Universida_{de}Vigo

IDENTIFYING DATA
(*)Procesado dixital de sinais

Subject	(*)Procesado dixital de sinais
Code	V05G300V01304
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación

Descriptors	ECTS Credits		Choose	Year	Quadmester
	6		Mandatory	2nd	1st

Teaching language	Spanish
Department	
Coordinator	Abreu Sernández, María Victoria
Lecturers	Abreu Sernández, María Victoria Alonso Alonso, Ignacio Márquez Flórez, Óscar Willian
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General description	Digital signal processing is nowadays a feature of most everyday communications and entertainment devices. The aim of this course is to equip students with a mathematical grounding in general signal and systems analysis. In subsequent course subjects, this knowledge will be applied to specific applications of signals and systems, including audio, image, video and voice signals. Objectives cover the following areas: Managing signals and systems mathematically and visually, including learning and applying their properties. Studying the different domains for signal and systems analysis: time domain, frequency domain and Z domain. Learning how to transfer a problem in one domain to a domain in which it is easier to solve. Mastering the concept of filter frequency response and learning to interpret the system function. Understanding the relationship between the poles and zeros of the system function and the frequency response. Acquiring basic notions of filter design in the Z domain. Managing specific digital signal processing software. Applying the above knowledge to simple and practical laboratory examples, including filtering, FFT, windowing and sampling of image and sound signals and touch-tone telephone systems.

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.
A57	(CE48/T16) The knowledge of the appropriate techniques to develop and exploit signal processing subsystems .
A58	(CE49/T17) The ability to analyze digital signal processing schemes.

Learning aims

Expected results from this subject	Training and Learning Results
Managing specific software for digital signal processing	A57
Applying mathematical knowledgements for signal filtering	A58
Mastering filtering opperations in frequency domain.	A3 A58

Learning mathematical issues for understanding the processes of sampling and windowing signals. A4

	A57
Analysis of simple processing systems.	A58

Contents

Topic	
Subject 1. Introduction and Review	Presentation. Detailed explanation of the program, assessment procedure. Review. Sinusoids and complex exponential. Fourier transform of continuous signals.
Subject 2. Analog-to-Digital Conversion	Uniform Sampling. Quantification and binary rate. Nyquist Theorem. Aliasing. D/A Conversion. Zero-Order and Linear Interpolation. C-D Conversion. Analog frequency vs discrete frequency.
Subject 3. FIR Filters	Difference equation. Filter Coefficients. Block Diagrams. Causality, linearity and time-invariance. LTI systems and convolution. FIR frequency response.
Subject 4. Spectrum of a Discret-Time Signal	DTFT and IDTFT definitions. Properties. Basic pairs. Windowing. Spectrum of a windowed signal. DFT and IDFT definitions. Properties.
Subject 5. Z Transform	Definition and properties. Convolution theorem. Poles and zeros of a FIR filter.
Subject 6. IIR Filters	Difference equation. Filter Coefficients. Block Diagrams. Stability. Relation between the position of poles and zeros of the system function and the frequency response.
Project 1. A/D and D/A Conversion	Digitalisation of Continuous-Time Signals. Quantization. Aliasing.
Project 2. FIR Filters	FIR filters in the time and frequency domains.
Project 3. FFT. IIR Filters	FFT and windowing. IIR Filters

Planning

	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	0	1
Master Session	22	44	66
Laboratory practises	11	18	29
Troubleshooting and / or exercises	15	30	45
Forum Index	0	2	2
Multiple choice tests	1.5	0	1.5
Short answer tests	1	0	1
Troubleshooting and / or exercises	4.5	0	4.5

