Linear systems

Academic Year: (2020 / 2021) **Review date: 27-03-2019**

Department assigned to the subject: Signal and Communications Theory Department

Coordinating teacher:

Type: Electives ECTS Credits : 6.0

Year : Semester :

OBJECTIVES

CB1. Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
CB2. Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
CB4. Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences
CB5. Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
CG2. Learn new methods and technologies from basic scientific and technical knowledge, and being able to adapt to new situations.
CG3. Solve problems with initiative, decision making, creativity, and communicate and transmit knowledge, skills and abilities, understanding the ethical, social and professional responsibility of the engineering activity. Capacity for leadership, innovation and entrepreneurial spirit.
CG4. Solve mathematical, physical, chemical, biological and technological problems that may arise within the framework of the applications of quantum technologies, nanotechnology, biology, micro- and nano-electronics and photonics in various fields of engineering.
CG5. Use the theoretical and practical knowledge acquired in the definition, approach and resolution of problems in the framework of the exercise of their profession.
CG6. Develop new products and services based on the use and exploitation of new technologies related to physical engineering.
CG7. Undertake further specialized studies, both in physics and in the various branches of engineering.
CE4. Analyze and manipulate analog and digital signals in the temporal and frequency domains, and understand and master the basic concepts of linear systems and related functions and transforms, as well as apply them to circuit design.
CT1. Work in multidisciplinary and international teams as well as organize and plan work making the right decisions based on available information, gathering and interpreting relevant data to make judgments and critical thinking within the area of study.
RA1. To have acquired sufficient knowledge and proved a sufficiently deep comprehension of the basic principles, both theoretical and practical, and methodology of the more important fields in science and technology as to be able to work successfully in them;
RA2. To be able, using arguments, strategies and procedures developed by themselves, to apply their knowledge and abilities to the successful solution of complex technological problems that require creating and innovative thinking;
RA3. To be able to search for, collect and interpret relevant information and data to back up their conclusions including, whenever needed, the consideration of any social, scientific and ethical aspects relevant in their field of study;
RA4. To be able to successfully manage themselves in the complex situations that might arise in their academic or professional fields of study and that might require the development of novel approaches or solutions;

RA6. To be aware of their own shortcomings and formative needs in their field of specialty, and to be able to plan and organize their own training with a high degree of independence.

DESCRIPTION OF CONTENTS: PROGRAMME

BLOCK 0: Introduction
Unit 0. Review of Signals and Systems in the Time-Domain
BLOCK 1: The Fourier Transform of Continuous-Time Signals
Unit 1. Fourier Series Representation of Continuous-Time Periodic Signals
1.1. Introduction: Response of LTI Systems to Complex Exponentials
1.2. Fourier Series Representation of Continuous-Time Periodic Signals: Analysis and Synthesis Equations
1.3. Convergence
1.4. Properties of Continuous-Time Fourier Series. Examples
Unit 2. The Continuous-Time Fourier Transform
2.1. Introduction
2.2. The Continuous-Time Fourier Transform for Aperiodic Signals
2.3. The Continuous-Time Fourier Transform for Periodic Signals
2.4. Properties of the Continuous-Time Fourier Transform. Examples.
BLOCK 2. The Fourier Transform of Discrete-Time Signals
Unit 3. Fourier Series Representation of Discrete-Time Periodic Signals
3.1. Fourier Series Representation of Discrete-Time Periodic Signals: Analysis and Synthesis Equations
3.2. Properties of Discrete-Time Fourier Series. Comparison with the Continuous Case. Examples.
Unit 4. The Discrete-Time Fourier Transform
4.1. Introduction
4.2. The Discrete-Time Fourier Transform for Aperiodic Signals
4.3. The Discrete-Time Fourier Transform for Periodic Signals
4.4. Properties of the Continuous-Time Fourier Transform. Parseval¿s Theorem. Duality
Unit 5. Systems
5.1. Introduction
5.2. Frequency Response of Systems Characterized by Linear Constant-Coefficient Differential Equations
5.3. Frequency Response of Systems Characterized by Linear Constant-Coefficient Difference Equations
BLOCK 3. Sampling
Unit 6. Sampling in the Time-Domain
6.1. Introduction
6.2. The Sampling Theorem
6.3. Reconstruction of Continuous-Time Signals from Its Samples Using Interpolation
6.4. Discrete-Time Processing of Continuous-Time Signals
6.5. Decimation and Interpolation
Unit 7. Sampling in the Frequency-Domain: Discrete Fourier Transform
7.1. Introduction
7.2. Sampling of the Fourier Transform
7.3. Discrete Fourier Transform
7.4. Properties
BLOCK 4. The z-Transform
Unit 8. The z-Transform
8.1. Introduction
8.2. The z-Transform
8.3. The Region of Convergence. Properties
8.4. The Inverse z-Transform
8.5. Properties of the z-Transform
8.6. Evaluation of the Frequency Response from the Pole-Zero Plot
8.7. Analysis and Characterization of LTI Systems Using the z-Transform
8.8. Block Diagram Representation

LEARNING ACTIVITIES AND METHODOLOGY

AF1. THEORETICAL-PRACTICAL CLASSES. Knowledge and concepts students mustacquire. Receive course notes and will have basic reference texts.Students partake in exercises to resolve practical problems
AF2. TUTORING SESSIONS. Individualized attendance (individual tutoring) or in-group (group tutoring)

for students with a teacher.Subjects with 6 credits have 4 hours of tutoring/ 100% on- site attendance.
AF3. STUDENT INDIVIDUAL WORK OR GROUP WORK.Subjects with 6 credits have 98 hours/0% on-site.
AF8. WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.
AF9. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course. It entails 4 hours/100% on-site
AF8. WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.
MD1. THEORY CLASS. Classroom presentations by the teacher with IT and audiovisual support in which the subject`s main concepts are developed, while providing material and bibliography to complement student learning
MD2. PRACTICAL CLASS. Resolution of practical cases and problem, posed by the teacher, and carried out individually or in a group
MD3. TUTORING SESSIONS. Individualized attendance (individual tutoring sessions) or in-group (group tutoring sessions) for students with teacher as tutor. Subjects with 6 credits have 4 hours of tutoring/100% on-site.
MD6. LABORATORY PRACTICAL SESSIONS. Applied/experimental learning/teaching in workshops and laboratories under the tutor's supervision.

ASSESSMENT SYSTEM

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

SE1. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course.The percentage of the evaluation varies for each subject between 60% and 0%.
SE2. CONTINUOUS EVALUATION. Assesses papers, projects, class presentations, debates, exercises, internships and workshops throughout the course.The percentage of the evaluation varies for each subject between 40% and 100% of the final grade.