ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

615001057 - Digital Signal Processing

DEGREE PROGRAMME

61CI - Grado En Ingenieria De Computadores

ACADEMIC YEAR & SEMESTER

2023/24 - Semester 2

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	615001057 - Digital Signal Processing
No of credits	6 ECTS
Type	Optional
Academic year ot the programme	Third year
Semester of tuition	Semester 6
Tuition period	February-June
Tuition languages	English
Degree programme	61CI - Grado en Ingenieria de Computadores
Centre	61 - Escuela Tecnica Superior De Ingenieria De Sistemas Informaticos
Academic year	2023-24

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Juan Jose Martin Sotoca (Subject coordinator)	2106	juan.martin.sotoca@upm.es	Sin horario. Serán publicadas en moodle.
Luis Miguel Pozo Coronado	2004	lm.pozo@upm.es	Sin horario. Serán publicadas en moodle.

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

- Analisis Matematico

- Algebra

- Probabilidad Y Estadistica

3.2. Other recommended learning outcomes

The subject - other recommended learning outcomes, are not defined.

4. Skills and learning outcomes *

4.1. Skills to be learned

CT12 - Uso de tecnologías de la información y las comunicaciones : Usar las tecnologías de la información y las comunicaciones en el ámbito de la ingeniería.

OB08 - Conocimiento de las materias básicas y tecnológicas, que capaciten para el aprendizaje y desarrollo de nuevos métodos y tecnologías, así como las que les doten de una gran versatilidad para adaptarse a las nuevas situaciones.

OB09 - Capacidad para resolver problemas con iniciativa, toma de decisiones, autonomía y creatividad. Capacidad para saber comunicar y transmitir los conocimientos, habilidades y destrezas de la profesión de Ingeniero Técnico en Informática.

4.2. Learning outcomes

RA491 - Aplica métodos de DataScience en analisis de patrones temporales

RA391 - Calcula y aplica transformadas z para el análisisi y control de sistemas lineales en tiempo discreto.

RA37 - Utiliza adecuadamente software matemático en la resolución de problemas.

RA390 - Maneja el algoritmo de transformada rápida para el cálculo eficiente de transformadas discretas de Fourier y convoluciones.

RA489 - Representa y analiza la voz en dominios de tiempo y frecuencia

RA490 - Diseña y evalua algoritmos para el procesado de la voz

RA389 - Utiliza adecuadamente la transformada de Fourier para el análisis de señales

RA403 - Maneja los elementos básicos del tratamiento de señales discretas

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

With this subject, we intend to cover the mathematical foundations of Digital Signal Processing. The mathematical tools thus presented can also be applied in other fields, such as Systems Control and Image Processing. Matlab shall be the software used in the learning and evaluation activities.

Classes will be in English.

5.2. Syllabus

1. Introduction to Digital Signal Processing

2. Sinusoids and spectrum representation

3. Sampling and aliasing

4. FIR Filters and its frequency response

5. Discrete-time Fourier transform

6. Discrete Fourier Transform and Fast Fourier transform

7. z-transform

8. IIR Filters

9. Additional subjects: Adaptive filtering, voice analysis

6. Schedule

6.1. Subject schedule*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1	**Sesión teórica** Duration: 02:00 Lecture	**Sesión de laboratorio** Duration: 02:00 Laboratory assignments		
2	**Sesión teórica** Duration: 02:00 Lecture	**Sesión de laboratorio** Duration: 02:00 Laboratory assignments		
3	**Sesión teórica** Duration: 02:00 Lecture	**Sesión de laboratorio** Duration: 02:00 Laboratory assignments		**Lab assignment** Group work Continuous assessment Not Presential Duration: 06:00 **Moodle questionnaire** Online test Continuous assessment Not Presential Duration: 00:30
4	**Sesión teórica** Duration: 02:00 Lecture	**Sesión de laboratorio** Duration: 02:00 Laboratory assignments		
5	**Sesión teórica** Duration: 02:00 Lecture	**Sesión de laboratorio** Duration: 02:00 Laboratory assignments		
6	**Sesión teórica** Duration: 02:00 Lecture	**Sesión de laboratorio** Duration: 02:00 Laboratory assignments		**Lab assignment** Group work Continuous assessment Not Presential Duration: 06:00 **Moodle questionnaire** Online test Continuous assessment Not Presential Duration: 00:30
7	**Sesión teórica** Duration: 02:00 Lecture	**Sesión de laboratorio** Duration: 02:00 Laboratory assignments		
8	**Sesión teórica** Duration: 02:00 Lecture	**Sesión de laboratorio** Duration: 02:00 Laboratory assignments		**Theory test** Written test Continuous assessment Presential Duration: 01:00 **Lab test** Problem-solving test Continuous assessment Presential Duration: 00:45

