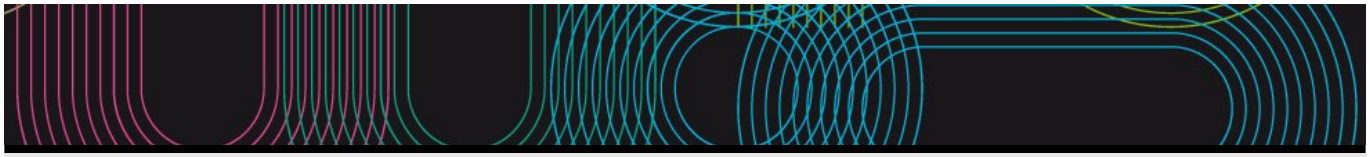

IDENTIFYING DATA				
Digital processing in real time				
Subject	Digital processing in real time			
Code	V05G300V01913			
Study programme	Degree in Telecommunications Technologies Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	Spanish			
Department	Signal Theory and Communications			
Coordinator	Cardenal López, Antonio José			
Lecturers	Cardenal López, Antonio José			
E-mail	cardenal@gts.uvigo.es			
Web				
General description	This course is designed to provide the student with basic knowledge about the design and implementation of real-time digital signal processing (DSP) algorithms. The main objective for the student is to obtain knowledge about the different platforms available for this purpose in scenarios with real-time restrictions, and to learn the practical issues related with the implementation of DSP algorithms in such platforms. Knowledge acquired on lectures will be reinforced by laboratory practices. For this purpose a Digital Signal Processor development board, will be employed. The course will be taught in Spanish, but all teaching materials will be in English.			

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.
C69	(CE69/OP12) The ability to implement digital signals processing schemes in programming devices.
C70	(CE70/OP13) The ability to interact digitally with radio signals.
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		
Know the architectures for applications in real time.	B3	C69	D2
Develop applications in real time on selected architectures.	B3 B4	C69	D2
Adapt the knowledges of digital signal processing to real time tasks.	B3 B4	C69 C70	D3
Propose digital solutions for its integration in radio transceptors.	B4	C70	D3

Contents	
Topic	
Topic 1 Elementary concepts	Definition of real-time processing. Real-time restrictions for digital signal processing. Overview of hardware platforms for real time digital signal processing.

Topic 2 Time-domain algorithms.	Signal generation. Advanced structures for IIR filters. Finite-precision effects.
Topic 3 Frequency-domain Algorithms	Fast Fourier Transform (FFT). Discrete Cosine Transform. Goertzel algorithm
Topic 4 Introduction to Digital Signal Processors.	DSP architecture. Arithmetic-logic unit. Address-Generation Unit. Program flow control. Performance measures.
Topic 5 High level programming for DSP	Development systems structure. Fixed point programming techniques. Optimising high level code.
Practice 1: Introduction to the development system	Compiling, runing and debugging programs on the DSP development system.
Practice 2: Signal generator	Generation of a sinusoidal signal using several approaches.
Practice 3: IIR filters (I)	IIR filters implementation using transposed and cascade structures.
Practice 4: IIR filters (II)	IIR filter programming using fixed-point arithmetic.
Practice 5: Frequency domain processing.	Using the DSP libraries for FFT computation. Frequency domain filtering.
Practice 6: Software defined radio.	Programming of basic algorithms for programmable transmiters and receptors.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	21	42	63
Supervised work	7	35	42
Laboratory practices	12	24	36
Essay questions exam	2	7	9

*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 of main topics in class. Multimedia material will be made available in faitic before classes take place. Personal study. Support from the instructors through tutorial help. Individual activity. Through this methodology the competencies CG3, CE69, CT2 and CT3 are developed.
Supervised work	Group work on a project centered in a practical application using the DSP development board employed in the laboratory. Group activity. Through this methodology the competencies CG3, CG4, CE69, CE70, CT2 and CT3 are developed.
Laboratory practices	Practical exercises on a DSP development board. Matlab will be used for designing filters, and for simulation purpose if necessary. Individual activity. Through this methodology the competencies CG4, CE69, CE70, CT2 and CT3 are developed.

Personalized attention

Methodologies	Description
Laboratory practices	In practical sessions, each student must solve his/her own tasks. The teacher will be available during the session to solve any problem/question or doubt the student may have.
Lecturing	Lectures are develop within a continuous interaction framework, where students can answer questions delivered by the teacher. They could also solve their particular doubts during the sessions.
Supervised work	Tutored works are developed in small working groups. The works are followed during meetings between the groups and the teacher. In those meetings the students can interact and ask their questions to the teacher.

Assessment

	Description	Qualification	Training and Learning Results		
Supervised work	Group work centred in a practical application of real-time signal processing, using the DSP development board.	30	B3 B4	C69	D3
Laboratory practices	Evaluation of practical exercices using the DSP development board.	50	B3 B4	C69 C70	D2
Essay questions exam	Written exam encompassing all the material exposed in the classroom and laboratory.	20	B3 B4	C69	D3

Other comments on the Evaluation

The course will be taught in Spanish, but all teaching materials will be in English.

Evaluation

Students shall be offered two evaluation systems: continuous evaluation or evaluation at the end of the semester.

CONTINUOUS EVALUATION

The continuous evaluation of the course will consist in:

- 5 practices developed on the DSP development board.These practices will account for 50% of the final grade.
- 1 project to be carried out in group, that will account for 30% of the final grade.
- A written exam encompassing all the material exposed in the classroom and in the laboratory. It will take place in the dates scheduled by the school. It will account for 20% of the final grade.

The final qualification of the student will be computed as a weighted sum (50%, 30% and 20%, respectively) of the qualifications of laboratory, group project and final exam.

The contents and the weight of each continuous evaluation exercise are the following:

- Signal generation (10%)
- IIR filter programming (10%)
- Programming IIR filters with fixed point arithmetic. (10%)
- Frequency domain processing (10%)
- Software defined radio (10%)
- Project: (30%)

The individual note for the group work, will be the common note wheighted using the results of a cross evaluation test between the members of the group.

EVALUATION AT THE END OF THE SEMESTER

Should a student decide not to be graded through continuous evaluation, he will have a written examination opportunity that will take place the same day of the final exam for all the students. The exam will cover all the material mastered in the classroom and the laboratory. Students should communicate their intention to renounce to be graded through continuous evaluation at least a week before the date of the final exam.

Students who do not pass the course at the end of the semester have an oportunity to retest on the end of the academic year. Previously to the exam, students will be asked to choose to be evaluated by continuous evaluation system or only by the final exam. In the former case, they will have the opportunity to improve the continous evaluation grade by means of redoing and improving selected practices.

EXTRAORDINARY EVALUATION (END OF CAREER)

The student will have a written examination covering all the material mastered in the classroom and the laboratory.

Sources of information

Basic Bibliography

Sen M. Kuo, Bob H. Lee, **Real-Time Digital Signal Processing,: Implementations, Application and Experiments with the TMS320C55X**, John Wiley & Sons,

Complementary Bibliography

Sanjit K. Mitra, **Digital Signal Processing: A Computer Based Approach**, McGraw-Hill,

Alan V. Oppenheim, Ronald W. Schafer, **Discrete-Time Signal Processing**, Prentice Hall,

Recommendations

Subjects that it is recommended to have taken before

Digital Signal Processing/V05G300V01304
Multimedia Signal Processing/V05G300V01513