



## IDENTIFYING DATA

### Radio Communication Systems

Subject	Radio Communication Systems			
Code	V05G301V01320			
Study programme	Grado en Ingeniería de Tecnologías 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			
E-mail	oscar@com.uvigo.es			
Web	http://moovi.uvigo.gal			
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.			

## Training and Learning Results

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.		

## Expected results from this subject

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	D2
		C25	

**Contents**

## Topic

1. RADIATION FUNDAMENTALS (theoretical-practical)	1.1 Electromagnetic Fundamentals 1.2 Antenna parameters in transmission 1.3 Antenna parameters in reception 1.4 Types of antennas
2. LINK BUDGET (theoretical-practical)	2.1 Friis transmission equation 2.2 Propagation losses. 2.3 Band frequencies.
3. NOISE (theoretical-practical)	3.1 Thermal noise. 3.2 Noise in antennas. 3.3 Noise factor and noise-equivalent temperature of a receiver.
4. INTERFERENCE (theoretical-practical)	4.1 Concept and types of interference 4.2 Characterization of interference
5. AVAILABILITY (theoretical-practical)	5.1 Concepts of availability, fading and diversity 5.2 Noise-limited Systems 5.3 Interference-limited Systems
6. RADIOWAVE PROPAGATION (theoretical-practical)	6.1 Propagation at very low frequencies 6.2 Surface wave propagation 6.3 Ionospheric propagation 6.4 Tropospheric Propagation
0. MEASUREMENTS (practical)	0.1 Introduction 0.2 Measurements with the field meter 0.3 Measurements with the spectrum analyzer

**Planning**

	Class hours	Hours outside the classroom	Total hours
Lecturing	11	11	22
Problem solving	7	7	14
Laboratory practical	7	14	21
Introductory activities	1	1	2
Case studies	10	50	60
Report of practices, practicum and external practices	0	15	15
Problem and/or exercise solving	4	8	12
Essay questions exam	2	2	4

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

**Methodologies**

	Description
Lecturing	Presentation, by the professor, of the contents of the course (theoretical basis, guidelines for solving exercises/problems or developing a radio communication project). The competencies B2, C21, C22, C25, D2 are worked with this methodology. In group.
Problem solving	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. The competencies B4, C21, C22, C25, D2 are worked with this methodology. Individual.
Laboratory practical	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. The competencies B4, C21, C22, C25 are worked with this methodology. In group.
Introductory activities	Review of necessary contents in that class that had previously been explained in previous classes and / or subjects. The competences B2, B4, C21, C22, C25, D2 are worked with this methodology. Group activity
Case studies	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. The competencies B4, C21, C22, C25, D2 are worked with this methodology. Individual.

**Personalized assistance**

Methodologies	Description
Lecturing	In this methodology, all the questions that each student can ask will be answered. ( <a href="https://www.uvigo.gal/universidade/administracion-persoal/pdi/jose-oscar-rubinos-lopez">https://www.uvigo.gal/universidade/administracion-persoal/pdi/jose-oscar-rubinos-lopez</a> )

Problem solving	Each student will be attended in an individual way. ( <a href="https://www.uvigo.gal/universidade/administracion-persoal/pdi/jose-oscar-rubinos-lopez">https://www.uvigo.gal/universidade/administracion-persoal/pdi/jose-oscar-rubinos-lopez</a> )
Case studies	Each student will be attended in an individual way. ( <a href="https://www.uvigo.gal/universidade/administracion-persoal/pdi/jose-oscar-rubinos-lopez">https://www.uvigo.gal/universidade/administracion-persoal/pdi/jose-oscar-rubinos-lopez</a> )
Laboratory practical	Each student will be attended in an individual way. ( <a href="https://www.uvigo.gal/universidade/administracion-persoal/pdi/jose-oscar-rubinos-lopez">https://www.uvigo.gal/universidade/administracion-persoal/pdi/jose-oscar-rubinos-lopez</a> )

## Assessment

	Description	Qualification	Training and Learning Results		
Case studies	Technique that consists of monitoring the student, who will be assessed from his autonomously solving of the proposed tasks (case studies / analysis of situations).  The professor will provide help students if necessary.	3	B2 B4	C25	D2
Report of practices, practicum and external practices	Evaluation of: - the preparation and development of the lab practices, - the reports and memories on lab practices.  The professor will provide help students if necessary.	7	B4	C21 C22 C25	D2
Problem and/or exercise solving	Continuous assessment: two examinations in which the student has to solve (in an autonomous way) 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.	50	B2 B4	C22	
Essay questions exam	Global examination: evaluation of the skills acquired by the student. He/she has to develop, relate, organise and present the knowledge acquired in the course in an autonomous way.	40	B2 B4	C22 C25	

## Other comments on the Evaluation

The student can choose between two evaluation systems: continuous assessment or exam-only examination. Previously to the global 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. 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:

- a) two examinations;
- b) delivery (in the last weeks of the course) of memories of the lab and autonomous-ICT practices (recommended, but not mandatory) ;
- c) autonomous tasks (case studies / analysis of situations) (recommended, not mandatory);
- d) the global examination.

2. GLOBAL ASSESSMENT at the end of the semester. It is mandatory for all students.

3. FIRST CALL

E1=score obtained in the mandatory part of the global 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 assessment:

If  $PEC < 4$  points, Qualification = PEC

If  $PEC \geq 4$  points, Qualification =  $0.4 * E1 + 0.5 * PEC + 0.07 * PM + 0.03 * S$

Exam-only assessment: Qualification = E1

4. SECOND CALL. Previously to the exam (or at the entrance of the session) the students choose between continuous or exam-only assessment. The qualification formulas are the same (as those of the first call).

5. END-OF-PROGRAM EXAM. Only exam-only-assessment.

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

7. Plagiarism is regarded as serious dishonest behavior. If any form of plagiarism is detected in any of the tests or exams, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution

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## Sources of information

### Basic Bibliography

Marcos Arias Acuña, Oscar Rubiños López, **Radiocomunicación**, 978-84-8408-603-1, 1ª, Andavira Editora, 2011

José María Hernando Rábanos, **Transmisión por Radio**, 978-84-9961-106-8, 7ª, Editorial Universitaria Ramón Areces, 2013

### Complementary Bibliography

Constantine A. Balanis, **Antenna Theory. Analysis and design**, 978-1-118-64206-1, 4th, Wiley, 2016

John Griffiths, **Radio Wave Propagation and Antennas. An Introduction**, 978-0-137-52312-2, 1st, Prentice Hall, 1987

Angel Cardama, L. Jofre, J.M. Rius, S. Balnch, M. Ferrando, **Antenas**, 978-84-8301-625-1, 2ª, Ediciones UPC, 2002

Maral, G. / Bousquet M. / Zhili Sun, **Satellite communications systems: systems, techniques and technology**, 978-1-119-38208-9, 6th, Wiley, 2020

Hernando Rábanos J.M., Mendo Tomás L. y Riera Salís, J.M., **Comunicaciones móviles**, 978-84-9961-208-9, 3ª, Editorial Universitaria Ramón Arecesº, 2015

Thomas A. Milligan, **Modern Antenna Design**, 978-0-471-45776-3, 2nd, Wiley, 2005

Robert E. Collin, **Antennas and Radiowave Propagation**, 978-0-070-11808-9, 1st, Mc Graw Hill, 1985

ITU-R, **Recommendations**,

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## Recommendations

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

Mathematics: Probability and Statistics/V05G301V01107

Physics: Fields and Waves/V05G301V01202

Electromagnetic Transmission/V05G301V01207