Course guide
330236 - PDS - Digital Signal Processing

Last modified: 27/05/2026

Unit in charge: Manresa School of Engineering
Teaching unit: 750 - EMIT - Department of Mining, Industrial and ICT Engineering.

Degree: BACHELOR'S DEGREE IN ICT SYSTEMS ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2026 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Bonet Dalmau, Jordi

Others: Moncunill Geniz, Francisco Javier

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Understanding and mastery of the basic concepts of linear systems and related functions and transforms, theory of electrical circuits, electronic circuits, physical principle of semiconductors and logic families, electronic and photonic devices, and their application for solving problems of l 'engineering
2. (ENG) El coneixement de les principals tècniques analògiques i digitals de caracterització i tractament de senyals i els principis i les tècniques que permeten la seva transmissió a distància.
3. The ability to define, analyze, design and evaluate communication circuits and systems, as well as knowledge of the principles and subsystems involved in communication systems via radio and optical signals.
4. Knowledge and ability to use existing tools and instrumentation for the analysis, design, development and verification of electronic, computer and communications systems.
5. The ability to perform the typical activities of the degree, taking into account the corresponding standards, rules and regulations.

Transversal:
6. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
7. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.
8. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

TEACHING METHODOLOGY

The subject consists of face-to-face activities consisting of 2 hours per week in the classroom (large group) and 2 hours per week in the laboratory (small group).
The student carries out learning through various mechanisms. In the lectures and participative classes in the classroom the contents of the subject are presented and the interaction between students and teacher is facilitated. Individual / group personal work activities are also proposed that should contribute to the understanding of the subject.
In the classes in the laboratory, the students carry out a preliminary work that helps to put in context the work that is intended to be carried out in the laboratory. The laboratory activity itself is developed in groups of two students and allows experimentation with certain aspects developed in the subject. The writing of the memory and the interaction with the teacher in the laboratory allows working on the oral and written communication skills.
In a timely manner, nomenclature is introduced in English to progressively initiate the student in learning this language.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course the student body:
- Understand and apply the main techniques of digital signal processing. Design basic digital filters.
- Understand the principles and subsystems involved in signal processing systems.
- Understand the principles of sampling and signal quantization.
- Carry out work individually and as a team and present it collectively, and search for information for this purpose.
- Become familiar with general software tools and apply them to digital signal processing.
- Implement filters on microcontrollers and FPGAs.

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	20.00
Self study	90,0	60.00
Hours small group	30,0	20.00

Total learning time: 150 h

CONTENTS

Content Title 1: Introduction to digital Signal Processing

Description:
1. Background: Signals and systems
2. Historical perspective
3. Digital signals and systems
4. Basic sequences and operations
5. A/D and D/A conversion

Related activities:
A1, A2, A3, A4 and A5

Full-or-part-time: 12h
Theory classes: 2h
Self study : 10h

Content Title 2: Sampling and quantification

Description:
1. Sampling of continuous-time signals
2. Quantization
3. Repercussions of the sampling theorem: aliasing and subsampling.

Full-or-part-time: 28h
Theory classes: 4h
Laboratory classes: 4h
Self study : 20h

Content Title 3: Z-transform

Description:
1. Classification of systems
2. Z-transform
3. Properties of Z-transform
4. Sinusoidal steady state response.

Related activities:
A1, A2, A3, A4 and A5

Full-or-part-time: 36h
Theory classes: 8h
Laboratory classes: 8h
Self study : 20h

Content Title 4: Frequency Response

Description:
1. Frequency response
2. Elementary filter design
3. FIR and IIR filters

Related activities:
A1, A2, A3, A4 and A5

Full-or-part-time: 36h
Theory classes: 8h
Laboratory classes: 8h
Self study : 20h

Content Title 5: The discrete Fourier transform

Description:
1. Signals in the frequency domain
2. Discretization of FT
3. The DFT. Relationship with other transforms
4. Signal filtering

Related activities:
A1, A2, A3, A4 and A5

Full-or-part-time: 38h
Theory classes: 8h
Laboratory classes: 10h
Self study : 20h

ACTIVITIES

TITLE OF ACTIVITY 1: LECTURES WITH EXERCISES

Description:
Face-to-face sessions focused on understanding the subject content, completing exercises and assigning new exercises that will lead to new content.

Specific objectives:
At the end of the course the student body:
- You will know and be able to apply the main digital signal processing techniques.
- You will be able to design basic digital filters.
- Know the principles and subsystems involved in signal processing systems.
- You will know the principles of signal sampling and quantification.

Material:
Recommended bibliography
Published teaching material

Full-or-part-time: 27h
Theory classes: 27h

TITLE OF ACTIVITY 2: INDEPENDENT STUDY

Description:
Independent study consists of studying to understand and solidify knowledge, vocabulary and techniques either individually or in a group.

Specific objectives:
At the end of the course the student body:
- You will know and be able to apply the main digital signal processing techniques.
- You will be able to design basic digital filters.
- Know the principles and subsystems involved in signal processing systems.
- You will know the principles of signal sampling and quantification.

