



## IDENTIFYING DATA

### Wireless Systems and Networks

Subject	Wireless Systems and Networks			
Code	V05G300V01615			
Study programme	Degree in Telecommunications Technologies Engineering - In extinction			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	3rd	2nd
Teaching language	Spanish			
Department				
Coordinator	Pérez Fontán, Fernando			
Lecturers	Pérez Fontán, Fernando			
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Web	<a href="http://http://fatic.uvigo.es/">http://http://fatic.uvigo.es/</a>			
General description	(*) A general overview of current wireless communications systems will be provided including standards and dimensioning issues.			

## Competencies

Code	
A2	Students can apply their knowledge to their jobs in a professional way and they have competences that are typically demonstrated through devising and sustaining arguments and solving problems within their field of study.
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical topics.
A4	Students can communicate information, ideas, problems and solutions to both general and specialized public.
B1	CG1: The ability to write, develop and sign projects in the field of Telecommunication Engineering, according to the knowledge acquired as considered in section 5 of this Law, the conception and development or operation of networks, services and applications of Telecommunication and Electronics.
B2	CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws.
B3	CG3: The knowledge of basic subjects and technologies that enables the student to learn new methods and technologies, as well as to give him great versatility to confront and adapt to new situations
B4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
B5	CG5: The knowledge to perform measurements, calculations, assessments, appraisals, technical evaluations, studies, reports, task scheduling and similar work to each specific telecommunication area.
B7	CG7: The ability to analyze and assess the social and environmental impact of technical solutions.
B8	CG8: To know and apply basic elements of economics and human resources management, project organization and planning, as well as the legislation, regulation and standardization in Telecommunications.
B9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
B13	CG13 The ability to use software tools that support problem solving in engineering.
C1	CE1/FB1: The ability to solve mathematical problems in Engineering. The aptitude to apply knowledge about linear algebra, geometry, differential geometry, differential and integral calculus, differential and partial differential equations; numerical methods, numerical algorithms, statistics and optimization
C3	CE3/FB3: Comprehension and command of basic concepts about the general laws of mechanics, thermodynamics, electromagnetic fields and waves and electromagnetism and their application to solve Engineering problems.
C4	CE4/FB4: Comprehension and command of basic concepts in linear systems and their related functions and transforms; electric circuits theory, electronic circuits, physical principles of semiconductors and logical families, electronic and photonic devices, materials technology and their application to solve Engineering problems.

C5	CE5/FB5: The necessary knowledge of business concepts, of law and institutional frameworks. business organization and management .
C6	CE6/T1: The ability to learn independently new knowledge and appropriate techniques for the conception, development and exploitation of telecommunication systems and services
C7	CE7/T2: The ability to use communication and software applications (ofimatics, databases, advanced calculus, project management, visualization, etc.) to support the development and operation of Electronics and Telecommunication networks, services and applications.
C8	CE8/T3: The ability to use software tools for bibliographical resources search or information related with electronics and telecommunications.
C10	CE10/T5: The ability to evaluate the advantages and disadvantages of different technological alternatives in the implementation and deployment of communication systems from the point of view of signals, perturbations, noise and digital and analogical modulation systems.
C11	CE11/T6: The ability to conceive, deploy, organize and manage networks, systems, services and Telecommunication infrastructures in residential (home, city, digital communities), business and institutional environments, being responsible for launching of projects and continuous improvement like knowing their social and economical impact.
C12	CE12/T7: The knowledge and use of basics in telecommunication networks, systems and service programming.
C13	CE13/T8: The ability to understand the electromagnetic and acoustic wave mechanisms of propagation and transmission, and their corresponding receiving and transmitting devices.
C16	CE16/T11: The ability to use different energy sources, especially photovoltaic and thermal ones, as well as the fundamentals of power electronics and electronics
C21	CE21/ST1 The ability to construct, exploit and manage telecommunication networks, services, process and applications, considered as systems of receiving, transporting, representation, processing, storage, management and presentation of multimedia information from the point of view of transmission systems.
C22	CE22/ST2 The ability of applying the basic techniques of telecommunication networks, services and applications for mobile and fixed environments, personal, local or long distance, with different bandwidth, including telephony, radio broadcasting, TV and data, from the point of view of transmission systems.
C25	CE25/ST5 The ability to select transmission antennas, equipment and systems, propagation of guided and non-guided waves, with electromagnetic, radiofrequency and optical media, and their corresponding radio electric spectrum management and frequency designation.
C28	CE28/TEL2 The ability to apply the techniques that are basis of computer networks, services and applications, such as management, signaling and switching, routing and securing systems (cryptographic protocols, tunneling, firewalls, charging mechanisms, authentication and content protection) traffic engineering (graph theory, queuing theory and teletraffic) rating, reliability and quality of service in both fixed, mobile, personal, local or long distance environments with different bandwidths, including telephony and data.
D1	CT1 Development of sufficient autonomy to carry out works within the area of Telecommunications in interdisciplinary contexts.
D2	CT2 Understanding Engineering within a framework of sustainable development.
D3	CT3 Awareness of the need for long-life training and continuous quality improvement, showing a flexible, open and ethical attitude toward different opinions and situations, particularly on non-discrimination based on sex, race or religion, as well as respect for fundamental rights, accessibility, etc.
D4	CT4 Encourage cooperative work, and skills like communication, organization, planning and acceptance of responsibility in a multilingual and multidisciplinary work environment, which promotes education for equality, peace and respect for fundamental rights.

