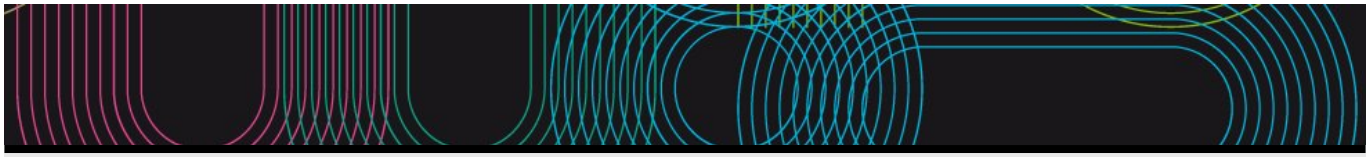

IDENTIFYING DATA				
(*)Procesado dixital en tempo real				
Subject	(*)Procesado dixital en tempo real			
Code	V05G300V01913			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	Spanish			
Department				
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	
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.
A78	(CE69/OP12) The ability to implement digital signals processing schemes in programming devices.
A79	(CE70/OP13) The ability to interact digitally with radio signals.

Learning aims	
Expected results from this subject	Training and Learning Results
Know the architectures for applications in real time. Develop applications in real time on selected architectures. Adapt the knowledges of digital signal processing to real time tasks. Propose digital solutions for its integration in radio transceptors.	A3 A4 A78 A79

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
Master Session	21	42	63
Tutored works	7	35	42
Laboratory practises	12	24	36
Long answer tests and development	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
Master Session	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.
Tutored works	Group work on a project centered in a practical application using the DSP development board employed in the laboratory.
Laboratory practises	Practical exercises on a DSP development board. Matlab will be used for designing filters, and for simulation purpose if necessary.

Personalized attention

Methodologies	Description
Laboratory practises	 The students will have access to tutorial hours as scheduled by the Telecommunication school at the beginning of the Fall semester. Any question related to the master sessions, the laboratory drills or the work being carried out in the projects can be raised by the students.
Master Session	 The students will have access to tutorial hours as scheduled by the Telecommunication school at the beginning of the Fall semester. Any question related to the master sessions, the laboratory drills or the work being carried out in the projects can be raised by the students.
Tutored works	 The students will have access to tutorial hours as scheduled by the Telecommunication school at the beginning of the Fall semester. Any question related to the master sessions, the laboratory drills or the work being carried out in the projects can be raised by the students.

Assessment

	Description	Qualification
Tutored works	Group work centred in a practical application of real-time signal processing, using the DSP development board.(Competencies A2, A4, A78)	30
Laboratory practises	Evaluation of practical exercices using the DSP development board. (Comptencies A2, A4, A78, A79)	50
Long answer tests and development	Written exam encompassing all the material exposed in the classroom and laboratory. (Competencies A2, A4, A78,)	20

Other comments on the Evaluation

Evaluation

Following the own guidelines of the degree 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%)

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.

Sources of information

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

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

(*)Procesado dixital de sinais/V05G300V01304
(*)Tratamento de sinais multimedia/V05G300V01513