

DIGITAL SIGNAL PROCESSING

20019 - DIGITAL SIGNAL PROCESSING (2024-25)

General

Code: 20019

Lecturer responsible:

GIMENO NIEVES, ENCARNACION

Credits ECTS:

6,00

Theoretical credits:

1,20

Practical credits:

1,20

Distance-base hours:

3,60

Departments involved

- **Dept:** PHYSICS, ENGINEERING SYSTEMS AND SIGNAL THEORY

Area: SIGNAL THEORY AND COMMUNICATIONS

Theoretical credits: 1,2

Practical credits: 1,2

This Dept. is responsible for the course.

This Dept. is responsible for the final mark record.

Study programmes where this course is taught

- [DEGREE IN SOUND AND IMAGE IN TELECOMMUNICATION ENGINEERING](#)
Course type: COMPULSORY (Year: 2)
- [UNIVERSITY MASTER'S DEGREE IN TELECOMMUNICATION ENGINEERING](#)
Course type: COMPLEMENTARY TRAINING (Year: 9)
Course type: COMPLEMENTARY TRAINING (Year: 1)

Competencies and objectives

Course context for academic year 2024-25

The Digital Signal Processing subject will provide students the assimilation of methods and strategies for analyzing discrete signals and designing digital filters. The knowledge imparted will enable students to recognize and use concepts related to signal processing in general and, specifically, to image and audio digital processing.

The course consists of different activities to be carried out as theory, problem solving practice and computer practice classes. In all activities it will be necessary both individual work and group work for successful achievement of the objectives of the course.

The activities related to theory and problem solving practice classes will be taught in the theory lecture room, and computer practice classes will be taught in one of the laboratories of Polytechnic University College.

RECOMMENDATIONS

Before you enroll in the course of Digital Signal Processing you have to study the following subjects:

- FOUNDATION MATHEMATICS
- MATHEMATICS II
- SIGNALS AND SYSTEMS

UA Basic Transversal Competences

- **CT10** : Capacitat d'afrontar, projectar i resoldre problemes reals demanats per la societat en l'àmbit de l'enginyeria.
- **CT12** : Capacitat d'assimilar l'evolució contínua de la tecnologia en l'àmbit de desenvolupament professional i adaptar-s'hi.
- **CT13** : Capacitat d'adoptar el mètode científic en el plantejament i realització de treballs diversos tant en l'àmbit acadèmic com en el professional.

Specific Competences:>>Basic

- **B1** : Capacitat per a resoldre els problemes matemàtics que es puguin plantejar en l'enginyeria. Aptitud per a aplicar els coneixements sobre àlgebra lineal, geometria, geometria diferencial, càlcul diferencial i integral, equacions diferencials i en derivades parcials, mètodes numèrics, algorísmia numèrica, estadística i optimització.
- **B2** : Coneixements bàsics sobre l'ús i programació dels ordinadors, sistemes operatius, bases de dades i programes informàtics amb aplicació en enginyeria.

Basic Transversal Competences

- **CT2** : Que els estudiants sàprien aplicar els seus coneixements al seu treball o vocació d'una forma professional i posseïsquen les competències que solen demostrar-se per mitjà de l'elaboració i defensa d'arguments i la resolució de problemes dins de la seua àrea d'estudi.
- **CT5** : Que els estudiants hagen desenvolupat aquelles habilitats d'aprenentatge necessàries per a emprendre estudis posteriors amb un alt grau d'autonomia.

**Specific Competences: >>
Competences Common to the
Telecommunications Branch**

- **C4** : Capacitat d'analitzar i especificar els paràmetres fonamentals d'un sistema de comunicacions.

**Specific Competences: >>
Competences Specific to Sound and
Image**

- **E1** : Capacitat de construir, explotar i gestionar serveis i aplicacions de telecomunicacions, enteses aquestes com a sistemes de captació, tractament analògic i digital, codificació, transport, representació, processament, emmagatzematge, reproducció, gestió i presentació de serveis audiovisuals i informació multimèdia.

Exclusive skill taught in this course

No data

Learning outcomes (Training objectives)

No data

Specific objectives stated by the academic staff for academic year 2024-25

Understanding and applying the Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT).

Understanding, analyzing, designing and implementing FIR and IIR digital filters.

Understanding and performing adaptive filters.

Understanding and applying spectral analysis of deterministic and random signals.

