COURSE DATA

DATA SUBJECT

Code: 44278
Name: Digital filtering
Cycle: Master's Degree / Doctorate
ECTS Credits: 3
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
2199 - Master's Degree in Electronic Engineering	Escola Tècnica Superior d'Enginyeria	1	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
2199 - Master's Degree in Electronic Engineering	Digital signal processing	COMPULSORY

COORDINATION

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SUMMARY

In this course you will be disclosed to the student optimal and adaptive signal processing. This type of processing is critical in time-variant environments where the system must optimize an a priori defined criteria. Major adaptive algorithms and their different structures and applications are given. The course ends with the description of the Kalman filter.

This is a mandatory course, which is taught in the first semester of the Master in Electronic Engineering. The total teaching load is 3 ECTS. The workload for the student is 75 hours over the semester, of which 30 are on-site and 45 correspond to individual work.

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 that students know the basic theory of digital signal processing in addition to base statistics and probability. Otherwise, they will be provided with a series of tutorials to follow the course.

COMPETENCES / LEARNING OUTCOMES

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Capacidad de analizar, especificar y diseñar sistemas de tratamiento digital de señales desde su concepción hasta su implementación en sistemas hardware de tiempo real..

Capacidad para el modelado matemático, cálculo y simulación en todos los ámbitos relacionados con la Ingeniería Electrónica y campos multidisciplinares afines. En especial los de tratamiento de la señal, sistemas digitales y de comunicaciones y electrónica industrial.

Capacidad para proyectar, calcular y diseñar productos, procesos e instalaciones en todos los ámbitos de la Ingeniería Electrónica y en particular los de tratamiento de la señal, sistemas digitales y de comunicaciones y electrónica industrial.

Conocer las técnicas avanzadas de análisis de datos.

Demostrar una comprensión sistemática de un campo de estudio y el dominio de las habilidades.

Diseñar un sistema, componente o proceso que cumpla unas especificaciones desde diferentes puntos de vista: electrónico, económico, social, ético y medioambiental.

Realizar un análisis crítico, evaluación y síntesis de ideas nuevas y complejas.

Ser capaz de fomentar, en contextos académicos y profesionales, el avance tecnológico, social o cultural dentro de una sociedad basada en el conocimiento.

Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.

Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.

Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.

Students should demonstrate self-directed learning skills for continued academic growth.

Take into account the economic and social context in engineering solutions, be aware of diversity and multiculturalism and ensure sustainability and respect for human rights and equality between men and women.

DESCRIPTION OF CONTENTS

1. Optimal digital filtering

UNIT 1
1.1 Optimal Linear Estimation.
1.2 Normal equations. Solution.
1.3 Optimal FIR Filters.
1.4 Linear Prediction (backward / forward).
1.5 Optimal IIR filters.

2. Adaptive Filtering

UNIT 2
2.1 Problems of optimal filters.
2.2 adaptive filters. LMS structures.
2.3 Variants of the most widespread LMS.
2.4 Variations in the frequency domain.
2.5 Volterra filters. Median filters.
2.6 RLS.
2.7 Kalman Filter.
2.8 Applications.
2.9 Other types of advanced digital filtering.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	15,00
Laboratory	15,00
Total hours	**30,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	15,00
Preparation of lessons	15,00
Preparation for assessment activities	5,00
Resolution of case studies	10,00
Total hours	**45,00**

TEACHING METHODOLOGY

The teaching methods employed in the development of the course are the following:

a) Theoretical activities.

Expository development of matter with the student's participation in the resolution of specific issues.

b) Practical activities.

Solving practical problems.

c) Student's personal work.

Description: Out-of-classroom development of problems as well as the preparation of classes and exams (study). This task will be performed individually and try to promote self-employment.

We will use e-learning platforms (Aula Virtual) to support communication with students; Aula Virtual will be used to access the course materials used in class, as well as solving problems and exercises.

EVALUATION

The evaluation of the subject will consist of a written test, with theoretical and practical questions, and laboratory.

REFERENCES

- Fundamental of Adaptive Filtering, Ali Sayed, Wiley, 2003.
- Adaptive Filter Theory, Simon Haykin, Prentice Hall, 1996.
- Tratamiento Digital de Señales. Principios Algoritmos y Aplicaciones. / John G. Proakis, Dimitris G. Manolakis, Prentice Hall, 2008.
- Introduction to Random Signals and Applied Kalman Filtering. Rober Grover, Patrick Hwang, Wiley 1992.
- Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modelling, Adaptive Filtering & Array Processing. D. Manolakis, V.K. Ingle, S.M. Kogon. Artech House 2005.
- Adaptive Signal Processing, Bernard Widrow, Samuel D. Stearns, Prentice Hall, 1985.

- Advanced Digital Signal Processing, John G. Proakis, Dimitris G. Manolakis, McMillan, 1992.