COURSE DATA

DATA SUBJECT

Code: 34892
Name: Digital signal processing
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1403 - Degree in Telematics Engineering	Escola Tècnica Superior d'Enginyeria	3	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1403 - Degree in Telematics Engineering	Digital communications	COMPULSORY

COORDINATION

BOTELLA MASCARELL CARMEN

SUMMARY

This course is part of the subject "Digital communications", being preceded by the subjects "Mathematical foundations of communications" and "Communication theory". It is assumed that the student is familiar with the mathematical tools needed (linear, algebra probability and stochastic processes, optimization, signals and linear systems) and with the basic concepts of the theory of communication (source, channel, modulation, coding and decoding). This course represents also a natural continuation of the course of signals and linear systems, where the general assumption is that signals, or inputs to the systems, are deterministic processes. In many real applications, however, it is more appropriate to model the signals as stochastic processes. This does not imply or mean that signals are completely random; they can in fact have much structure, but from the point of view of the design of systems, cannot be described in a deterministic manner. A classic example of such stochastic processes are noisy signals observed in any communication system. This course explores the major signal processing algorithms used in telecommunications systems, analyzing: a) their theoretical foundations, b) the design of different processing functional blocks, c) their application to problems found in practice (communications, voice and image), as well as the most important associated standards.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

It is recommended to have previously passed in this degree the areas of Mathematics, the subject of Signals and Linear Systems (of the matter of Signals, Systems and Telecommunication Services), the subjects corresponding to this same matter of Mathematical Foundations of Communications and Communications Theory (Digital Communications).

COMPETENCES / LEARNING OUTCOMES

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E1 - Ability to construct, exploit and manage telecommunication networks, services , processes and applications, understood as systems for the acquisition, transport, representation, processing, storage, management and presentation of multimedia information, from the perspective of telematics services.

E5 - Ability to follow the technological progress of transmission, commutation and proccess to improve the telemactic networks and services.

G1 - Ability to write, develop and sign projects in the field of Telecommunication Engineering aimed - according to the knowledge acquired in section 5 of CIN/352/2009 regulation - at the conception and the development or the exploitation of networks, services and applications of telecommunications and electronics.

G4 - Ability to solve problems with initiative, decision-making and creativity, and to communicate and transmit knowledge, abilities and skills, understanding the ethical and professional responsibility of the activity of a telecommunications technical engineer.

G5 - Knowledge to carry out measurements, calculations, assessments, evaluations, loss adjustments, studies, reports, task planning, and other analogous work in the specific field of telecommunications.

G6 - Ability in the handling of specifications, regulations and norms of compulsory compliance.

R1 - Ability for self-learning of new knowledge and techniques appropriate for the conception, development and exploitation of telecommunications systems and services.

R4 - Ability to analyze and specify the fundamental parameters of communication systems.

R5 - Ability to assess the advantages and drawbacks of different technological alternatives for the deployment and implementation of communications systems, from the point of view of signal space, perturbations and noise and analogue and digital modulation systems.

R8 - Ability to understand the mechanisms of propagation and transmission of electromagnetic and acoustic waves, and their corresponding transmitting and receiving devices.

DESCRIPTION OF CONTENTS

1. Introduction and motivation

Applications of statistical disgital signal processing. Review of basic concepts of signals and vectors.

2. Sampling and reconstruction of signals

Temporal and frequencial analysis of sampled signals: the sampling theorem. Aliasing. Reconstruction of sampled signals and interpolation types. A/D and D/A conversion. Digital processing of analog signals.

3. Discrete Fourier transform

The F.T. of discrete periodic signals (DFT). Discrete Fourier Series (DFS). Representation of aperiodic discrete signals (DTFT). Correlation and spectrum. Relatuionship among the different transforms. Properties and fundamental theorems. Representation in the frequency domain of linear time invariant discrete systems (LTI). DFT calculation with Matlab (Fast FT algorithm).

4. The Z transform

Definition and basic properties. The Z transform (ZT) of basic signals. Other properties of the ZT. Representation and analysis of discrete systems with the ZT. Inverse ZT. Resolution of difference equations using the ZT.

