

## 30157 - Linear Systems

### Syllabus Information

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**Academic Year:** 2019/20

**Subject:** 30157 - Linear Systems

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

**Degree:** 457 - Bachelor's Degree in Industrial Organisational Engineering  
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.

### 1.2.Context and importance of this course in the degree

The subject is part of the Transmissions specialty of Industrial Organization Engineering and is essential for the students to become part of the ?Transmissions Weapon? within the Ground Army, thus integrating it in the training in the corresponding fundamental specialty.

### 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)**

The assessment of the subject will be performed based on the following activities:

1. Midterm written exam about theoretical and practical aspects of the lessons 1-3 of the subject (50%).
2. Final written exam, at the date given by the centre, about theoretical and practical aspects of the lessons 4-5 of the subject (50%).

In order to pass the subject it is necessary to obtain, at least, a score of 3.5 (maximum is 10) in both written exams. If a student does not obtain that score in the midterm exam, they could do an exam about the lessons 1-3 in the final exam.

## **4.Methodology, learning tasks, syllabus and resources**

### **4.1.Methodological overview**

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://biblos.unizar.es/br/br\\_citas.php?codigo=30157&year=2019](http://biblos.unizar.es/br/br_citas.php?codigo=30157&year=2019)

