COURSE DATA

DATA SUBJECT

Code: 44277
Name: Signal processing
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

LAPARRA PEREZ-MUELAS VALERO

SUMMARY

This subject provides the student with notions of different essential aspects in advanced statistical signal processing. The content of the subject covers three blocks: 1) introduction to probability theory and random variables; 2) analysis and decomposition of signals; 3) advanced signal processing techniques. The theoretical part is complemented by a series of practical applications of these techniques in real problems of different areas of knowledge.

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 should have a solid background on digital signal processing, and some notions on statistics and probability theory. Otherwise, basic material and tutorials will be provided to achieve the needed level 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. Introduction to probability theory and random variables

Probability, statistics, stochastic processes and noise description. Information theory.

2. Analysis and decomposition of signals

Signal preprocessing. Selection of features. Decomposition with fixed transforms (Fourier and Wavelets). Decomposition with adaptive transforms (PCA and ICA).

3. Advanced signal processing techniques

Classification and regression. Machine learning. Introduction to deep learning. Hardware for advanced signal processing.

4. Laboratory

Lab Class 1: Random processes: Estimates. Dependency measures.

Lab Class 2. Signal preprocessing. Selection and extraction of characteristics.

Lab Class 3. Adaptive transforms. Fixed transforms.

Lab Class 4. Signal processing with deep learning.

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:

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: Performing outside the classroom to issues and 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 (LMS) to support communication with students. Through it the student will have access to 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

- Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modelling, Adaptive Filtering & Array Processing. D. Manolakis, V.K. Ingle, S.M. Kogon. Artech House 2005.
- An Introduction To Statistical Signal Processing / Robert M. Gray, Lee D. Davisson, Cambridge University Press, 2004.
- Probability and Random Processes with Applications to Signal Processing. Henry Stark, John W. Woods, Prentice Hall, 2002.
- Introduction to random processes, William A. Gardner, 2nd Ed. McGraw-Hill, 1990.
- H. Stark and J.W. Woods. Probability and random processes with applications to Signal Processing. Prentices Hall
- Fundamentals of Statistical Signal Processing, Steven M. Kay, Prentice Hall, 1998.

- A Wavelet Tour of Signal Processing, Stephane Mallat, Academic Press, 1999.
- P. Billingsley. Probability and Measure. Wiley & Sons, 1995. 3rd Edition.
- Advanced Digital Signal Processing, John G. Proakis, MacMillan 1992.