Universitat Autònoma de Barcelona

2022/2023

Foundations of Signals and Systems

Code: 102690
ECTS Credits: 6

Degree	Type	Year	Semester
2500895 Electronic Engineering for Telecommunication	FB	1	2
2500898 Telecommunication Systems Engineering	FB	1	2

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: Yes

Teachers

Javier Martin Martinez

Jose Lopez Vicario

Prerequisites

The student must have an adequate level of calculus (real and complex variable functions, complex numbers, differentiation and integration) and basic circuit theory (Kirchhoff laws, Thévenin-Norton equivalents, superposition principle, voltage-current laws of elementary devices and basic circuital analysis).

Objectives and Contextualisation

- Introduce the student to the analysis and characterization of signals and systems, with emphasis on linear systems.
- Learn the Laplace transform and its properties.
- Learn how to apply the Laplace transform to circuit analysis.
- Learn and apply the concept of transfer function of an LTI system.
- Learn how to obtain the Bode diagram of a system.
- Learn the Fourier transform and its properties.
- Learn how to apply the Fourier transform to periodic signals (Fourier series) and the limitation in time (windowing) and frequency (Gibbs phenomenon).
- Learn and apply the concepts of energy and power of a signal.
- Learn and know how to apply the concepts of correlation and spectrum of signals

Competences

Electronic Engineering for Telecommunication

- Communication
- Develop personal attitude.
- Develop personal work habits.

- Develop thinking habits.
- Learn new methods and technologies, building on basic technological knowledge, to be able to adapt to new situations.

Telecommunication Systems Engineering
- Communication
- Develop personal attitude.
- Develop personal work habits.
- Develop thinking habits.
- Learn new methods and technologies, building on basic technological knowledge, to be able to adapt to new situations.

Learning Outcomes

1. Analyse and design analogue signal processing diagrams.
2. Apply the basic concepts of linear systems and the related functions and transforms, to resolve engineering problems.
3. Autonomously learn new and suitable knowledge and techniques for devising, developing or exploiting telecommunication systems, especially with regard to basic signal processing subsystems.
4. Communicate efficiently, orally and in writing, knowledge, results and skills, both professionally and to non-expert audiences.
5. Describe the fundamental parameters of a communications system, in the functional aspect.
6. Develop curiosity and creativity.
7. Develop independent learning strategies.
8. Develop the capacity for analysis and synthesis.
9. Manage available time and resources.
10. Manage available time and resources. Work in an organised manner.
11. Use computer tools to research bibliographic resources or information on telecommunications and electronics.
12. Work autonomously.

Content

1. Introduction to the subject. Signals and systems.
    1. Signals. Independent variable transforms and basic signals.
    2. System properties: linearity, invariance, causality and stability.
    3. Linear and time invariant systems (LTI). Convolution equation.
3. The Laplace transform.
    1. Laplace transform. Definition. Properties.
    2. Solution of differential equations using the Laplace transform.
    3. Obtaining the inverse Laplace transform.
5. Applications of the Laplace transform.
    1. Analysis of circuits with capacitors and inductors.
    2. Transfer function of a system. Definition and obtention of the impulse response.
    3. Pole and zero diagrams and system stability.
    4. Permanent response of a system. Bode diagrams.
7. The Fourier transform.
    1. Definition of the Fourier transform.
    2. Transform of basic signals.
    3. Properties of the Fourier transform.
    4. Limitation in frequency (Gibbs phenomenon) and limitation in time (windowing).
    5. Fourier transform of periodic signals. The Fourier series.
9. Correlation and spectrum of deterministic signals.
    1. Energy and power
    2. Correlation and energy spectrum.
    3. Correlation and power spectrum

Methodology

The course consists of:

- Master classes where the teacher explains the basic concepts of the subject.
- Problem solving classes where the teacher solves problems on the blackboard.
- Guided problem classes, where the students solve the problems and the teacher supervises and solves doubts.
- Troubleshooting online.
- The communication tool with the students will be the UAB Virtual Campus: https://cv.uab.cat.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Master class	20	0.8	1, 2, 5
Problems solving	15	0.6	1, 5, 8, 6
Summary lessons	10	0.4	1, 2, 4, 5, 8
Type: Supervised			
Seminars	5	0.2	1, 2, 3, 4, 5, 8, 6, 10
Type: Autonomous			
Autonomous work	70	2.8	1, 2, 3, 7, 8, 6, 10, 12, 11
On-line problems solving	10	0.4	1, 2, 3, 4, 5, 9, 10, 11

Assessment

The subject is evaluated according to 2 different types of evaluation:

- Written tests of subjects 1-5 with a weight of 90%. This part is recoverable to the final exam.
- Online problem solving with a weight of 10% and not recoverable

The final grade (NF) of the subject, as long as the notes P1, P2, P3, P4 and P5 are equal or superior to 2.0 points, is calculated as:

NF = (P1 + P2 + P3 + P4 + P5) * (9/50) + (Pol1r + Pol2r + Pol3r + Pol4r) * (1 / 40)

Otherwise, NF = min {P1, P2, P3, P4, P5}

Due to academic needs, and according to the development of the course, the evaluation procedures may be adjusted by the teacher responsible for the subject.

