

30157 - Linear Systems

Syllabus Information

Academic Year: 2022/23

Subject: 30157 - Linear Systems

Faculty / School: 179 - Centro Universitario de la Defensa - Zaragoza

Degree: 563 - Bachelor's Degree in Industrial Organisational Engineering

ECTS: 6.0

Year: 4

Semester: First semester

Subject Type: Optional

Module:

1. General information

1.1. Aims of the course

The subject Linear Systems makes students know and be able to analyse different aspects related to the linear systems that a typical communication system consists of. In order to achieve this, the main objectives can be summarized as follows:

- To describe the basic aspects of signals and systems analysis in continuous time.
- To characterize time invariant linear systems in continuous time.
- To describe the properties of time invariant linear systems.
- To apply the Fourier Transform of signals in continuous time.
- To perform the analysis of signals and systems in the transformed domain.
- To know the main analogical modulations, their properties and mathematical expressions.

Specialization in Defence: These approaches and objectives are in line with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (<https://www.un.org/sustainabledevelopment/>), in such a way that the acquisition of the course learning outcomes provides training and competence to contribute to their achievement to some degree:

Goal 9: Industry, innovation and infrastructure.

1.2. Context and importance of this course in the degree

The subject is part of the Communication Systems speciality of Industrial Organization Engineering and it is essential for the students to become part of the Transmissions Branch within the Spanish Army, thus integrating it in the training in the corresponding fundamental speciality.

1.3. Recommendations to take this course

The subject is mainly theoretical, thus making attendance to theoretical sessions, active participation in them, as well as presentation of different tasks for homework in the indicated date is highly recommended. Previous knowledge required to be able to properly follow the subject are basic concepts of trigonometry, complex numbers and integrals.

2. Learning goals

2.1. Competences

- Ability to plan, budget, organise, manage and monitor tasks, people and resources.
- Ability to solve problems and take decisions with initiative, creativity and critical reasoning.
- Ability to communicate knowledge and skills in Spanish.

- Ability to work in a multidisciplinary group and in a multilingual setting.
- Ability to continue learning and develop self-learning strategies.
- Knowledge of the basic aspects of signals and systems analysis, both in continuous and discrete times.
- Knowledge and application of the characterisation of linear and constant systems by means of response to impulse, convolution, Fourier transform (FT) in constant and discrete time, analysis of signals and systems in the transformed domain and sampling.

2.2. Learning goals

In order to successfully pass the subject, the students will have to show that they are able to:

1. Describe the basic aspects of signals and systems analysis, both in continuous and discrete time.
2. Characterize time invariant linear systems in continuous and discrete time.
3. Perform the convolution operation in discrete and continuous time.
4. Describe the properties of the convolution operator.
5. Describe the properties of time invariant linear systems.
6. Apply the Fourier transform in continuous and discrete time.
7. Perform signals and systems analysis in the transformed domain, and signal sampling.

2.3. Importance of learning goals

The learning goals are essential to successfully pass the rest of subjects of the Transmissions fundamental specialty, since they are key to understand the basic mathematical principles to model any communication system. Furthermore, some basic analogical modulations used in real communication systems are presented.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

FIRST CALL

Continuous assessment:

The students will be able to pass the total of the subject by the continuous assessment procedure. To do this, they must demonstrate that they have achieved the expected learning outcomes by passing the assessment instruments indicated below, which will be carried out throughout the semester:

1. Midterm written exam about theoretical and practical aspects of the lessons 1-3 of the subject (30%).
2. Final term written exam about theoretical and practical aspects of the lessons 4-5 of the subject (30%).
3. Continuous assessments during all the semester with autonomous work, and laboratory sessions (40%).

In the final mark of the continuous assessment (100%) all the assessment instruments carried out throughout the course and its weight will be taken into account. In order to pass the subject it is necessary to obtain, at least, a score of 4 (maximum is 10) in both written exams and the student's final grade must be equal to or greater than 5 in the final mark of the continuous assesment.

Final Exam:

The students who do not pass the subject by continuous assessment or who would like to improve their grades, will have the right to take the Final Exam set in the academic calendar, prevailing, in any case, the best of both grades. This global assessment will be a single exam and will have the 100% weight in the final grade. To pass the subject, the student's final grade must be equal to or greater than 5.

SECOND CALL

Final Exam:

The students who do not pass the subject in the first call may take the Final Exam set in the academic calendar for the second call. This Final Exam will be a single exam and will have the 100% weight in the final grade. To pass the subject, the student's final grade must be equal to or greater than 5.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The approach, methodology and assessment of this course is prepared to be equivalent in any teaching scenario. It will be adjusted to the socio-sanitary conditions of each moment, as well as to the indications given by the competent authorities.

The methodology followed for the teaching-learning process is mainly based on masterclasses exposing the main theoretical concepts of each topic. These theoretical concepts will be complemented by problem sessions that apply those concepts in realistic scenarios. In all the cases, active participation of the students will be promoted planning and solving topics proposed in class.

4.2. Learning tasks

Learning activities are mainly the study of the learning material given in the classes, the realization of the practical exercises provided for each topic and the realization of the evaluating exercises given periodically.

4.3. Syllabus

The course will address the following topics:

1. INTRODUCTION TO SIGNALS AND SYSTEMS: Basic operations with signals, energy and power concepts, system classification
2. SPECTRAL ANALYSIS: Fourier series analysis for periodic signals, Fourier Transform and its properties, energy and power spectral densities, bandwidth
3. SIGNAL TRANSMISSION: Transfer function, amplitude and phase functions. Filtering
4. AMPLITUDE MODULATIONS: DSB modulation. SSB modulation. Demodulation of DSB and SSB. Modulation and demodulation of AM signals. Power ratios for pure tone modulations. Commutation modulators
5. ANGLE MODULATIONS: Frequency and phase modulations for pure tones. The spectrum of a pure tone modulated with FM. Approximate bandwidth of FM signal. Frequency translation and multiplication. FM modulators and demodulators. Superheterodine receivers

4.4. Course planning and calendar

The schedule of the subject will be determined by the Centre in the academic calendar of the corresponding year. Lessons start at the end of September, the first semester. The activities of the subject can be consulted in the Activities and Resources section. Important dates of the subject, such as tests and other programmed activities, will be indicated beforehand by the teacher both in class and Moodle.

4.5. Bibliography and recommended resources

<http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=30157>