ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

593000608 - Wireless Channel Modelling

DEGREE PROGRAMME

59AI - Master Universitario En Comunicaciones Inalámbricas

ACADEMIC YEAR & SEMESTER

2022/23 - Semester 2

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	593000608 - Wireless Channel Modelling
No of credits	4.5 ECTS
Type	Optional
Academic year ot the programme	First year
Semester of tuition	Semester 2
Tuition period	February-June
Tuition languages	English
Degree programme	59AI - Master Universitario en Comunicaciones Inalámbricas
Centre	59 - Escuela Tecnica Superior De Ingenieria Y Sistemas De Telecomunicacion
Academic year	2022-23

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Yolanda Blanco Archilla (Subject coordinator)	8203	yolanda.blanco@upm.es	Sin horario. Arrange by email
Juan Anton Moreno Garcia-Loygorri	8418	juan.moreno.garcia-loygorri@upm.es	Sin horario. Arrange by email
Antonio Perez Yuste	8304	antonio.perez@upm.es	Sin horario. Arrange by email

* 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

- Operation of RF instrumentation

- Management of technical information

- Programming in MATLAB and SIMULINK

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

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

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

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.

CGI03 - Valorar la importancia de las fuentes documentales, manejarlas y buscar la información para el desarrollo de cualquier trabajo de investigación.

CGI04 - Leer y comprender publicaciones dentro de su ámbito de estudio/investigación, así como su catalogación y valor científico.

UPM1 - Uso de la lengua inglesa

UPM4 - OrganizaciÃ³n y planificaciÃ³n /

4.2. Learning outcomes

RA37 - RA03-Choose the mathematical methods and tools necessary to tackle the solution of a problem.

RA39 - RA05-Interpret data derived from empirical observations and measurements in terms of their importance and relate them to the appropriate theory.

RA36 - RA02-Apply the acquired knowledge to the solution of qualitative and quantitative problems related to the modeling of the mobile radioelectric channel.

RA38 - RA04-Identify errors and estimate orders of magnitude of parameters related to the mobile radioelectric channel.

RA35 - RA01-Collect the precise information to be able to evaluate the impact of the mobile radioelectric channel on the propagation of a signal.

* 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 aimed to give a comprehensive view of the wireless channel characteristics. This includes an understanding of the underlying physical propagation mechanisms and measurements of the channel properties.

This course deals with the main propagation mechanisms in wireless communications channel. In this sense, some of the goals are to know the main characteristics of wireless radio channels, and to understand how they can impact on communication performance as well.

In a second stage, specific wireless radio channels using appropriate models will be described using suitable models

Besides, some practical experiences will be driven in order to measure the main charecteristics of some wireless channels.

5.2. Syllabus

1. Introduction
    1.1. Radio spectrum: band names and allocations
    1.2. Basic radio propagation principles
    1.3. Channel modelling approaches: deterministic vs stochastic
2. Generic channel models
    2.1. SISO Time-variant channels
        2.1.1. Narrowband
        2.1.2. Wideband
    2.2. SISO Time-invariant channels
        2.2.1. Frequency dispersion
        2.2.2. Stationarity
        2.2.3. Coherence functions
    2.3. MIMO channels
    2.4. Lab Activity
3. Models for specific radio channels
    3.1. Outdoor: rural, urban, microcellular
    3.2. Indoor
    3.3. Vehicle-to-vehicle
    3.4. Body-Area
    3.5. Millimeter-wave
    3.6. Lab activity
4. Channel sounding
    4.1. Basic principles
    4.2. Channel sounding approaches: waveforms and processing
    4.3. Parameters of a channel sounder
    4.4. Lab activity

6. Schedule

6.1. Subject schedule*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Distant / On-line	Assessment activities
1	**Introduction** Duration: 04:00			
2	**Introduction** Duration: 02:00 **2. Generic channel models** Duration: 02:00			**Dissertation about Channel modelling approaches: deterministic vs stochastic** Continuous assessment Not Presential Duration: 02:00
3	**2. Generic channel models** Duration: 04:00			**Problems-exercises about generic channel models** Continuous assessment Not Presential Duration: 02:00
4	**2. Generic channel models** Duration: 02:00	**2. Generic Channel Model** Duration: 02:00		**Quizz: Generic channel models** Continuous assessment Presential Duration: 00:20
5	**3. Models for specific radio channels** Duration: 04:00			**Lab Report (unit 2)** Continuous assessment Not Presential Duration: 04:00
6		**3. Models for specific radio channels** Duration: 04:00		
7	**3. Models for specific radio channels** Duration: 04:00			
8		**3. Models for specific radio channels** Duration: 02:00		**Problems about specific channel models** Continuous assessment Not Presential Duration: 02:00
9		**3. Models for specific radio channels** Duration: 02:00		**Quizz: Models for specific radio channels** Continuous assessment Presential Duration: 00:20

10	**4. Channel sounding** Duration: 02:00			**Lab Report (unit 3)** Continuous assessment Not Presential Duration: 06:00
11	**4. Channel sounding** Duration: 02:00			
12	**4. Channel sounding** Duration: 02:00			
13		**4. Channel sounding** Duration: 02:00		**Problems/exercises about channel sounding** Continuous assessment Not Presential Duration: 02:00
14		**4. Channel sounding** Duration: 02:00		**Quizz: Channel Sounding** Continuous assessment Presential Duration: 00:20
15				**Lab Report (unit 4)** Continuous assessment Not Presential Duration: 06:00
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.

* 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. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
2	Dissertation about Channel modelling approaches: deterministic vs stochastic		No Presential	02:00	5%	/ 10	CB7 UPM4 UPM1
3	Problems-exercises about generic channel models		No Presential	02:00	10%	/ 10	CB6 CGI02 CGI03
4	Quizz: Generic channel models		Face-to-face	00:20	10%	4 / 10	UPM1 CB7 CB8
5	Lab Report (unit 2)		No Presential	04:00	10%	/ 10	
8	Problems about specific channel models		No Presential	02:00	10%	/ 10	CB6 CGI02 CGI03
9	Quizz: Models for specific radio channels		Face-to-face	00:20	10%	4 / 10	UPM5 CB7 UPM1
10	Lab Report (unit 3)		No Presential	06:00	10%	/ 10	UPM4 CGI02 CB7 CB8
13	Problems/exercises about channel sounding		No Presential	02:00	15%	/ 10	CB6 CGI02 CGI03
14	Quizz: Channel Sounding		Face-to-face	00:20	10%	4 / 10	CGI04 UPM4 UPM5
15	Lab Report (unit 4)		No Presential	06:00	10%	/ 10	UPM4 CGI02 CB7 CB8

7.1.2. Final examination

No se ha definido la evaluacion sólo por prueba final.

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 and exersices (problems) resolution .

The assessment of lab practices is based on the realization of a report (in pairs) will be also considered

If some quizzed are failled will be retrieved in a final exam at the end of the course

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
- LTE-advanced and next generation wireless networks: channel modelling and propagation. G. de la Roche et al, John Wiley & Sons, 2012.	Bibliography	
- Radio propagation measurement and channel modelling, S. Salous, John Wiley & Sons, 2013.	Bibliography	
- Propagation channel characterization, parameter estimation, and modeling for wireless communications, X. Yin et al, John Wiley & Sons, 2016.	Bibliography	
Slides	Web resource	Moodle
Lab guides	Web resource	Moodle

- The Mobile Radio Propagation Channel, J.D. Parsons, John Wiley & Sons, 2000.	Bibliography	