### Learning outcomes

Expected results from this subject	Training and Learning Results			
Cellular and wireless network specifications.	B7	C1 C3 C6 C7 C10 C22		
To apply previously acquired knowledge on wave propagation for the planning of radio networks.	B1 B5 B8 B9 B13	C6 C10 C16 C21		
To specify the various elements (antennas, transmitters and receivers) which make up a global system.	A2 A3 A4	B1 B2 B7 B8	C5 C8 C12 C25	D1 D2

Provide access solutions to communications systems.

A2 B4 C3 D1  
B8 C4 C12 C13 C22 C28

Develop roll-out models which minimize the social and environmental impact of the radio communication networks, understanding the ethic and moral responsibilities involved in such work.	A2 A4	B1 B2 B3 B4 B5	C11 C22	D1 D2 D3 D4
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## Contents

### Topic

Theory 1. Introduction to radiocommunications	Basic concepts Current situation
Theory 2. Cellular systems	Fundamental concepts The radio propagation channel Multiple access techniques Interference Network sizing up Countermeasures Medium access control. Security and access control. Network management. Mobility management. Quality of service.
Theory 3. Review of cellular and wireless standards and other proposals	Cell network generations. Evolution for the technological solutions in each generation.
Tutored work 1. Introduction to multipath effects	Reproducing multipath fading Doppler effect Narrow and wideband channel
Lab. 1. Introduction to the radio channel	Statistical representation.
Lab 2. Channel effects on 3G	DS-SS
Lab 3. Introduction to 4G standard LTE	OFDMA

## Planning

	Class hours	Hours outside the classroom	Total hours
Mentored work	7	14	21
Problem solving	6	18	24
Practices through ICT	14	28	42
Introductory activities	1	0	1
Lecturing	12	0	12
Objective questions exam	1	0	1
Report of practices, practicum and external practices	0	8	8
Problem and/or exercise solving	1	0	1
Essay	0	14	14

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

## Methodologies

	Description
Mentored work	GROUP AND INDIVIDUAL. Simulation work to be carried out in Matlab language will be proposed to C class groups where they will go deeper into specific issues discussed in less detail in the theoretical classes. Through this methodology the competencies CG2, CG4, CG7, CT2 and CE21
Problem solving	INDIVIDUAL. The theoretical treatment of the various topics studied in theoretical classes will be complemented by performing numerical calculations relative to radio network dimensioning. Through this methodology the competencies CG2 and CE22
Practices through ICT	GROUP AND INDIVIDUAL. In laboratory sessions (type B) various Matlab simulations will be proposed to the students in order to study specific topics which are more suitably approached this way. Through this methodology the competencies CE21, CE22 and CE25
Introductory activities	In the course of the explanations provided in the lectures as well as during lab work or supervised work mention will be made to concepts already presented in earlier lectures from previous years
Lecturing	INDIVIDUAL. In classroom lectures the more theoretical issues will be presented. Through this methodology the competencies CE21, CE22, CE25 and CT2

## Personalized assistance

Methodologies	Description
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Lecturing	The student will be able to consult individually during tutoring hours all his/her doubts arising during the study of the theoretical contents as well as in the resolution of numerical exercises, laboratory work and supervised projects
Mentored work	The student will be able to consult individually during tutoring hours all his/her doubts arising during the study of the theoretical contents as well as in the resolution of numerical exercises, laboratory work and supervised projects
Problem solving	The student will be able to consult individually during tutoring hours all his/her doubts arising during the study of the theoretical contents as well as in the resolution of numerical exercises, laboratory work and supervised projects
Practices through ICT	The student will be able to consult individually during tutoring hours all his/her doubts arising during the study of the theoretical contents as well as in the resolution of numerical exercises, laboratory work and supervised projects
Introductory activities	In the same way as with the above points, personalized attention will be provided to the students in all aspects related to introductory activities.

