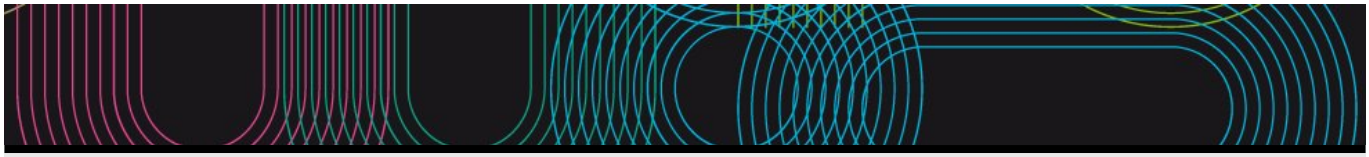

IDENTIFYING DATA				
Signal Transmission and Reception Techniques				
Subject	Signal Transmission and Reception Techniques			
Code	V05G306V01208			
Study programme	Grado en Ingeniería de Tecnologías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	English			
Department				
Coordinator	Rodríguez Banga, Eduardo Gómez Cuba, Felipe			
Lecturers	Gómez Cuba, Felipe Rodríguez Banga, Eduardo			
E-mail	erbanga@uvigo.es gomezcuba@gts.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	The course "Signal Transmission and Reception Techniques" is an introduction to the different existing 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. English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
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.

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
Practical content	In this course there is no division between theoretical and practical content. Indeed, practical exercises related to many of the previously described contents are considered.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	34	34	68
Practices through ICT	24	31	55
Problem and/or exercise solving	3	6	9
Problem and/or exercise solving	2	16	18

*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. The explanation will be complemented by the resolution of questions and exercises. Through this methodology, skills C9, C10, C20, B3, B4, B6, D2, D3 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 C7, C9, C10, B3, B4, D2 are developed

Personalized assistance

Methodologies	Description
Lecturing	Personalized attention will be offered during office hours, which can be consulted on the institutional page of the instructors. Spanish Degree: Felipe Gómez Cuba (https://www.uvigo.gal/es/universidad/administracion-personal/pdi/felipe-gomez-cuba) Óscar Márquez Flórez (https://www.uvigo.gal/es/universidad/administracion-personal/pdi/oscar-willian-marquez-florez) Eduardo Rodríguez Banga (https://www.uvigo.gal/es/universidad/administracion-personal/pdi/eduardo-rodriguez-banga) English Degree: Pedro Comesaña Alfaro (https://www.uvigo.gal/es/universidad/administracion-personal/pdi/pedro-comesana-alfaro) Eduardo Rodríguez Banga (https://www.uvigo.gal/es/universidad/administracion-personal/pdi/eduardo-rodriguez-banga)
Practices through ICT	Beyond the initial explanation to the group, instructors will answer individual students' questions. In addition, instructors will be available to students at office hours.

Assessment

	Description	Qualification	Training and Learning Results		
Problem and/or exercise solving	Three midterm exams will be given during the semester. Their influence on the final grade is detailed in the section "Other comments on the Evaluation".	60	B3 B4 B6	C7 C9 C10 C20	D2 D3
Problem and/or exercise solving	Final examination with questions of any type. It will cover all of the material covered during the course and will take place during the exam period as established by the Center. The influence of the exam on the final grade is described in the section "Other comments on the Evaluation".	40	B3 B4 B6	C7 C9 C10 C20	D2 D3

Other comments on the Evaluation

The final grade will be computed based on the grades obtained in the three midterm exams (P1, P2 and P3, respectively) and the grade in the final exam (EX), all of them in a ten-point scale.

The contribution of the midterm exams to the final grade (P) is obtained as

P = V1*P1 + V2*P2 + V3*P3

where

V1 =0.15 if P1 >= 5, V1 = 0 otherwise

V2 =0.2 if P2 >= 5, V2 = 0 otherwise

V3 =0.25 if P3 >= 5, V3 = 0 otherwise

Then, the final grade (F) will be computed as:

F =min(10, P + EX*(10-P)/(10-0.3*P)) if EX>=3.5

F = min(4, P + EX*(10-P)/(10-0.3*P)) if EX < 3.5

The schedule of the midterm exams will be approved in the Comisión Académica de Grado (CAG) and will be available at the beginning of each academic semester. These exams 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 midterm exam, the material covered from the start of the course until the previous week (included) will be evaluated.

For those students who choose to follow global assessment, the final grade will be directly the final exam grade (F = EX).

Students will be graded at the ordinary opportunity of evaluation as long as they take any midterm exam and do not waive

the continuous assesment (C.A.) track within a period established by the instructors; this period will last at least for one month and will be included in the period between the publication of the grades of the first midterm exam and the date of the third midterm exam.

For those students following C.A., any not attended midterm exam or final exam will be graded with zero points.

The mark achieved in the three midterm exams (P) will be kept for the second call of evaluation to those students attending the final exam of that call, but not for subsequent years. Regarding this second call, the same rules stated above will apply.

For the end-of-program exam, a comprehensive exam will be given, corresponding to 100% of the final grade.

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.

Sources of information

Basic Bibliography

A. Grami, **Introduction to Digital Communications**, 1, 2016

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

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

Complementary Bibliography

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

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

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

Se asume que el/la estudiante posee conocimientos básicos sobre la disciplina del procesado de señal (analógico y digital), así como de probabilidad y estadística.