



## IDENTIFYING DATA

### Radio Communication Systems

Subject	Radio Communication Systems			
Code	V05G300V01512			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	3rd	1st
Teaching language	Spanish			
Department				
Coordinator	Rubiños López, José Óscar			
Lecturers	Arias Acuña, Alberto Marcos Rubiños López, José Óscar			
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General description	This course is devoted to the study of the fundamentals of radio communications systems, including the antennas, the link budget as well as those factors that limit the correct reception such as noise and interference.			

## Competencies

Code	
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.
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.
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.
D2	CT2 Understanding Engineering within a framework of sustainable development.

## Learning outcomes

Expected results from this subject	Training and Learning Results		
Ability to apply the techniques underlying radio communications systems in fixed and mobile communication services in local or long-distance links at different bandwidths.	B4	C22	D2
Ability to understand the concept of systems limited by noise, as well as the types of noise and interferences.	B2		D2
Ability to understand the mechanisms of propagation and how to model the propagation channel.	B2	C25	
Ability to understand the foundations of antennas.	B2	C25	
Ability to know and characterize the different types of antennas.			
Ability to understand and specify the foundations of terrestrial and satellite broadcast services.	B2	C21	
Ability to understand the foundations of the radio links.	B2	C21	

Ability to understand the concept of coverage and to apply it to the radio link and broadcasting services.	B2	C22 C25	D2
Ability to analyse the coverage in order to specify the quality of service.	B4	C21	D2

## Contents

Topic	
1. RADIATION FUNDAMENTALS	1.1 Electromagnetic Fundamentals 1.2 Antenna parameters in transmission 1.3 Antenna parameters in reception 1.4 Types of antennas
2. LINK BUDGET	2.1 Friis transmission equation 2.2 Propagation losses. 2.3 Band frequencies.
3. NOISE	3.1 Thermal noise. 3.2 Noise in antennas. 3.3 Noise factor and noise-equivalent temperature of a receiver.
4. INTERFERENCE	3.1 Concept and types of interference 3.2 Characterization of interference
5. AVAILABILITY	5.1 Concepts of availability, fading and diversity 5.2 Noise-limited Systems 5.3 Interference-limited Systems
6. RADIOWAVE PROPAGATION	6.1 Propagation at very low frequencies 6.2 Surface wave propagation 6.3 Ionospheric propagation 6.4 Tropospheric Propagation

## Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	14	14	28
Troubleshooting and / or exercises	7	7	14
Laboratory practises	5	10	15
Autonomous practices through ICT	0	8	8
Case studies / analysis of situations	10	40	50
Reports / memories of practice	0	15	15
Troubleshooting and / or exercises	4	8	12
Long answer tests and development	2	6	8

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

## Methodologies

	Description
Master Session	Presentation, by the professor, of the contents of the course (theoretical basis, guidelines for solving exercises/problems or developing a radio communication project). Through this methodology the competencies CG2, CE21, CE22, CE25, CT2 are developed.
Troubleshooting and / or exercises	Resolution, by the student, of problems and/or exercises related with the course. The student not only has to get the suitable or correct solutions by the application of the theory previously explained but also has to interpret correctly the results. Through this methodology the competencies CG4, CE21, CE22, CE25, CT2 are developed.
Laboratory practises	Application of knowledge to specific situations and acquisition of basic skills and procedures in the related field. They are developed in laboratories with specialized equipment. Through this methodology the competencies CG4, CE21, CE22, CE25 are developed.
Autonomous practices through ICT	Application through ICT of the knowledge and the procedural skills that the student has acquired in the course to specific situations. Through this methodology the competencies CG4, CE21, CE22, are developed.
Case studies / analysis of situations	Study and analysis of problems based on real events in order to know them, think about them, interpret them, generate hypothesis, contrast data ... and train in the use of different procedures of solution. Through this methodology the competencies CG4, CE21, CE22, CE25, CT2 are developed.

## Personalized attention

Methodologies	Description
Master Session	In this course, students have the opportunity to attend personal tutorials at the time that will be published on the website of the course. In addition, they can also pose all the questions related to Radio Communication field electronically.

