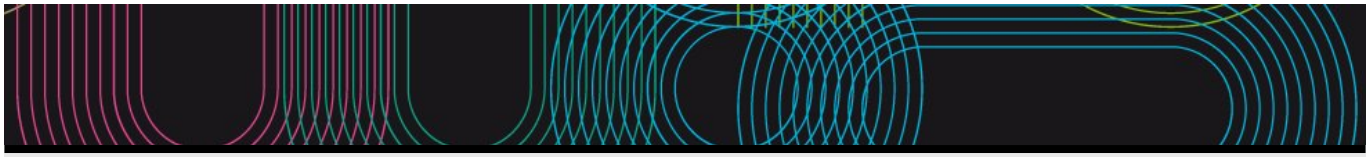

IDENTIFYING DATA				
Signal Transmission and Reception Techniques				
Subject	Signal Transmission and Reception Techniques			
Code	V05G301V01208			
Study programme	Degree in Telecommunications Technologies Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish			
Department				
Coordinator	López Valcarce, Roberto Comesaña Alfaro, Pedro			
Lecturers	Comesaña Alfaro, Pedro Gómez Cuba, Felipe López Valcarce, Roberto Márquez Flórez, Óscar Willian Mosquera Nartallo, Carlos Rodríguez Banga, Eduardo			
E-mail	pcomesan@gts.uvigo.es valcarce@gts.uvigo.es			
Web	http://faitic.uvigo.es			
General description	The course "Signal Transmission and Reception Techniques" is an introduction to the different existent methods for the exchange of information in digital format at the physical layer level. Its main focus is on pulse amplitude modulation (PAM) as illustrative example. The main components of a digital transmitter and receiver are described, as well as the different effects caused by the communication channel and the different performance parameters of a digital system.			

Competencies	
Code	
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.
B6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
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.
C9	CE9/T4: The ability to analyze and specify the main parameters of a communications system.
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.
C20	CE20/T15: The knowledge of national, European and international telecommunication regulations and laws.
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.

Learning outcomes	
Expected results from this subject	Training and Learning Results

Differentiate the blocks and functionalities of a complete data transmission sytem	B3	C9 C10	
Identify the minimum requirements for a reliable data communication.	B3 B4	C9 C10	
Distinguish the fundamental parameters of a complete communications system oriented to data transmission.	B3 B4	C9 C10	
Describe, develop and analyse the different blocks of a data transmission system.	B3 B6	C9 C10 C20	D3
Develop and implement basic circuits for modulation and demodulation of signals.	B4 B6	C9 C10 C20	D2
Use applications of communication and computer (text processing, databases, advanced calculus, management of projects, visualisation, etc.) to support the design of data transmission systems.	B4	C7	D2 D3
Recognise the different quality assessment measures of a digital signal.		C9 C10	
Statistically analyse the noise and understand its effects.	B3	C9 C10	

Contents

Topic	
1. Introduction to digital communication systems	-Basic elements and general description of a communication system. -Analog and digital communications -Description of a digital transmitter -Description of a digital receiver
2. Signals, systems and stochastic processes in communications	-Review of basic concepts: signals and systems. Continuous time Fourier transform. - Deterministic signals: energy-defined and power-defined. Autocorrelation. Spectral density. - Random variables. Stochastic processes: stationarity, autocorrelation, power spectral density, bandwidth. White noise.
3. Frequency conversion and analog processing	-Amplitude modulation (AM) and frequency modulation (FM) -I/Q modulation and demodulation - Transceiver requirements and specifications -Receiver architectures: direct conversion, intermediate frequency. Analog and digital stages.
4. Pulse amplitude modulation (PAM)	- Baseband PAM - Bandlimited channels and intersymbol interferences (ISI) - Nyquist criterion, raised cosine pulses, eye diagram - Matched filtering - Bandpass PAM
5. Modulation and detection in Gaussian channels	- Introduction to the Signal Subspace - Discrete equivalent channel - Maximum A Posteriori (MAP) and Maximum Likelihood (ML) detectors - Probability of error
6. The communication channel	-Transmission media -Signal to noise ratio -Multipath and frequency selectivity -Fading -Doppler effect

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	24	24	48
Practices through ICT	21	31.5	52.5
Problem solving	2	8	10
Laboratory practical	6	9	15
Essay questions exam	2	16	18
Problem and/or exercise solving	1	5.5	6.5