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

Methodologies

	Description
Introductory activities	Course presentation: programme, reading materials, teaching methodology and assessment system
Master Session	Instructor presentation of the main concepts of each subject. Classes do not cover all content that is examination material. The student should take the content indicated in the guidelines for each subject into account as orientation for exams. During the 5 minutes before the lecture, a student will summarize the main concepts presented in the previous session. Students will participate by answering questions during the explanation and by doing exercises. Student will work alone afterwards on the concepts studied in class and on expanding this content using the guidelines provided for each subject. Identification of doubts that need to be resolved in personalized tutorials.
Laboratory practises	Application of Matlab functions and commands for digital signal processing to solving practical exercises. Identification of doubts that need to be resolved in personalized tutorials.
Troubleshooting and / or exercises	Problems and exercises formulated according to the content of the lectures and the guidelines for each subject. Students solve problems and exercises prior to the class in which one or several students explain the solution on the board. Identification of doubts that need to be resolved in personalized tutorials.
Forum Index	The website for the course is included in the TEMA platform (http://faitic.uvigo.es). Subscription to this platform, including a photograph, is mandatory. The website provides all the information related to the course. It also publishes continuous assessment grades and runs forums for students to exchange ideas and discuss doubts.

Personalized attention

Methodologies	Description
Master Session	Students will have the opportunity to attend personal tutorials in their lecturer⬜s office at times established by lecturers for this purpose at the beginning of the academic year and published on the course website. These tutorials are aimed at resolving student doubts and providing guidance regarding: ⬜ The content of the lectures and approaches to study. ⬜ Laboratory projects and the software used. ⬜ Problems and exercises proposed and solved in the classroom as well as other problems and exercises arising during the course.
Laboratory practises	Students will have the opportunity to attend personal tutorials in their lecturer⬜s office at times established by lecturers for this purpose at the beginning of the academic year and published on the course website. These tutorials are aimed at resolving student doubts and providing guidance regarding: ⬜ The content of the lectures and approaches to study. ⬜ Laboratory projects and the software used. ⬜ Problems and exercises proposed and solved in the classroom as well as other problems and exercises arising during the course.
Troubleshooting and / or exercises	Students will have the opportunity to attend personal tutorials in their lecturer⬜s office at times established by lecturers for this purpose at the beginning of the academic year and published on the course website. These tutorials are aimed at resolving student doubts and providing guidance regarding: ⬜ The content of the lectures and approaches to study. ⬜ Laboratory projects and the software used. ⬜ Problems and exercises proposed and solved in the classroom as well as other problems and exercises arising during the course.

Assessment

	Description	Qualification
Multiple choice tests	These tests are a requirement to pass the subject. See details in the "Other comments and second call" section. In these tests the skill A57 will be evaluated.	0
Short answer tests	These tests are a requirement to pass the subject. See details in the "Other comments and second call" section. In these tests the skill A53 will be evaluated.	0
Troubleshooting and / or exercises	These tests are a requirement to pass the subject. See details in the "Other comments and second call" section. In these tests the skills A3, A4 and A58 will be evaluated.	100

Other comments on the Evaluation

1. Basic knowledge test

- The objective of this test is to determine whether the student has acquired the minimum knowledge and skills needed to pass the course.

- Students are graded as pass or fail. Students must obtain a pass grade in this test in order to pass the course.

- To pass, the student must correctly answer at least 70% of the questions.

- There are 3 opportunities to pass this test: in an hour of classroom time in the second-last week of the course, in the December exam period and in the July exam period. A pass grade is valid for the entire academic year.

- Students may not use books, notes or a calculator for this test.

- The test, which lasts about an hour, usually consists of 10 sections including multiple-choice questions and short theoretical and practical questions. Note that this structure may change.

2. Continuous assessment

The course can be passed with full marks from continuous assessment, with no need to sit the final exam.

Students who sit any of the assessment tests may not be listed as "Not Present".

The weighting and content of each continuous assessment test are as follows:

Assessment 1 (25%):

- Subject 2.
- It will take place during the 6th week of the course.

Assessment 2 (35%):

- From Subject 2 to Subject 4.
- It will take place during the 11th week of the course.

