Course guide
330231 - SS - Signals and Systems

Last modified: 05/07/2023

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: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Moncunill Geniz, Francisco Javier

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. (ENG) La comprensió i el domini dels conceptes bàsics de sistemes lineals i les funcions i transformades relacionades i la seva aplicació per a la resolució de problemes propis de l'enginyeria.
2. An understanding and mastery of the basics of linear systems and the associated functions and transforms. Knowledge of the main analogue and digital techniques of signal characterization and processing, and the principles and techniques that make their long-distance transmission possible
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. The 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:
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.
9. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
6. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
05 TEQ N2. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.

TEACHING METHODOLOGY

The subject consists of face-to-face activities consisting of 3 hours per week of class and 2 hours per fortnight of laboratory practices.
The student carries out learning through various mechanisms. In the lectures and participative classes 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 laboratory classes, students carry out preliminary work that helps to put into context the work that is intended to be carried out in the laboratory. The laboratory activity itself is developed in groups, preferably of two students, and allows experimenting 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 ability in oral and written communication.
From time to time, nomenclature is introduced in English to progressively start the student in learning this language.

LEARNING OBJECTIVES OF THE SUBJECT

Upon completion of the Signals and Systems course, the student will be able to:

- Understand and apply the main analogue techniques of signal processing and the main techniques for long-distance transmission.
- Design analogue filters.
- Understand the principles and subsystems involved in communication systems and signal processing.
- Understand the principles of sampling.
- Become familiar with general software tools and apply them to signal processing.
- Carry out work individually and on a team and present it collectively, and search for information for this purpose.

STUDY LOAD

Type	Hours	Percentage
Hours large group	45,0	30.00
Self study	90,0	60.00
Hours small group	15,0	10.00

Total learning time: 150 h

CONTENTS

1. INTRODUCTION TO SIGNALS AND SYSTEMS

Description:
In this topic, the aim is for students to:
- Understand the fundamentals of signals and systems.
- Learn the techniques of signal handling and characterization in the time and frequency domains.
- Understand the characteristics of systems and calculate the result of their interaction with signals in the time and frequency domains, especially for linear time-invariant systems.

Related activities:
All.

Full-or-part-time: 30h
Theory classes: 9h
Laboratory classes: 3h
Self study : 18h

2. RANDOM SIGNALS AND NOISE

Description:
In this topic, the aim is for students to:
- Learn techniques for characterizing random signals.
- Interpret the information provided by the power spectral density of random signals.
- Quantify noise at the output of a signal processing chain.

Related activities:
All.

Full-or-part-time: 30h
Theory classes: 9h
Laboratory classes: 3h
Self study : 18h

3 . SIGNAL PROCESSING

Description:
In this topic, the aim is for students to:
- Apply knowledge of signals in the time and frequency domains to signal processing problems.
- Understand the main techniques of analogue modulation.
- Understand multiplexing techniques.
- Understand the principles of signal sampling and interpolation.

Related activities:
All.

Full-or-part-time: 60h
Theory classes: 18h
Laboratory classes: 6h
Self study : 36h

4. FILTER DESIGN

Description:
In this topic, the aim is for students to:
- Know and define filter templates.
- Calculate some approaches to common templates.
- Design active and passive circuits that fit specification templates.

Related activities:
All.

Full-or-part-time: 30h
Theory classes: 9h
Laboratory classes: 3h
Self study : 18h

ACTIVITIES

TITLE OF ACTIVITY 1: LECTURES WITH EXERCISES

Description:
Theoretical content will be presented during these sessions. Students will have the opportunity to participate and interact with the professor.

Specific objectives:
- Know elementary signals and understand elementary transformations on them.
- Decompose arbitrary signals as a combination of elementary signals.
- Calculate and interpret the convolution integral.
- Calculate Fourier transforms of elementary signals.
- Calculate and interpret the interaction of signals and systems in the frequency domain.
- Calculate the mean value and the mean square value.
- Calculate and know how to use the equivalent noise bandwidth.
- Know elementary types of noise.
- Identify the factors that determine the total noise in a two-port cascade connection.
- Apply techniques of the temporal and frequency domains to signal processing problems.
- Know amplitude, phase and frequency modulations.
- Know multiplexing techniques.
- Apply Nyquist's theorem to signal sampling.
- Apply sampling and interpolation techniques.
- Specify filters using specification templates.
- Find approximations to specification templates.
- Design active filters with first and second order cells.
- Design passive filters corresponding to certain approximations.

Material:
Published teaching material.
Recommended bibliography.

Delivery:
Occasionally some evaluable activity will be carried out, which will contribute in a proportional part to the EXE variable.

Full-or-part-time: 40h
Theory classes: 40h

TITLE OF ACTIVITY 2: LABORATORY SESSIONS

Description:
The practices to be carried out in the laboratory will be two hours a fortnight, in groups of two people. The student will have the statement of the practice that will have previously been posted in ATENEA. The laboratory will have the necessary material and equipment to carry out the work. In addition, each group must bring their personal material that will be described at the beginning of the course. At the end of each practice, each group will post a report in ATENEA where the work done and the knowledge acquired will be explained.

Specific objectives:
- Use support software tools in the field of signals and systems.
- Know and apply measuring instruments for signal processing.
- Experimentally validate signal processing concepts.
- Write and present documents reflecting the design and validation process of signal processing circuits.

Material:
Electronic equipment, components and computer with suitable software.
Statement of the practice and supporting information to carry out the work.

Delivery:
Before carrying out the practice, the students will deliver the previous individual study corresponding to the practice to be carried out.
During the session, the achievement of the objectives of each laboratory session 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 that reflects the main features of the work carried out.
The qualification obtained in these activities configures the LAB variable.

Full-or-part-time: 25h
Laboratory classes: 15h
Self study: 10h

TITLE OF ACTIVITY 3: INDEPENDENT STUDY AND EXERCISES

Description:
Students must complete certain activities on their own time in order to achieve the objectives of the subject.

Specific objectives:
All of the subject.

Material:
Published teaching material.
Recommended bibliography.

Delivery:
Individual / group personal work will be translated, in part, into exercises during the course. The grading of these exercises will contribute to the EXE variable.

Full-or-part-time: 50h
Self study: 50h

TITLE OF THE ACTIVITY 4: EXAM

Description:
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:
The control test grade sets the CON variable.
The final test grade sets the FIN variable.

Material:
Test statements.

Delivery:
The control test score sets the variable CON.
The final test grade sets the FIN variable.

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

GRADING SYSTEM

The final grade for the course will be obtained as follows:

Final grade = 0.15 * EXE + 0.25 * LAB + 0.20 * CON + 0.40 * FIN

Note 1. The qualification in a part or in the whole of the final test will replace, if it is higher and there is a coincidence in the evaluated aspects, the results obtained in other evaluation acts carried out throughout the course.
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 groups may be required. The last qualification will replace the original ones.

EXAMINATION RULES.

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:
- Carlson, A. Bruce. Communications systems: an introduction to signals and noise in electrical communication. 3rd ed. New York: McGraw-Hill, 1986. ISBN 007009960X.
- Van Valkenburg, Mac Elwyn. Design of analog filters. New York: Oxford University Press, 2001. ISBN 0195118774.

RESOURCES

Other resources:
- Teaching and support material published on the ATENEA platform.
- Open Courseware portal of the ITIC degree http://ocw.itic.cat