Troubleshooting and / or exercises	In this course, students have the opportunity to attend personal tutorials at the time that will be published on the website of the course. In addition, they can also pose all the questions related to Radio Communication field electronically.
Case studies / analysis of situations	In this course, students have the opportunity to attend personal tutorials at the time that will be published on the website of the course. In addition, they can also pose all the questions related to Radio Communication field electronically.
Laboratory practises	In this course, students have the opportunity to attend personal tutorials at the time that will be published on the website of the course. In addition, they can also pose all the questions related to Radio Communication field electronically.
Autonomous practises through ICT	In this course, students have the opportunity to attend personal tutorials at the time that will be published on the website of the course. In addition, they can also pose all the questions related to Radio Communication field electronically.

### Assessment

	Description	Qualification	Training and Learning Results
Case studies / analysis of situations	Technique that consists of monitoring the student, who will be assessed from his autonomously solving of the proposed tasks (case studies / analysis of situations).	10	B2 C25 D2 B4
Reports / memories of practice	Evaluation of: - the preparation and development of the lab practices - the reports and memories on lab practices	10	B4 C21 D2 C22 C25
Troubleshooting and / or exercises	Two examinations in which the student has to solve a number of exercises by applying the acquired knowledge in the time and conditions established by the professor. The student can take them during the course or together with the final examination, depending on the evaluation system chosen.	40	B2 C22 B4
Long answer tests and development	Final examination: evaluation of the skills acquired by the student. He/she has to develop, relate, organise and present the knowledge acquired in the course.	40	B2 C22 B4 C25

### Other comments on the Evaluation

According to the guidelines of the degree, the student can choose between two evaluation systems: continuous assessment or only final examination. Previously to the final examination (or at the entrance of the session), the student will decide the evaluation system. Before performing each task or delivery, the procedure and dates for the review of the qualifications will be published within a reasonable period of time.

1. The continuous assessment includes a series of tasks performed during the course (70%). They are not recoverable, i.e., if a student can not fulfilled them in the time established, the professor is not bound to repeat them. The obtained qualification will be valid only for the current academic course.

The continuous assessment consists of:

- two examinations (approximately in the weeks 4 and 9);
- delivery (in the last weeks of the course) of memories of the lab and autonomous-ICT practices;
- autonomous tasks (case studies / analysis of situations);
- the mandatory part of the final examination.

2. FINAL EXAMINATION at the end of the semester: the final examination consists of two parts:

- one part is mandatory for all the students,
  - the second one is optional for students who had chosen continuous assessment and mandatory for the rest of students.
- The students who had chosen continous assessment can do this part to improve their marks.

#### FORMULA OF QUALIFICATION

E1=score obtained in the mandatory part of the final examination (up to 10 points).

E2=score obtained in the other part of the final examination (up to 10 points).

PM=score obtained in the lab practices (attendance, quality of the reports...) (up to 10 points).

PEC=score obtained in both exams (continuous assessment) (up to 10 points).

S=score obtained in the autonomous tasks (case studies / analysis of situations) (up to 10 points).

Continuous evaluation:  $0.4 * E1 + \text{MAX}(0.6 * E2; 0.4 * PEC + 0.1 * PM + 0.1 * S)$

No continuous Evaluation:  $0.4 * E1 + 0.6 * E2$

4. RECOVERY IN the JULY SESSION. Previously to the exam (or at the entrance of the session) the students choose the evaluation system. The qualification formulas are the same.

5. STUDENTS PRESENTED AT THE COURSE. A student is considered "presented" if he/she receives the final exam or both exercises of the continuous assessment.

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### Sources of information

Marcos Arias Acuña, Oscar Rubiños López, **Radiocomunicación**, 1ª,

José María Hernando Rábanos, **Transmisión por Radio**, 7ª,

John Griffiths, **Radio Wave Propagation and Antennas. An Introduction**, 1st,

Robert E. Collin, **Antennas and Radiowave Propagation**, 1st,

Thomas A. Milligan, **Modern Antenna Design**, 2nd,

Angel Cardama, L. Jofre, J.M. Rius, S. Balnch, M. Ferrando, **Antenas**, 2ª,

Constantine A. Balanis, **Antenna Theory. Analysis and design**, 3rd,

ITU-R, **Recommendations**,

The first three references are considered as basic. The others are complementary bibliography for specific topics.

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### Recommendations

#### Subjects that continue the syllabus

Wireless Systems and Networks/V05G300V01615

#### Subjects that are recommended to be taken simultaneously

Radio Frequency Circuits/V05G300V01511

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

Physics: Fields and Waves/V05G300V01202

Signal Transmission and Reception Techniques/V05G300V01404

Electromagnetic Transmission/V05G300V01303