COURSE DATA

Data Subject	
Code	34800
Name	Digital signal processing
Cycle	Grade
ECTS Credits	6.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1402 - Degree in Telecommunications Electronic Engineering	School of Engineering	3	First term

Subject-matter

Degree	Subject-matter	Character
1402 - Degree in Telecommunications Electronic Engineering	10 - Telecommunication signals, systems and services	Obligatory

Coordination

Name	Department
MUÑOZ MARI, JORDI	242 - Electronic Engineering
RODRIGO BORT, MIGUEL	242 - Electronic Engineering

SUMMARY

The subject of "Digital Signal Processing", 6 ECTS, taught in the first semester of the third Course of Electronic Engineering Degree in Telecommunications (GIET). Part of the matter, "Signals, Systems and Telecommunication services" is mandatory and is taught by professors from the Department of Electronic Engineering.

This course complements the subject of signals and systems studied in the second degree course. It begins with a review of basic skills, taught in the course Signals and Systems (sampling AD / DA conversion, Z transform, etc.) to move on to define a fundamental tool in signal analysis such as Discrete Fourier Transform seeing the advantages and limitations of this tool for the analysis of discrete signals. The next block of the course is the design and analysis of digital filters (both FIR and IIR type) studied the different possibilities of implementation (structures) and the effects of finite precision that has these elements. After seeing the digital filter goes on to describe two fundamental operations in digital signal processing such as the decimation and interpolation. Finally, for the student to acquire a thorough

knowledge of digital signal processing is introduced the problem of hardware implementation of the systems digital signal processing with the different elements available for conducting such implementation.

The objectives of this course is summarized in the following points:

• Consolidate knowledge related to the digital processing that have been taught in other subjects of such material, and taught.

• Present the discrete Fourier transform as a tool for signal analysis and their corresponding fast versions.

• To guide design of digital filters (FIR and IIR both) with emphasis on the different structures and finite precision errors that we can find.

• Show where and how to apply adaptive systems systems, digital signal processing.

• Publicize the alternatives have when implementing a digital processing system hardware as well as the advantages and disadvantages of each.

The course contents are:

Review of digital signal processing. Discrete Fourier Transform. Fast algorithms FFT. Design of FIR and IIR filters. Multirate signal processing. Adaptive systems. Implementation techniques. Finite arithmetic. Introduction to digital signal processing in real time.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

The student must have taken the course of Signals and Systems for this subject taught in second year of the degree (GIET).

OUTCOMES

1402 - Degree in Telecommunications Electronic Engineering

- R4 - Ability to analyze and specify the fundamental parameters of communication systems.
- R1 - Ability for self-learning of new knowledge and techniques appropriate for the conception, development and exploitation of telecommunications systems and services.

LEARNING OUTCOMES

1 Evaluate the advantages and disadvantages of different technological alternatives for deploying or implementing communication systems, from the point of view of signal space, disturbances and noise, and analogue and digital modulation systems. (G3, G4, G5, G6)

2 Autonomy in the apprehension of new knowledge and techniques suitable for the conception, development or exploitation of telecommunication systems and services. (R1, R4)

3 Perform analysis / design of communications elements from a systemic point of view. (R1, R4)

Once this subject has been passed the student will have enough elements of judgment to know the basic characteristics of a digital processing system from the initial stages of the Analog-Digital conversion, analysis of the discrete systems in the temporal and frequency domain, as well Such as the design and implementation of digital filters (both non-variant-temporal systems and adaptive filters). In addition, it will be able to analyze and specify the fundamental parameters of a digital signal processing system and perform simple processing applications that operate in real time in a fixed-point DSP.

The student must have acquired the following skills:

Analyze discrete signals using the Discrete Fourier Transform.

Design digital filters, FIR and IIR, taking into account the effects of finite precision and structure that may be interesting in each situation.

Implement an adaptive system using the basic LMS algorithm or its most widespread variants.

Learn how multiple devices with different sampling rates can be connected using decimation and interpolation blocks.

Perform a digital processing application on a digital signal processor (DSP).

DESCRIPTION OF CONTENTS

1. Discrete Systems (Review)

A/D and D/A conversion
Discrete signals. LTI discrete systems
Impulse response.
Convolution.
Z transform
Frequency response

2. Discrete Fourier Transform

Definition of the DFT. Properties.
Signal analysis using the DFT.
Algorithms for calculating the DFT.