Content and bibliography

Content for academic year 2024-25

UNIT 1: Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT).

1.1 Introduction.

1.2 Definition and properties of DFT.

1.3 Implementation of LTI filters by using DFT.

1.4 Fast Fourier transform.

UNIT 2: Digital filter design.

2.1 Introduction.

2.2 FIR filter design.

2.3 IIR filter design from analogical filters.

2.4 Frequency transformations.

2.5 Direct digital filter design.

UNIT 3: Digital filter implementation.

3.1 Introduction.

3.2 Digital filters implementation forms.

3.3 Effects of quantization on digital filtering.

UNIT 4: Adaptive filters.

4.1 Introduction.

4.2 Optimal Filtering.

4.3 LMS algorithm.

4.4 Applications.

UNIT 5: Spectral analysis.

5.1 Introduction.

5.2 Spectral analysis of deterministic signals.

5.3 Non-parametric spectral analysis.

Related links

No data

Tratamiento digital de la señal : teoría y aplicaciones

Author(s): Albiol Colomer, Antonio

Issue: Valencia : Universidad Politécnica de Valencia, 2007;

ISBN: 978-84-8363-180-5

Category: Sin especificar

Adaptive filter theory

Author(s): Haykin, Simon

Issue: - : Prentice Hall, 2002;

ISBN: 978-0130901262

Category: Sin especificar

Digital signal processing : a practical approach

Author(s): Ifeachor, Emmanuel C.

Issue: Harlow : Prentice Hall, 2002;

ISBN: 0-201-59619-9

Category: Sin especificar

Modern spectral estimation : theory and application

Author(s): Kay, Steven M.

Issue: - : Prentice Hall, 1988;

ISBN: 978-0130151599

Category: Sin especificar

Digital spectral analysis : with applications

Author(s): Marple, S. Lawrence

Issue: - : Prentice Hall, 1987;

ISBN: 978-0132141499

Category: Sin especificar

Discrete-time signal processing

Author(s): Oppenheim, Alan V.

Issue: Upper Saddle River, N.J. : Prentice-Hall, cop.1999;

ISBN: 0-13-754920-2

Category: Sin especificar

Señales y sistemas

Author(s): Oppenheim, Alan V.; Willsky, Alan S.

Issue: México : Prentice-Hall Hispanoamericana, 1998;

ISBN: 978-970-17-0116-4

Category: Sin especificar

Tratamiento digital de señales : principios, algoritmos y aplicaciones

Author(s): PROAKIS, John G. ; MANOLAKIS, Dimitris G.

Issue: Madrid : Prentice Hall, 1997;

ISBN: 84-8322-000-8

Category: Sin especificar

Adaptive signal processing

Author(s): WIDROW, Bernard; STEARNS, Peter

Issue: - : Prentice Hall, 1985;

ISBN: 978-0130040299

Category: Sin especificar

Assessment

Assessment procedures and criteria 2024-25

A minimum mark of 3.5 in the average of the exams about computer practicals and a minimum mark of 3.5 in the final exam are required in order to pass the course in June. If these limits are exceeded, the final mark in the subject is calculated as follows:

FINAL MARK = 0.05 * (Cross-disciplinary competences) + 0.20 * (Exams about computer practicals) + 0.20 * (Problem practicals) + 0.20 * (Exams about theory) + 0.35 * (Final exam)

There will exist the chance of recovering 95% of the subject mark in the extraordinary exams in July and December, by solving an exam about theory, problem practicals and computer practicals. The non-recoverable 5% corresponds to the part of Cross-disciplinary competences.

The detection of copy or plagiarism will be marked "0" in the corresponding test. The Department and the Polytechnic School or Faculty will be informed about this incident. The reiteration in the conduct in this or other subject will entail the notification to the corresponding vice-rector of the faults committed so that they study the case and sanction according to the legislation.