Material:
Recommended bibliography
Published teaching material

Full-or-part-time: 20h
Self study: 20h

TITLE OF ACTIVITY 3: LABORATORY SESSIONS

Description:
The sessions will be conducted at the university laboratories. If the practical worksheet includes a preliminary study, it must be delivered by the corresponding deadline before doing the laboratory practical. In the laboratory, the results of this preliminary study are compared and contrasted with the experimental results of the assembly performed. Throughout the lab session, students must explain the differences between the theoretical and experimental results, propose solutions and redesign or propose new experiments, where appropriate.

Specific objectives:
At the end of the course the student body:
- You will know and be able to apply the main digital signal processing techniques.
- You will be able to design basic digital filters.
- Know the principles and subsystems involved in signal processing systems.
- You will know the principles of signal sampling and quantification.
- You will know general purpose software tools and will be able to apply them to digital signal processing.
- It will have implemented filters on microcontrollers and FPGAs.

Material:
Practice Manual
Laboratory equipment
Recommended bibliography
Published teaching material

Delivery:
Before carrying out the practice, when appropriate, students will prepare the corresponding prior study.
During the laboratory session, the achievement of the practice objectives will be assessed taking into account the degree of understanding of the work demonstrated by each student.
At the end of the session, each working group will prepare a final report explaining the work done, the knowledge gained and the conclusions.
The grade obtained in these tasks, which may include an oral or written defense of them, contributes 40% to the final grade.

Full-or-part-time: 58h
Laboratory classes: 28h
Self study: 30h

TITLE OF ACTIVITY 4: EXERCISES

Description:
Exercises that students must solve individually or in a group and which they must deliver and, eventually, defend individually before the professor in an interview.

Specific objectives:
At the end of the course on Digital Signal Processing, the student:
- You will know and be able to apply the main digital signal processing techniques.
- You will be able to design basic digital filters.
- Know the principles and subsystems involved in signal processing systems.
- You will know the principles of signal sampling and quantification.
- You will be able to carry out individual and team work and present them collectively and you can carry out the search for information for this purpose.
- You will know general purpose software tools and will be able to apply them to digital signal processing.

Material:
Recommended bibliography
Published teaching material

Delivery:
Proposed exercises, which will contribute 15% to the final grade.

Full-or-part-time: 30h
Self study: 30h

TITLE OF ACTIVITY 5: EXAM

Description:
Written exam in which the knowledge acquired up to the time of examination is evaluated. There will be a midterm that students must take individually. At the end of the class, there will be a final exam on the overall knowledge acquired.

Specific objectives:
At the end of the course on Digital Signal Processing, the student:
The concepts and techniques worked so far must be synthesized and consolidated.

Material:
Test statements
The work of the entire course

Delivery:
Exercises of the tests, which will contribute 45% to the final grade.

Full-or-part-time: 15h
Theory classes: 3h
Laboratory classes: 2h
Self study: 10h

GRADING SYSTEM

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the **Action Framework for Academic Integrity in Assessment at the UPC**.

The final mark for the class will be calculated using the following equation:
40% Lab sessions (A3)
15% Exercises (A4)
45% Exam (A5)

Assessment will be continuous.
Note 1. If the final exam mark is greater (in part or in total) than other aspects assessed, it will substitute the results obtained on other activities during the class.
Note 2. When the results of the evaluation acts corresponding to individual activities are substantially lower than those obtained in group activities, the individual execution of activities similar to those carried out in a group may be required. The last qualification will replace the original ones.

EXAMINATION RULES.

All activities are compulsory.
If any of the activities of the subject is not carried out, it will be considered a zero.
Carrying out the laboratory activities is a necessary condition to pass the subject.
In the case of laboratory activities for which a previous study has been established, it will be mandatory to submit it before accessing the laboratory.
Those activities that are explicitly declared as individual, whether in person or not, will be carried out without any collaboration from other people.
The dates, formats and other delivery conditions that are established will be mandatory.

BIBLIOGRAPHY

Basic:
- Oppenheim, Alan V.; Schafer, Ronald W. Tratamiento de señales en tiempo discreto [on line]. 2ª ed. Madrid: Prentice Hall, 2000 [Consultation: 02/06/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=3044. ISBN 8420529877.

Complementary:
- Proakis, John G.; Manolakis, Dimitris G. Tratamiento digital de señales [on line]. 4ª ed. Madrid: Prentice-Hall, 2007 [Consultation: 02/06/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=3042. ISBN 9788483223475.
- Wescott, Tim. Applied control theory for embedded systems [on line]. Burlington, MA: Newnes, cop. 2006 [Consultation: 20/06/2024]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/9780750678391/applied-control-theory-for-embedded-systems. ISBN 0750678399.

RESOURCES

Other resources:
Documentation published in the OpenCourseWare (ocw.itic.cat), which includes statements of the practices, exercises, statements of exams from previous courses and other resources.