3. Digital Filter Design

FIR filter design
IIR filter design.
Adaptive filters.
Implementation of discrete systems
Finite precision effects

4. Multirate systems

Decimation.
Interpolation.
Applications.

5. Hardware and digital processing

Hardware architectures for DSP.
Software development tools.
Application deployment.

6. Laboratory

LAB 1: Computer Hardware

Getting starter with the board eZdsp 5515 of Texas Instruments using Code Composer Studio.

LAB 2: Transform Discrete Fourier
Resolution, windowing, spectral leakage, Goertzel algorithm.

LAB 3: Frequency selective digital filters
Properties of the filters FIR and IIR: design methods. Using SpTool and FDATool.

LAB 4: Adaptive Filters
System identification. Active noise canceling

LAB 5: Laboratory exam.

Along with these labs is expected to make a mini-project. Students have to develop a digital processing

system in real time on a fixed-point digital processor.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	35,00	100
Laboratory practices	15,00	100
Classroom practices	10,00	100
Development of group work	15,00	0
Development of individual work	15,00	0
Study and independent work	12,00	0
Readings supplementary material	4,00	0
Preparation of evaluation activities	14,00	0
Preparing lectures	15,00	0
Preparation of practical classes and problem	15,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

The training activities are conducted in accordance with the following distribution:

• theoretical activities. (G3, G4, G5, G6)

Description: In the theoretical issues will be developed to provide a global and inclusive, analyzing in detail the key issues and more complex, promoting at all times, student participation.

• Practical activities.

Description: Complementing the theoretical activities in order to apply the basic concepts and extend them with knowledge and experience they acquire during the course of the work proposed. They include the following types of classroom activities:

• Classes of problems and issues in the classroom (G4, G5, G6)
• Regular discussion and resolution of problems and exercises for students previously worked (G4, G5, G6)
• Laboratory sessions. (R1, R4)
• Making a mini-project. (G4, R1, R4)

To carry out the mini-project will form pairs and the teacher will distribute a plate eZdsp 5515 / eZdsp5505 with Code Composer Studio software in the first class sessions. The students will have this badge during the entire course could prepare the mini-project pair, whose memory and presentation will be held at the end of the semester.

It will use the platform of e-learning (virtual classroom) from the University of Valencia in support of communication with students. Through it you will have access to learning materials used in class as well as solve problems and exercises.

EVALUATION

The evaluation of the learning will be carried out in the following way:

Continuous assessment:

• SE1. Objective test, consisting of one or several exams with both theoretical-practical questions and problems (40%).

• SE2. Evaluation of laboratory activities (25%), distributed as follows:

SE2.1. Laboratory exam (last session): 50% (12,5% of the total).

SE2.2. Evaluation of sessions: 50% (12,5% of the total). In each session a pre-laboratory questionnaire will be made (3%), a post-laboratory questionnaire (4,5%), and the achievement of the session will be evaluated (4,5%).

• SE3. Evaluation of deliverables (10%) (NON-RECOVERABLE activity).

• SE5.Evaluation of the memory and presentation of a signal processing miniproject (25%).

If SE2 is not passed, the day of the examination of the official call it will be a laboratory exam, SE2.1b. The final mark for SE2 will be computed as max(SE2.1b x 50% + SE2.2 x 50%), that is, as the maximum between the average of SE2.1b and SE2.2, and SE2.1b.

Alternative evaluation only valid for the second call:

• SE1. Objective test, consisting of one or several exams that will consist of both theoretical-practical issues and problems (50%).

• SE2. Evaluation of laboratory activities (25%).

SE2.1c. Laboratory exam (day of the **second** official call): 50% of the laboratory mark if the student has assisted to the sessions SE2.2, 100% of the laboratory mark otherwise.

SE2.2: Evaluation of sessions: if the student has assisted to them, 50% of the laboratory mark.

The final mark for SE2 will be computed as the maximum between the average of SE2.1c and SE2.2, and SE2.1c, that is, using the formula max(SE2.1c x 50% + SE2.2 x 50%, SE2.1c).

• SE5.Evaluation of the memory and presentation of a signal processing miniproject (25%).

It is necessary to obtain a minimum of **4 points out of 10** in sections (SE1, SE2 and SE5) to approve.

"In any case, the evaluation system will be governed by what is established in the Evaluation and Qualification Regulations of the Universitat de València for Degrees and Masters (https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?acci

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