Description	Criteria	Type	Weighting system
Cross-disciplinary competences	It will be evaluated: - Punctuality. - Compliance with deadlines. - Writing.	ACTIVITIES OF EVALUATION DURING THE SEMESTER	5
Computer practicals	Two exams about computer practicals. Planned performing weeks: 7 and 16.	ACTIVITIES OF EVALUATION DURING THE SEMESTER	20
Problem practicals	Delivery of solved problems (4 deliveries). Via Virtual Campus on PDF format. Planned delivery weeks: 4, 8, 13 and 15.	ACTIVITIES OF EVALUATION DURING THE SEMESTER	20
Theory	Two unit exams. Planned performing weeks: 7 and 14.	ACTIVITIES OF EVALUATION DURING THE SEMESTER	20
Final exam	Written exam consisting of questions about theory and theoretical and practical problems.	FINAL TEST	35

Official exam dates for academic year 2024-25

Exam session	Date	Time	Group - Classroom(s) allocated	Comments
(C3) Periodo ordinario para asignaturas de segundo semestre y anuales	05/06/2025			Teoría

(C4) Pruebas
extraordinarias para
asignaturas de grado y
máster

04/07/2025

Ex. Teoría
en
Laboratorio.

Academic staff



GIMENO NIEVES, ENCARNACION

Lecturer responsible

THEORY CLASS: Groups: 1 , 2

PROBLEM PRACTICALS / WORKSHOP: Groups: 1 , 2

COMPUTER PRACTICALS: Groups: 2



GONZALEZ RUIZ, JUAN DE DIOS

COMPUTER PRACTICALS: Groups: 1



PALOMARES LORENZO, FERNANDO

COMPUTER PRACTICALS: Groups: 3

Groups

THEORY CLASS

Group	Semester	Morning or afternoon session	Language	No. of enrolled students	
Gr. 1 (THEORY CLASS) : 1 (ARA)	2S	Morning	English	5	▪ Allowed DEGREE IN SOUND AND IMAGE IN TELECOMMUNICATION ENGINEERING
Gr. 2 (THEORY CLASS) : 2	2S	Morning	Spanish	38	

PROBLEM PRACTICALS / WORKSHOP





Group	Semester	Morning or afternoon session	Language	No. of enrolled students	
Gr. 1 (PROBLEM PRACTICALS / WORKSHOP) : 1 (ARA)	2S	Afternoon	English	5	▪ Allowed DEGREE IN SOUND AND IMAGE IN TELECOMMUNICATION ENGINEERING
Gr. 2 (PROBLEM PRACTICALS / WORKSHOP) : 2	2S	Morning	Spanish	38	

COMPUTER PRACTICALS



Group	Semester	Morning or afternoon session	Language	No. of enrolled students	
Gr. 1 (COMPUTER PRACTICALS) : 1 (ARA)	2S	Afternoon	English	5	▪ Allowed DEGREE IN SOUND AND IMAGE IN TELECOMMUNICATION ENGINEERING
Gr. 2 (COMPUTER PRACTICALS) : 2	2S	Morning	Spanish	19	
Gr. 3 (COMPUTER PRACTICALS) : 3	2S	Morning	Spanish	19	

Timetables









THEORY CLASS

Group	Start date	End date	Day	Start time	End time	Lecture room
1	27/01/2025	23/05/2025	LUN	14:30	16:00	0016P2008 
1	27/01/2025	23/05/2025	MAR	14:30	15:00	0016P2008 
2	27/01/2025	23/05/2025	LUN	12:30	14:00	A2/C02 
2	27/01/2025	23/05/2025	JUE	11:00	11:30	A2/C02 

PROBLEM PRACTICALS / WORKSHOP

Group	Start date	End date	Day	Start time	End time	Lecture room
1	27/01/2025	23/05/2025	MAR	15:00	16:00	0016P2008 
2	27/01/2025	23/05/2025	JUE	11:30	12:30	A2/C02 

COMPUTER PRACTICALS

Group	Start date	End date	Day	Start time	End time	Lecture room
1	12/02/2025	12/03/2025	MIE	19:30	21:00	0013PB008 
1	02/04/2025	09/04/2025	MIE	19:30	21:00	0013PB008 
1	07/05/2025	21/05/2025	MIE	19:30	21:00	0013PB008 
2	13/02/2025	13/03/2025	JUE	08:30	10:00	0016P2003 
2	03/04/2025	10/04/2025	JUE	08:30	10:00	0016P2003 
2	08/05/2025	22/05/2025	JUE	08:30	10:00	0016P2003 
3	11/02/2025	11/03/2025	MAR	12:00	13:30	0013PB008 
3	01/04/2025	08/04/2025	MAR	12:00	13:30	0013PB008 
3	06/05/2025	20/05/2025	MAR	12:00	13:30	0013PB008 