



IDENTIFYING DATA

Principles of Digital Communications

Subject	Principles of Digital Communications			
Code	V05G300V01613			
Study programme	Degree in Telecommunications Technologies Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	3rd	2nd
Teaching language	Spanish			
Department				
Coordinator	González Prelcic, Nuria			
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General description	The basic aims of the subject are the following: <ul style="list-style-type: none"> - Apply optimisation criteria for the realisation of diagrams of estimate and synchronisation in digital receptors of communications. - Differentiate the blocks and the functionalities of a data transmission system. - Use digital signal processing to transmit and receive analog waveforms. - Apply the basic mechanisms of reduction of the impact of noise in a communications 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.
B11	CG11 To approach a new problem considering first the essential and then the secondary aspects
C26	CE26/ST6 The ability to analyze, codify, process and transmit multimedia information using analogical and digital signal processing techniques.
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		
Apply criteria of optimisation for the realisation of diagrams of estimate and synchronisation in digital receptors of communications	B3	C26	
Differentiate the blocks and the functionalities of a system of transmission of complex data	B11	C26	D2
Use the processed digital of signals to transmit and receive forms of analog wave	B3 B4		D3
Apply the basic mechanisms of reduction of the impact of noise in a system of communications		C26	D2

Contents

Topic

1. Introduction to digital communications.	<ul style="list-style-type: none"> - The software radio concept - Elements of a digital receiver - Wireless communications, past and present
2. Review of signal processing concepts and communication theory	<ul style="list-style-type: none"> - Review of Fourier Transforms - Frequency response of random signals. Bandwidth, power spectrum. - Up-conversion and down-conversion. Complex baseband representation, lowpass equivalent channel. - Intersymbol interference and Nyquist pulses. - Maximum likelihood detection in white noise. Probability of error.
3. Timing recovery	<ul style="list-style-type: none"> - Introduction to the problem of timing recovery. - Synchronization algorithms
4. Channel estimation and equalization	<ul style="list-style-type: none"> - Channel estimation - MSE estimation - Frequency selective channels. - LS equalizer. - Adaptation algorithms: pilot-based, decision directed, blind. - Frequency domain equalizers.
5. Carrier recovery	<ul style="list-style-type: none"> - Phase estimation - Phase Locked Loop. Costas loop. - Decision directed recovery. - Frequency estimation with dual loops.
6. Standards of digital communications	<p>Subject planning to changes in function of the publication of new standard</p> <ul style="list-style-type: none"> - 802.11to - *GSM

Planning

	Class hours	Hours outside the classroom	Total hours
Troubleshooting and / or exercises	6	14.46	20.46
Laboratory practises	12	36	48
Projects	7	35	42
Master Session	15	22.5	37.5
Long answer tests and development	2	0	2

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

Methodologies

	Description
Troubleshooting and / or exercises	In the hours type To will resolve the problems proposed in the bulletins.
Laboratory practises	With this methodology work the competitions: *CG3, *CG4, *CG11, *CE26. In the hours type *B will realise practices in *USRPs with *LabView that drive to the creation of a receptor of software irradiate that it include all basic functionalities studied in the *asignatura.
Projects	With this methodology work the competitions: *CG4, *CG11, *CE26. In the hours type C will pose practical projects in which it will develop a digital receptor that will have to show his good operation in the application proposed on *USRPs. The projects will realise in small groups. All the members of the group have to comprise the operation of all the blocks of the complete receptor that will deliver at the end of the *cuatrimestre.
Master Session	With this methodology work the competitions: *CG3, *CG4, *CG11, *CE26, *CT2, *CT3. Exhibition and discussion of the fundamental concepts associated to the different blocks that constitute a digital receptor.
	With this methodology work the competitions: *CG4, *CG11, *CT2, *CT3.

Personalized attention

Methodologies	Description
Master Session	They will resolve the doubts that each student formulate during the presentation realised in the session *magistral
Laboratory practises	The students will work in small groups and will resolve the doubts that each group can present.
Projects	The students will work in small groups and will resolve the doubts that each group can present.

Assessment

Description		Qualification	Training and Learning Results		
Laboratory practises	Short exercises associated to the contents explained in the masterclasses and in the laboratory. They will realise three exercises in the hours type To of the following weeks: 4 or 5; 8 or 9; 12 or 13. Each exercise will have a weight of 10% in the final note.	30	B3 B4	C26	D3
Projects	Realisation of a practical project in group that will evaluate individually the last week of class in the hour type C corresponding.	40	B3 B4 B11	C26	D2 D3
Long answer tests and development	Final examination of resolution of exercises, that will coincide with the fourth proof of continuous evaluation. The weight will be of 100% for the students that do not subject to continuous evaluation, and of 30% for which himself.	30	B3 B4 B11	C26	

Other comments on the Evaluation

For those students that opt by continuous evaluation the final note will obtain eat:

*Npuntuables+*Nproyecto+*Nexamenbeing *Npuntuables the note accumulated in the scored short exercises, until a maximum of 3 points; *Nproyecto the note of the practical project until a maximum of 4 points, and *Nexamen the note of the final examination until a maximum of 3 points. To approve the *asignatura a student has to have a minimum of 3.5 points on 10 in the examination; but it reaches this minimum, the final note of the student will be the obtained in the examination, although it have opted by continuous evaluation. For the students that do not opt by continuous evaluation, the final note will be the obtained in the final examination. The final examination of the students that do not opt by continuous evaluation will consist of an exercise more than the one of the students that evaluate by continuous evaluation. The student has to decide, after the realisation of the second race, if it opts by continuous evaluation or no, communicating it to the professor inside the term that establish . The students that opted by the continuous evaluation and did not approve the matter will receive the qualification of "suspense" independently that they present to the final examination or no. The note of the scored conserves for the announcement of Julio, but no for back courses. In the examination of the announcement of Julio the students that opt by continuous evaluation will be able to choose if they wish to keep the note obtained in the races and project, or be evaluated only by the final examination with a weight of 100%.

Sources of information

R. W. Heath Jr., **Intro. to Wireless Digital Commun.: A Signal Processing Perspective**,
 J.R. Barry, E. A. Lee y D. G. Messerschmitt, **Digital communication**, 3rd edition,
 A. Artés Rodríguez, F. Pérez González y otros,, **Comunicaciones Digitales**,

Recommendations

Subjects that continue the syllabus

Digital Communications/V05G300V01914

Subjects that it is recommended to have taken before

Signal Transmission and Reception Techniques/V05G300V01404

Multimedia Signal Processing/V05G300V01513