COURSE DATA

Data Subject	
Code	36420
Name	Signals and systems
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1406 - Degree in Data Science	School of Engineering	2	First term

Subject-matter

Degree	Subject-matter	Character
1406 - Degree in Data Science	7 - Signals	Obligatory

Coordination

Name	Department
LAPARRA PEREZ-MUELAS, VALERO	242 - Electronic Engineering

SUMMARY

In Signals and Systems students learn a series of concepts and techniques for working with signals that have a certain temporal and/or spatial structure, such as biosignals (ECG, EEG, etc) and images. As these data appear frequently, it is important that data scientists know them.

The mathematical foundations for handling this type of data (transformed Z and Fourier) and the associated operations for treating them (convolution / correlation) are developed.

The theory classes will be taught in Spanish. The language for the practical and laboratory classes will be stated in the course guidelines available on the website for this degree.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

Given the basic nature of this course and its position in the curriculum, the only prerequisites are those stipulated for admission to the degree.

OUTCOMES

1406 - Degree in Data Science

- (CG01) Knowledge of basic subjects and technologies that enable students to learn new methods and technologies, and to provide them with versatility to adapt to new situations.
- (CG02) Ability to solve problems with initiative and creativity and to communicate and transmit knowledge, abilities and skills, which should include the ethical and professional responsibility of the activity of a data scientist.
- (CT02) To be able to complete technical, scientific, social and human training in general, and to organise self-learning with a high degree of autonomy.
- (CT04) To be responsible for ones own professional development and specialisation, applying the acquired knowledge in the identification of career opportunities and sources of employment.
- (CE10) Ability to digitally process signals and extract information from them.
- (CB3) Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.
- (CB4) Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.

LEARNING OUTCOMES

- Characterize signals in different domains (CB3, CB4, CG01, CG02, CT02, CT04, CE10).
- Know the impulse response (CB3, CB4, CG01, CG02, CT02, CT04, CE10).
- Know how to determine the output of an LTI system (CB3, CB4, CG01, CG02, CT02, CT04, CE10).
- Know the Fourier methods (CB3, CB4, CG01, CG02, CT02, CT04, CE10).
- Know how to apply and design digital filters (CB3, CB4, CG01, CG02, CT02, CT04, CE10)

DESCRIPTION OF CONTENTS

1. Introduction

Signals. Definition. Types.
Energy and power.
Systems. Definition. Types.
LTI systems. Examples.

2. Analysis in the time domain

Equation in differences.
Impulsional response.
Convolution. Examples. Properties
Autocorrelation and cross correlation.

3.

Z transform. Definition and properties.
Use to process signals.
Use to implement systems. Structures

4. Fourier transform

Fourier series. Fourier transform. Inverse transformations.
Fourier transform in discrete time. Inverted transformations.
Frequency response.

5. Digital filters

Digital filters. Types and use.
Design by poles and zeros of the Z Transform. Examples.
Other types of design. Examples

6. Laboratory practice

Due to its importance in the subject, it has been considered convenient to include as an independent thematic unit the practices to be carried out in the laboratory (computer room), where the student will learn to implement the models described in the theory classes.
Six laboratory practices are proposed, corresponding to the theoretical contents previously described in the previous thematic units:
Session I: Introduction to R y Conversion A/D y D/A
Session II: Analysis of systems in the time domain
Session III: Transformations for the analysis of linear systems

Session IV: Fourier transform
Session V: Frequency response of LTI systems
Session VI: Frequency-selective digital filters

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	28,00	100
Laboratory practices	20,00	100
Classroom practices	12,00	100
Development of group work	5,00	0
Development of individual work	10,00	0
Study and independent work	20,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	20,00	0
Preparing lectures	5,00	0
Preparation of practical classes and problem	15,00	0
Resolution of online questionnaires	10,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

Theory lessons: In the theory lessons, the concepts will be explained and illustrated with examples, sometimes by computer. Standard procedures for solving problems related to this course will be explained (MD1, developed competences: CB3, CB4, CG01, CT02, CT04,CE10).