*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 and discussion of the fundamental theory. Through this methodology, skills CE9, CE10, CE20, CG3, CG4, CG6, CT2, CT3 are developed
Practices through ICT	The concepts presented in the class sessions will be further illustrated and developed by means of Matlab-based simulation and signal processing tools. Through this methodology, skills CE7, CE9, CE10, CG3, CG4, CT2 are developed
Problem solving	A simple problem will be solved after each batch of slides. This problem will help to understand the concepts introduced in that batch of slides. Through this methodology, skills CE9, CE10, CG4 are developed
Laboratory practical	Experimental study with real communication signals by means of Software-Defined Radio tools. Through this methodology, skills CE9, CE10, CG3, CG6, CT2 are developed

Personalized assistance

Methodologies	Description
Laboratory practical	Beyond the initial explanation to the group, instructors will answer individual students' questions.
Lecturing	Personalized attention will be offered during office hours.
Practices through ICT	Beyond the initial explanation to the group, instructors will answer individual students' questions.
Problem solving	Personalized attention will be offered during office hours. Special group sessions will be organized for solving selected problems; in those sessions students will try to solve the problems, and then the instructors will answer questions and provide feedback.

Assessment

	Description	Qualification	Training and Learning Results		
Essay questions exam	Final examination. It will cover all of the material covered during the course and will take place during the exam period as established by the Center.	40	B3 B4 B6	C9 C10 C20	D2 D3
Problem and/or exercise solving	Three short tests will be given during the semester.	60	B3 B4 B6	C7 C9 C10 C20	

Other comments on the Evaluation

For those students who choose the continuous assesment track. Four tests: 15% the first, 20% the second, 25% the third, and 40% the fourth.

The first three tests will take place following the schedule to be approved by the Academic Committee, which will be published by the beginning of the semester. These tests are not recoverable, that is to say, if a student does not show up when they take place, the instructors do not have the obligation to repeat them. In each test, the material covered from the start of the course until the previous week (inclusive) will be evaluated.

For those students who do not choose the continuous assessment track. Final examination: 100%

Students will be graded as long as they take any test (either the short-answer tests, or the final exam). Students will be assumed to choose the continuous assesment track as soon as they take any two of the short-answer tests. Students taking at most one of the short answer tests and the final exam will be assumed to choose the final assesment track.

Students choosing the continuous assesment track and not passing the subject will receive the "fail" mark, regardless of whether they took the final exam or not.

The mark achieved in the first three short-answer tests will be kept for the second call, but not for subsequent years.

Regarding the second call, students in the continuous assessment track will be allowed to choose if they wish to keep the mark achieved in the first three short-answer tests and re-take the fourth, or if they want to be assessed only by the final exam.

For the end-of-program call. Final examination: 100%.

Plagiarism is regarded as serious misconduct. If any form of plagiarism is detected in any of the tests or exams, the final grade will be FAIL (0), and the corresponding academic authorities will be informed about the fact, in order to take adequate measures.

Sources of information

Basic Bibliography

A. Artés, F. Pérez González et al., **Comunicaciones Digitales**, 1,

J. G. Proakis, M. Salehi, **Fundamentals of Communication Systems**, 1,

Complementary Bibliography

C.R. Johnson Jr., W.A. Sethares, **Telecommunication Breakdown**, 1,

Bernard Sklar, **Digital Communications: Fundamentals and Applications**, 2,

B. Razavi, **RF Microelectronics**, 1,

Recommendations

Subjects that continue the syllabus

Principles of Digital Communications/V05G301V01324

Subjects that it is recommended to have taken before

Physics: Analysis of Linear Circuits/V05G301V01108
Mathematics: Probability and Statistics/V05G301V01107
Digital Signal Processing/V05G301V01205

Other comments

It is assumed that the student has basic knowledge of analog and digital signal processing, as well as of probability and statistics.

Contingency plan

Description

=== ADAPTATION OF THE METHODOLOGIES ===
* Teaching methodologies maintained
All of them
* Teaching methodologies modified
None of them
* Modifications (if applicable) of the contents
N/A
* Additional bibliography to facilitate self-learning
N/A
* Other modifications
None
=== ADAPTATION OF THE TESTS ===
No modification is required neither of the assessment tests nor of their corresponding weights

* Additional Information
The "Practices through ICT" will be maintained even if they can not be done face-to-face. If necessary, both in the mixed modality and in the non-face-to-face modality those "Laboratory practicals" that require specific hardware will be replaced by alternative practices through ICT.

In order to facilitate as much as possible the self-organization of the work by the students, and preventing potential conciliation and/or connectivity problems, the material used in each session will be provided to students sufficiently in advance.