## Assessment

	Description	Qualification	Training and Learning Results
Objective questions exam	Adequate knowledge of the theoretical materials of the lecture will be assessed by means of short response questions during the final exam. A minimum mark of 3 over 10 points is set for this part. Continued class attendance will be evaluated.	25	C21 D2 C22 C25
Report of practices, practicum and external practices	For each lab assignment, the students in pairs, will present an individual written report. The evaluation will be carried out by means of (1) group reports and (2) a specific part in the final exam to be taken individually. The weights of parts one and two will be 2/3 and 1/3, respectively. A minimum mark of 3 over 10 points is set for this part. Continued class attendance will be evaluated.	25	C21 D2 C22 C25
Problem and/or exercise solving	In the final exam, there will be a part containing various short numerical problems. A minimum mark of 3 over 10 points is set for this part. Continued class attendance will be evaluated.	25	B2 C21 C22 C25
Essay	The evaluation of supervised group work (C classes) will be carried out through (1) a group report and (2) a specific test to be taken individually. The weights of parts one and two will be 2/3 and 1/3, respectively. A minimum mark of 3 over 10 points is set for this part. Continued class attendance will be evaluated.	25	B4 C21 B7 C22 C25

## Other comments on the Evaluation

### GENERAL.FIRST CALL

If possible all skills pertaining to this subject will be evaluated in all the various tests and exercises proposed: short answer tests, lab reports, problem solving and projects.

For those who choose to take the Final Exam (alternatively to Continuous Assessment), this will have a weight of 100% of the final grades and will cover all issues dealt with in the theoretical lectures, the problem solving lectures, tutored group work and laboratory. In this case, it will not be compulsory to present all lab and supervised project works. The exam will contain a fourth part to assess the concepts presented in the supervised work classes.

As a minimum grade is set for each part making up the final evaluation, if this threshold is not exceeded in any of the four parts, the final mark will be limited, as a maximum, to this threshold.

The schedule for the various intermediate tests will be decided at a (Academic Commission) CAG meeting and published at the beginning of the semester.

The grades for the lab. work and group work will only be valid during the current school year.

Those students who choose the Continuous Assessment option shall inform the professor of this during the first few weeks of the school term. The Continuous Assessment option entails the completion of all activities proposed: lab works and group work, and taking all tests comprising the Continuous Assessment route. Those students not fulfilling the above will be assessed with the final exam only.

A student will be attributed the "no presentado" grade if he or she has not followed the full Continuous Assessment route and has not taken the final exam. In case of choosing the Continuous Assessment option, the student will be graded "no presentado" if he or she has not taken the final exam.

### SECOND AND END-OF-PROGRAM CALLS

Evaluation will be different for those following the Continuous Evaluation path and those following the Exam-only path. For the Continuous Assessment case, the student will only need to take those part of the finals exam he or she failed. Exam-only students will have to take the full final exam.

Evaluation in the case of end-of-program call will be done on the basis of a final exam.

## ETHICS CODE

Should a case of plagiarism be detected in any of the various activities and tests , the final mark will be FAILED (0) and the school direction team will be advised on the fact.

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### Sources of information

#### Basic Bibliography

José María Hernando Rábanos, **Comunicaciones Móviles. 2ª ed.**, Ed. Centro de Estudios Ramón Areces, S.A., 2014

F.Pérez-Fontán and P.Mariño Espiñeira, **Modeling of the wireless propagation channel. A simulation approach with Matlab**, Wiley, 2008

Oriol Sallent Roig, Jordi Pérez Romero, **Fundamentos de diseño y gestión de sistemas de comunicaciones móviles celulares**, UPC, 2014

#### Complementary Bibliography

Fernando Pérez Fontán, Sigfredo Pagel Lindow, **Introducción a las. Comunicaciones Móviles**, Servicio de Publicaciones. Universidad de Vigo, 1997

José María Hernando Rábanos, **Comunicaciones Móviles de Tercera Generación**, Telefónica Móviles, 2000

Simon R. Saunders, **Antennas and Propagation for Wireless Communications Systems**, Wiley, 2007

José María Hernando Rábanos, Fernando Pérez Fontán, **Introduction to Mobile Communications Engineering**, Artech House, 1999

Ramón Agustí Comés, **LTE: nuevas tendencias en comunicaciones móviles**, Fundación Vodafone, 2010

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### Recommendations

#### Subjects that it is recommended to have taken before

Radio Frequency Circuits/V05G301V01319

Radio Communication Systems/V05G301V01320

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### Contingency plan

#### Description

In case the teaching will be done exclusively by telematic means, the planing of this lecture will be as follows:

\*The teaching of A, B and C groups will be carried out by telematic means through the classrooms in Campus Remoto.

\*All group A, B and C sessions will provide the same contents as indicated in this guide.

In case the teaching will be done exclusively by telematic means, student assessment will be carried according to the following criteria:

\*The various parts of the final exam will take place in a synchronous way through the classrooms in Campus Remoto.

\*Any other parts will be assessed by grading the various reports provided by the students.