Problem lessons: Most exercises will be solved by the students themselves or by the teacher during problem lessons. Work conducted in these lessons may be evaluated as a component of the student's final grade. (MD2, developed competences: CB3, CB4, CG01, CG02, CE010).

Laboratory lessons: In these lessons, computer tools will be used to state and solve problems related to the course. Work conducted in these lectures will be taken into account for the student's final grade (MD4, developed competences: CB3, CB4, CG01, CT02, CT04,CE10)

EVALUATION

Students will be evaluated as follows:

- There will be a final exam of a fundamentally practical nature with a 50% weighting on the final mark. In order to pass the course it is necessary to obtain a minimum qualification of 4 points (out of 10) in this exam. Students who do not reach this minimum qualification in the final exam will have a "failing" grade and their final qualification will not exceed 4 points. Students who do not pass the subject in the first call will have a new final exam on the day of the second call under the same conditions. (SE1, competences evaluated: CB3, CB4, CG01, CG02, CT02, CT04, CE010)

- The 30 % of the qualification corresponds to the computer laboratory classes. The laboratory grade will be obtained as a result of evaluating each practice and a final, individual, practical test of the same characteristics as the practices carried out, which will take place in the last practice session. The continuous evaluation of each practice (preparation 30% and completion 70%) will constitute 40% of the final laboratory note, while the remaining 60% will be obtained from the completion of the individual final test. In order to be able to take the final test, it is necessary to have attended the laboratory practices. It will be necessary to obtain a 4 out of 10 in this mark to be able to pass the course. For students who do not obtain a 4 or more attending the laboratories there will be two more convocations on the dates and times officially designated by the center for the official examination of the subject, after the theory exam. The mark of the laboratory exam obtained in this way will be 60% of the laboratory mark. It will be necessary to obtain at least a 4 out of 10. The remaining 40% will not be recoverable since it is obtained from the continuous evaluation of the laboratory sessions. For organizational reasons, teachers may require prior registration for this test, which would be announced well in advance. (SE2/SE3, competences evaluated: CB3, CB4, CG01, CG02, CT02, CT04, CE010)

- The 20 % of the grade is obtained by continuous student evaluation carried out through the use of assignments and online questionnaires that are done after theory classes. This part of the grade is not recoverable in the second call. Students who do not pass the subject in the first call will use in the second call the grade obtained in this part in the first call. (SE2/SE3, competences evaluated: CB1, CB2, CG01, CG05. CT03, CE01)

In all cases the evaluation system will be governed by the University of Valencia's regulations on grading and assessment for bachelor's degrees and master's degrees, which is available at:

http://www.uv.es/graus/normatives/2017_108_Reglament_avaluacio_qualificacio.pdf

REFERENCES

Basic

- John G. Proakis & Dimitris G. Manolakis. Tratamiento digital de señales. ISBN: 978-84-8322-347-5
- Emilio Soria Olivas & Marcelino Martínez Sober & Jose & Vicente Frances Villora & Gustavo Camps i Valls. Problemas de tratamiento digital de señales. Prentice-Hall.

Additional

- S. S. Soliman, M. A. Rodríguez Hernández, M. Srinath and A. Torres Suárez, Señales y Sistemas Continuos y Discretos. ,2 , última reimpr ed.Madrid etc.: Prentice Hall, 2000, pp. 542. ISBN:8483221543
- A. V. Oppenheim, S. H. Nawab and A. S. Willsky, Señales y Sistemas. ,2 ed.México etc.: Prentice-Hall Hispanoamericana, 1998, pp. 956. ISBN:970170116X
- H. P. Hsu, Schaum's Outline of Theory and Problems of Signals and Systems. New York etc.: McGraw-Hill, 1995, pp. 466. ISBN:0070306419