Recovery process:

- The final exam of the subject will consist of 5 different parts (1 for each subject of the subject), so that the notes Pr1 to Pr5 are obtained.

- The student can take the parts of the exam that he considers appropriate and the continuous evaluation note will be replaced in all cases by the one obtained in the recovery test. For example, if the student takes parts 1 and 3 of the exam by obtaining Pr1 and Pr3, the NF will be calculated exactly as described above but replacing P1 for Pr1 and P3 for Pr3.
- Once the student begins the final exam, he or she must necessarily hand in some answer sheet for correction. That is, the possibility of entering the examination room and leaving it without handing in anything for correction is not contemplated.
- The student can take the Pr1-Pr5 tests whenever he / she has particpated in a set of activities that represents at least two thirds of the total grade of the subject.
- In the event that a student can not attend P1, P2, P3, P4 or P5 tests for justified reasons, they must present the corresponding proof document, signed and stamped. In this case, he/she can be evaluated for the test in question with a grade of 0.0, thus not preventing from participation in the recovery process.
- With the recovery processes established in the subject, every student has the opportunity to be evaluated twice in each of the evaluation activities except evaluations related to online work, which are not recoverable. It is for this reason that in no case will additional evaluation tests be done if a student can not attend one or more of the tests.

Programming evaluation activities:

- The scheduling of the evaluation activities will be given on the first day of the subject and will be made public through the Virtual Campus and on the website of the Engineering School, in the exams section. The defense of the online activities will only be published in the CV of the subject.

Evaluation for students repeating the subject:

- No differences with respect to first enrollment students.

Procedure for review of qualifications:

- For each evaluation activity, the procedure for reviewing the activity will be indicated through the Virtual Campus of the subject. In this context, claims may be made on the grade of the activity, which will be evaluated by the teacher responsible for the subject.

Ratings:

- Evaluation with honors (MH): it is the decision of the faculty responsible for the subject. The regulations of the UAB indicate that MH can only be granted to students who have obtained a final grade equal to or greater than 9.0. You can grant aMH up to 5% of the total number of students enrolled.
- A student will be considered not evaluable (NA) if s/he does not obtain a minimum grade of 0.5 in P1, P2, P3, P4 or P5 or their corresponding recovery tests(Pr1 - Pr5).

Irregularities by the student, copy and plagiarism:

- Without prejudice to other disciplinary measures deemed appropriate, the irregularities committed by the student that may lead to a variation of the grade of an evaluation act will be scored with a zero. Therefore,copying, plagiarism, cheating, letting copy, etc. in any of the evaluation activities will involve suspending with a zero. The evaluation activities qualified in this way and by this procedure will not be recoverable.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
On-line problems solving 1 (Pol1r)	2,5%	1.5	0.06	1, 2, 3, 5, 7, 8, 6, 9, 10, 12, 11

On-line problems solving 2 (Pol2r)	2,5%	1.5	0.06	1, 2, 3, 5, 7, 8, 6, 9, 10, 12, 11
On-line problems solving 3 (Pol3r)	2,5%	1.5	0.06	1, 2, 3, 5, 7, 8, 6, 9, 10, 12, 11
On-line problems solving 4 (Pol4r)	2,5%	1.5	0.06	1, 2, 3, 5, 7, 8, 6, 9, 10, 12, 11
Recuperation exam chapters 1-5 (Pr1, Pr2, Pr3, Pr4, Pr5)	90%	4	0.16	1, 2, 3, 4, 5, 8, 10, 12
Written exam chapter 1 (P1)	18%	2	0.08	1, 2, 3, 4, 5, 8, 9, 10, 12
Written exam chapter 2 (P2)	18%	2	0.08	1, 2, 3, 4, 5, 7, 8, 10, 12
Written exam chapter 3 (P3)	18%	2	0.08	1, 2, 3, 4, 5, 8, 10, 12
Written exam chapter 4 (P4)	18%	2	0.08	1, 2, 3, 4, 5, 8, 10, 12
Written exam chapter 5 (P5)	18%	2	0.08	1, 2, 3, 4, 5, 8, 10, 12

Bibliography

1. Haykin /Van Ven, "Señales y sistemas", Limusa Wiley.
2. A. V. Oppenheim, "Signals and Systems", Prentice Hall.
3. A. B. Carlson, "Communication Systems", McGraw Hill.
4. Donald E. Scott, "Introducción al análisis de circuitos", McGraw Hill.
5. Leon O. Chua, "Linear and non linear circuits", McGraw Hill.
6. H. Baher, "Analog & digital signal processing", John Wiley.
7. Thomas Shubert, "Active and non-linear electronics".
8. A. Papoulis, M. Bertran, "Sistemas y circuitos", Marcombo.

Software

Not considered