9	**Sesión teórica** Duration: 02:00 Lecture	**Sesión de laboratorio** Duration: 02:00 Laboratory assignments		**Lab assignment** Group work Continuous assessment Not Presential Duration: 06:00 **Moodle questionnaire** Online test Continuous assessment Not Presential Duration: 00:30
10	**Sesión teórica** Duration: 02:00 Lecture	**Sesión de laboratorio** Duration: 02:00 Laboratory assignments		
11	**Sesión teórica** Duration: 02:00 Lecture	**Sesión de laboratorio** Duration: 02:00 Laboratory assignments		
12	**Sesión teórica** Duration: 02:00 Lecture	**Sesión de laboratorio** Duration: 02:00 Laboratory assignments		**Lab assignment** Group work Continuous assessment Not Presential Duration: 06:00 **Moodle questionnaire** Online test Continuous assessment Not Presential Duration: 00:30
13	**Sesión teórica** Duration: 02:00 Lecture	**Sesión de laboratorio** Duration: 02:00 Laboratory assignments		
14	**Sesión teórica** Duration: 02:00 Lecture	**Sesión de laboratorio** Duration: 02:00 Laboratory assignments		
15	**Sesión teórica** Duration: 02:00 Lecture	**Sesión de laboratorio** Duration: 02:00 Laboratory assignments		**Lab assignment** Group work Continuous assessment Not Presential Duration: 06:00 **Moodle questionnaire** Online test Continuous assessment Not Presential Duration: 00:30
16				
17				**Theory test** Written test Continuous assessment Presential Duration: 01:00 **Lab test** Problem-solving test Continuous assessment Presential Duration: 00:45 **Theory test** Written test Final examination

				Presential Duration: 01:30 **Lab test** Problem-solving test Final examination Presential Duration: 01:30 **Lab assignments** Individual work Final examination Not Presential Duration: 30:00

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

* The schedule is based on an a priori planning of the subject; it might be modified during the academic year, especially considering the COVID19 evolution.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
3	Lab assignment	Group work	No Presential	06:00	10%	/ 10	CT12 OB08 OB09
3	Moodle questionnaire	Online test	No Presential	00:30	2%	/ 10	OB08
6	Lab assignment	Group work	No Presential	06:00	10%	/ 10	CT12 OB08 OB09
6	Moodle questionnaire	Online test	No Presential	00:30	2%	/ 10	OB08
8	Theory test	Written test	Face-to-face	01:00	15%	/ 10	OB08 OB09
8	Lab test	Problem-solving test	Face-to-face	00:45	5%	/ 10	CT12 OB08 OB09
9	Lab assignment	Group work	No Presential	06:00	10%	/ 10	CT12 OB08 OB09
9	Moodle questionnaire	Online test	No Presential	00:30	2%	/ 10	OB08
12	Lab assignment	Group work	No Presential	06:00	10%	/ 10	CT12 OB08 OB09
12	Moodle questionnaire	Online test	No Presential	00:30	2%	/ 10	OB08
15	Lab assignment	Group work	No Presential	06:00	10%	/ 10	CT12 OB08 OB09
15	Moodle questionnaire	Online test	No Presential	00:30	2%	/ 10	OB08
17	Theory test	Written test	Face-to-face	01:00	15%	/ 10	OB08 OB09
17	Lab test	Problem-solving test	Face-to-face	00:45	5%	/ 10	CT12 OB08 OB09

7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Theory test	Written test	Face-to-face	01:30	40%	/ 10	OB08 OB09
17	Lab test	Problem-solving test	Face-to-face	01:30	10%	/ 10	CT12 OB08 OB09
17	Lab assignments	Individual work	No Presential	30:00	50%	/ 10	CT12 OB08 OB09

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Lab test	Problem-solving test	Face-to-face	01:30	10%	/ 10	CT12 OB08 OB09
Theory test	Written test	Face-to-face	01:30	40%	/ 10	OB08 OB09
Lab assigments	Individual work	Face-to-face	30:00	50%	/ 10	CT12 OB08 OB09

7.2. Assessment criteria

Progressive evaluation consists of theory (40 %) and lab (60%) activities.

Theory activities include five online questionnaires to be answered using the moodle platform. The account for 10% of the final grade. The are also two written tests, each of one weighing 15% of the final grade. The first written test and the online questionnaires can be taken again in the date of the second written test, by taking a global theory test, which would account for 40 % of the final grade.

Lab activities consist of five lab assignments, that can be done individually or in pairs and account for 10 % of the final grade each, and two lab tests, that must be taken individually and have a weight of 5 % each. It is possible to recover from a failure in the first lab test in the date of the second lab test, by taking a global lab test that accounts for 10 % of the final grade.

In case of choosing evaluation by final test only, the student will have to take the global theory (40 %) and lab (10 %) tests, and also produce the five lab assignments (50 %) on the test day.

Extraordinary evaluation will also consist on the realization of the global theory (40 %) and lab (10 %) tests, and also producing the five lab assignments (50 %) on the test day.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
McCLELLAN, J; SCHAFER, R; YODER, M: DSP First. Pearson, 2017.	Bibliography	Textbook.
BRIGHAM, E.O.: The fast Fourier transform and its applications. Prentice-Hall, 1988.	Bibliography	Supplementary textbook
CARTWRIGHT, M.: Fourier methods for mathematicians, scientists and engineers. Ellis Horwood, 1990.	Bibliography	Supplementary textbook
OPPENHEIN, A.V.; SCHAFER, R.W. Tratamiento de señales en tiempo discreto. Prentice-Hall, 2000	Bibliography	Supplementary textbook
OPPENHEIN, A.V; WILLSKY, A.S.; HAMID, S. Signals and systems. Prentice-Hall, 1996.	Bibliography	Supplementary textbook
Moodle: https://moodle.upm.es/titulaciones/oficiales	Web resource	Plataforma de aprendizaje on line. Información, actividades y material de apoyo.
Digital Signal Processing. Markus Kuhn (U. of Cambridge) (2009)	Web resource	Online course, available in http://www.cl.cam.ac.uk/teaching/0910/DSP/

Lab Equipment	Equipment	Personal Computers
Matlab	Equipment	Mathematical Software with UPM license.

9. Other information

9.1. Other information about the subject

This subject is taught in English.