Assessment 3 (40%):

- From Subject 2 to Subject 6.
- It will take place during the last week of the course.

3. Lab assessments

- Their goal is to determine whether the student has acquired all the knowledge and/or skills corresponding to the laboratory practice, emphasizing the use of MATLAB for digital signal processing.
- There will be three mandatory tests in the lab. The student will pass this part if he/she gets an average greater than or equal to 5.

4. Final exam

- There is a final exam in December and another in July. In the final exam, all content is evaluated according to the information contained in the guidelines for each subject.
- The pass mark for this test is 5 out of 10.
- The final exam usually consists of 3 problems and lasts about 2.5 hours. Note that this structure may change.

4.1 First opportunity to pass the course (December)

- Students can opt for continuous assessment and also take the exam. The note will be the highest of the two grades provided the student has passed the basic knowledge test.
- If the student passes the course in this period, the grade will be final and will become part of their academic record.
- If the student fails the course, a provisional fail grade will be recorded on their academic record along with the grade obtained.

3.2 Second opportunity to pass the course (July)

- The July final exam, a lab test and a basic knowledge test will only be held for students who failed the course in January.
- Students who obtained a pass grade in the basic knowledge test in the previous assessment period will not need to do this test in July.
- The basic knowledge test must be taken by students who obtained a fail in the basic knowledge test in the previous assessment period but who passed the continuous assessment or the final examination in January.
- Students who do not sit any of the tests corresponding to this second period will be listed as "Not Present" if this was their situation after the first assessment period.
- Provisional fails will become definitive fails for students who do not present for the second period assessment tests.

4. Other comments

- The grades obtained in the basic knowledge test, the lab test, the continuous assessment and the December and July exams are only valid for the current academic year.
- The use of books, notes or electronic devices such as phones or computers is not permitted in any test or exam. Mobile phones must be turned off and out of reach of the student. If calculator use is permitted, the calculator must be a conventional scientific calculator. Under no circumstances may calculators be used that allow formulas to be saved or that have libraries that automatically perform operations with complex numbers, calculation of roots, etc.

Sources of information
J.H. McClellan y R.W. Schafer, R, **Signal Processing First**, Pearson Prentice Hall,
A. Quarteroni y F. Saleri, **Cálculo científico con Matlab y Octave**, Springer,
M. J. Roberts, **Señales y Sistemas**, McGraw Hill,
A.V. Oppenheim y R.W. Schafer, **Tratamiento de señales en tiempo discreto**, Prentice Hall,

It is recommended to purchase the *Signal Processing First (SPF)* book, as it constitutes the main source of content for the course.

Students will be provided with guidelines for each subject that includes the following sections:

- Theoretical content: The theory that will be evaluated in exams.
- Basic knowledge: Content considered essential for the course and tested by the basic knowledge test described in the section on assessment.
- Problems proposed: A set of problems recommended for each subject.
- SPF vocabulary: A Spanish-English vocabulary with a set of selected terms is included to facilitate reading of the book.

Students will also be provided with a document describing the Matlab content considered essential for the course.

Recommendations
Subjects that continue the syllabus
(*)Fundamentos de son e imaxe/V05G300V01405
(*)Técnicas de transmisión e recepción de sinais/V05G300V01404
(*)Fundamentos de procesado de imaxe/V05G300V01632
(*)Procesado de son/V05G300V01634
(*)Sistemas de audio/V05G300V01532
(*)Sistemas de imaxe/V05G300V01633
(*)Sistemas electrónicos de procesado de sinal/V05G300V01522
(*)Tratamento de sinais multimedia/V05G300V01513
(*)Vídeo e televisión/V05G300V01533

Subjects that it is recommended to have taken before
(*)Física: Análise de circuítos lineais/V05G300V01201
(*)Matemáticas: Álxebra lineal/V05G300V01104
(*)Matemáticas: Cálculo I/V05G300V01105
(*)Matemáticas: Cálculo II/V05G300V01203