5. Digital filter design

Types and filter order. Butterworth filters. Basic design from specifications. Digital fiters: basic secifications. IIR and FIR filters. Design of digital filters based on a) Discretization of continuous filters b) windowing. Filtering structures and digital filter implementation.

6. Parameter estimation in discrete processes

Stochastic processes and linear systems, the problem of parameter estimation, MAP and ML estimation, quality of an estimator, rational models of processes AR, MA and ARMA.

7. Optimal filtering

Estimation based on cuadratic error, Wiener filtering in the frequency domain, Wiener filtering from the data, linear prediction, applications.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	30,00
Laboratory	20,00
Classroom practices	10,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	32,00
Independent study and work	0,00
Preparation of lessons	40,00
Preparation for assessment activities	18,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

1 / Presential work consisting of:

1.1 / Theory classes, which consist of the presentation and basic explanation of the corresponding matter. Periodically the lecturer will propose activities of short duration, which require the intervention of the students in order to confirm the understanding of the explained theory. (It develops competences G5, R4, R5, E1 and E5)

1.2 / Exercise classes, designed to solve problems of higher difficulty, either conceptual or temporal.(It develops competences G4 and R1)

1.3 / Laboratory classes designed to experimentally verify some of the most relevant issues seen in the classes of theory. (It develops competences G4, R1 and R4)

2 / Non-presencial work consisting of:

2.1 / Resolution and reporting exercises. These classes are meant to solve bulletins exercises proposed by the teacher and/or exposure in public of the resolution of some of them.(It develops competences G4, R1 and R4)

2.2 / Preparation for the examinations. (It develops competences R1 and R4)

2.3 / Preparation of the laboratory practice, for which the student must have read and assimilated the content of the practice bulletin, as well as having reviewed the relevant theory. (It develops competences E1 and E5)

3 / Tutorials individual and/or collective:

Certain individual unscheduled tutoring hours will be schaduled per week to which students may attend to clarify their doubts, as well as hours of collective scheduled tutoring for the clarification of the doubts raised during exercises classes.

EVALUATION

The fundamental learning outcomes expected from this course are essentially practical in nature and are measured by the degree to which the student has acquired the relevant skills. To this end, assessment will be based primarily on the resolution of practical problems simplified in the case of exams or proposed exercises.

The selected assessment system consists of the following components and weightings:

- Assessment of attendance and participation (up to 5% of the final grade)
- Attendance, completion, and evaluation of labs (up to 20% of the final grade). This 20% corresponds to 5% for the development and submission of lab reports, and the remaining 15% for a test related to the topics covered during the practical sessions.
- Individual resolution of proposed exercises (up to 15% of the final grade)

- Final exam (60% of the final grade)

For students who are unable to attend classes regularly, an alternative model is offered in which the evaluation of attendance and participation will be replaced by additional work with an equivalent total weighting.

In the second exam sitting, students may choose to be assessed under one of two options, which must be communicated to the course instructor before the final exam date:

Option A) Same weightings as in the first sitting, repeating only the final exam and/or lab test.

Option B) Final exam (80% of the final grade) + Practical work (20% of the final grade, of which, the 5% related to attendance and completition is not recoverable).

The minimum requirement to pass the course is the equivalent of 4 out of 10 in the final exam. The remaining assessable items are not subject to a minimum passing score. In the second call, option A, the resolution of proposed exercises is a not recoverable item.

The attendance to the laboratory classes will be mandatory for the evaluation of the same. Failure to attend more than one session without justification will result in a zero in the laboratory part of the evaluation. Students who, for justified reasons, cannot systematically attend the laboratory sessions, must inform the professors before the beginning of the sessions and, if necessary, an alternative evaluation will be agreed upon.

Any clear case of copying or plagiarism in an activity that is part of the evaluation will result in a failure of the course, and the student will be subject to the appropriate disciplinary procedures outlined in the PROTOCOL FOR ACTION AGAINST FRAUDULENT PRACTICES AT THE UNIVERSITY OF OF VALENCIA (ACGUV 123/2020).

In any case, the evaluation system will comply with the provisions of the "Reglament d' Avaluació i Qualificació de la Universitat de València per a Graus i Màsters" (https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?accion=inicio&idEdictoSeleccionado=5639)

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