Universida_{de}Vigo

IDENTIFYING DATA

Signal Transmission and Reception Techniques

Subject	Signal Transmission and Reception Techniques
Code	V05G300V01404
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación

Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd

Teaching language	Spanish
Department	
Coordinator	López Valcarce, Roberto
Lecturers	Comesaña Alfaro, Pedro Fernández Barciela, Mónica González Prelcic, Nuria Isasi de Vicente, Fernando Guillermo López Valcarce, Roberto Márquez Flórez, Óscar Willian Rodríguez Banga, Eduardo Romero González, Daniel
E-mail	valcarce@gts.uvigo.es
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General description	The course "Techniques for Signal Transmission and Reception" 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	
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	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.
A6	CG6: The aptitude to manage mandatory specifications, procedures and laws.
A16	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.
A18	CE9/T4: The ability to analyze and specify the main parameters of a communications system.
A19	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.
A29	CE20/T15: The knowledge of national, European and international telecommunication regulations and laws.

Learning aims

Expected results from this subject	Training and Learning Results
Ability to use communication and office computer applications (databases, advanced computation, project management, visualisation tools, etc.) to support the development and exploitation of networks, services, and telecommunication and electronics applications.	A16
Ability to analyse and specify the fundamental parameters of a communications system.	A18

Ability to evaluate the advantages and drawbacks of different technological alternatives for the deployment or implementation of analog and digital communication systems, from the signal space point of view, and taking into account the perturbations and the noise.	A19
Knowledge of basic technologies that enable the student to learn new methods and techniques, with the flexibility required to adapt to new situations.	A3
Ability to solve problems with initiative, decision making, and creativity.	A4
Familiarity with telecommunication regulations and standards at the national, European and world levels.	A29
(*)	A6

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, systems, transforms. -Autocorrelation function of a stochastic process. -Power spectral density. Transmitted power, transmission bandwidth. -Noise characterization
3. Frequency conversion and analog processing	-Amplitude modulation (AM): with large carrier, with suppressed carrier -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 - Bandpass PAM
5. Modulation and detection in Gaussian channels	-Introduction to the Signal Space -Derivation of the Matched Filter -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
Master Session	24	24	48
Practice in computer rooms	21	31.5	52.5
Troubleshooting and / or exercises	2	8	10
Laboratory practises	6	9	15
Long answer tests and development	2	16	18
Short answer tests	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
Master Session	Presentation and discussion of the fundamental theory
Practice in computer rooms	The concepts presented in class will be further illustrated and developed by means of Matlab-based simulation and signal processing tools
Troubleshooting and / or exercises	Students will be given different take-home sets of problems. The answers to selected problems will be provided later on.
Laboratory practises	Experimental study of different components and effects in analog transmitter/receiver frontends

Personalized attention

Methodologies	Description
Laboratory practises	Student aid will be provided during office hours as well as on-line (email, chat). On-line discussion forums will be set up for each chapter, through the usual e-learning platform.

Master Session	Student aid will be provided during office hours as well as on-line (email, chat). On-line discussion forums will be set up for each chapter, through the usual e-learning platform.
Practice in computer rooms	Student aid will be provided during office hours as well as on-line (email, chat). On-line discussion forums will be set up for each chapter, through the usual e-learning platform.
Troubleshooting and / or exercises	Student aid will be provided during office hours as well as on-line (email, chat). On-line discussion forums will be set up for each chapter, through the usual e-learning platform.

Assessment

	Description	Qualification
Long answer tests and development	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. In this exercise, skills A3, A4, A6, A18, A19 and A29 will be assessed.	60
Short answer tests	Three short tests will be given during the semester. These exercises will assess skills A3, A4, A16, A18 and A19.	40

Other comments on the Evaluation

The final grade will consist of: - grade of comprehensive test (up to 4 points)- lab reports (up to 4 points)- final project (up to 2 points)

Grades from lab reports will be kept for the second call, in which the student will be able to resubmit his/her final project, as well as take a new comprehensive test.

Sources of information

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

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

Leon W. Couch, **Digital & Analog Communication Systems**, 7,

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

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

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

R. Sobot, **Wireless communication electronics : introduction to RF circuits and design techniques**, 1,

Recommendations

Subjects that continue the syllabus

Principles of Digital Communications/V05G300V01613

Subjects that it is recommended to have taken before

Physics: Analysis of Linear Circuits/V05G300V01201

Mathematics: Probability and Statistics/V05G300V01204

Digital Signal Processing/V05G300V01304

Other comments

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