159 - Design wireless communication systems.

RA153 - Characterize microstrip antennas.

RA156 - Use propagation models to calculate radio coverage of a transmitter.

RA155 - Analyze and characterize mobile communication channels.

* 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 gives the student the basic knowledge and skills to understand, characterize and analyze wireless communication systems. Some radiating systems typically employed in wireless communications are presented, analyzed and measured in the laboratory. There is a detail description of the propagation mechanisms affecting the radio channel, especially multipath fading, as well as radio access technologies currently used in wireless systems: multicarrier transmission, multi-antenna techniques and different radio-related procedures. The physical layer of two wireless communications standards, IEEE 802.11 for wireless LAN and Long Term Evolution for mobile communications, are studied in depth.

5.2. Syllabus

1. Introduction to wireless communication systems
   1.1. The wireless spectrum
   1.2. Structure of a wireless communication system
   1.3. Digital modulations
   1.4. The cellular concept
   1.5. Wireless communication standards
2. Radiating systems and propagation in wireless communications
   2.1. Fundamentals of antennas
   2.2. Linear, printed and active antennas
   2.3. Antennas for wireless and mobile systems
   2.4. Fundamentals of radiowave propagation applied to wireless communications
3. Radio access technologies
   3.1. The wireless channel environment
   3.2. Multipath fading
   3.3. Multicarrier transmission
   3.4. Multi-antenna techniques
   3.5. Radio-related procedures
4. Wireless Local Area Networks. IEEE 802.11
   4.1. Network architecture
   4.2. IEEE 802.11 family of standards
5. Long Term Evolution (LTE)
   5.1. General overview of 4G communications
   5.2. LTE channel models
   5.3. Physical layer
   5.4. Scheduling, link adaptation, multi-antenna techniques

6. Schedule

6.1. Subject schedule*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Other face-to-face activities	Assessment activities
1	**Unit 1. Introduction to wireless communication systems** Duration: 03:00 Lecture			
2	**Unit 1. Introduction to wireless communication systems** Duration: 02:00 Lecture **Unit 2. Radiating systems** Duration: 01:00 Lecture			
3	**Unit 2. Radiating systems** Duration: 01:00 Lecture	**Measurement of antenna parameters** Duration: 02:00 Laboratory assignments		
4	**Unit 2. Radiating systems** Duration: 02:00 Lecture	**Antennas simulation** Duration: 01:00 Laboratory assignments		**Antenna measurements. Exercises and laboratory report** Group work Continuous assessment Duration: 03:00
5	**Unit 2. Fundamentals of radiowave propagation** Duration: 02:00 Lecture	**Antennas simulation** Duration: 01:00 Laboratory assignments		
6	**Unit 3. Radio-access technologies** Duration: 03:00 Lecture			
7	**Unit 3. Radio-access technologies** Duration: 01:00 Lecture	**Simulation of multipath fading channel** Duration: 02:00 Laboratory assignments		
8	**Unit 3. Radio-access technologies** Duration: 03:00 Lecture			**Multipath fading. Report on the activity** Individual work Continuous assessment Duration: 02:00
9	**Unit 3. Radio-access technologies** Duration: 01:30 Lecture	**Simulation of multi-antenna techniques** Duration: 01:30 Laboratory assignments		**Multi-Antenna Techniques. Report on the activity** Individual work Continuous assessment Duration: 02:00
10	**Unit 4. Wireless Local Area Networks (WLAN)** Duration: 03:00 Lecture			

11	**Unit 4. Wireless Local Area Networks (WLAN)** Duration: 01:00 Lecture	**Visualization of the physical layer of IEEE 802.11 in WinIQSIM 2** Duration: 02:00 Laboratory assignments		**WiFI physical layer. Report on the activity** Individual work Continuous assessment Duration: 02:00
12	**Unit 5. LTE** Duration: 03:00 Lecture			
13	**Unit 5. LTE** Duration: 01:00 Lecture	**Visualization of the LTE physical layer in WinIQSIM2** Duration: 01:00 Laboratory assignments **LTE-Visualization Tool** Duration: 01:00 Laboratory assignments		**LTE physical layer in WinIQSIM2. Report on the activity** Individual work Continuous assessment Duration: 01:00
14		**LTE propagation through a multipath fading channel** Duration: 01:00 Laboratory assignments **LTE Vienna Simulator** Duration: 02:00 Laboratory assignments		**Vienna simulator. Report on the activity** Individual work Continuous assessment Duration: 02:00
15				
16				
17				**Written exam about the activities carried out during the course** Written test Continuous assessment Duration: 03:00 **Final exam** 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 theorical planning of the subject plan and might go to through experience some unexpected changes along throughout the academic year.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
4	Antenna measurements. Exercises and laboratory report	Group work	Face-to-face	03:00	18%	5 / 10	CESI.1 CGEN.2 CGEN.6 CEI.2 CEI.1 CEP.1 CEI.3 CEI.4
8	Multipath fading. Report on the activity	Individual work	Face-to-face	02:00	8%	5 / 10	CESI.1
9	Multi-Antenna Techniques. Report on the activity	Individual work	Face-to-face	02:00	8%	5 / 10	CESI.1
11	WiFI physical layer. Report on the activity	Individual work	Face-to-face	02:00	8%	5 / 10	CEP.1
13	LTE physical layer in WinIQSIM2. Report on the activity	Individual work	Face-to-face	01:00	8%	5 / 10	CEP.1
14	Vienna simulator. Report on the activity	Individual work	Face-to-face	02:00	10%	5 / 10	CGEN.6
17	Written exam about the activities carried out during the course	Written test	Face-to-face	03:00	40%	5 / 10	CESI.1 CGEN.2 CGEN.6 CEI.2 CEI.1 CEP.1 CEI.3 CEI.4

7.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Final exam	Written test	Face-to-face	03:00	100%	5 / 10	CESI.1 CGEN.2 CGEN.6 CEI.2 CEI.1 CEP.1 CEI.3 CEI.4

7.1.3. Referred (re-sit) examination

No se ha definido la evaluación extraordinaria.

7.2. Assessment criteria

All the students should perform the proposed activities and deliver the corresponding reports.

The weight of the activities on the final grade is 60%. There is a written exam about the activities carried out during the course, with a weight of 40%.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
E. Dahlman, S. Parkvall, J. Sköld and P. Beming. 4G: LTE/LTE-Advanced for Mobile Broadband	Bibliography	
C.A. Balanis. Antenna Theory: Analysis and Design	Bibliography	
K. Daniel Wong. Fundamentals of Wireless Communication Engineering Technologies	Bibliography	
K. Du, M. Swamy. Wireless Communication Systems	Bibliography	
M. Sauter. From GSM to LTE-Advanced: An Introduction to Mobile Networks and Mobile Broadband	Bibliography	
Rappaport. Wireless Communications. Principles and Practice	Bibliography	