



Universitat de Lleida

## DEGREE CURRICULUM

# **SIGNALS AND SYSTEMS**

Coordination: Francisco Claria Sancho

Academic year 2014-15

## Subject's general information

<b>Subject name</b>	Signals and Systems
<b>Code</b>	102121
<b>Semester</b>	1r Q Avaluació Continuada
<b>Typology</b>	Obligatòria
<b>ECTS credits</b>	6
<b>Theoretical credits</b>	0
<b>Practical credits</b>	0
<b>Coordination</b>	Francisco Claria Sancho
<b>Office and hour of attention</b>	by agreement
<b>Department</b>	Informàtica i Enginyeria Industrial
<b>Teaching load distribution between lectures and independent student work</b>	(40%) 60 h classroom (60%) 90 h autonomous work
<b>Modality</b>	Presencial
<b>Important information on data processing</b>	Consult <a href="#">this link</a> for more information.
<b>Language</b>	Castellano
<b>Degree</b>	Degree in Automation and Industrial Electronic Engineering
<b>Office and hour of attention</b>	by agreement
<b>E-mail addresses</b>	claria@diei.udl.cat

Francisco Claria Sancho

## Subject's extra information

This subject is imparted during the first semester of third year.

The concepts that brings this subject, in general, are often new to the student and assimilate them requires significant dedication and study time. These concepts are basic to understand subjects such as modeling and control systems, content that will be in other subjects.

## Learning objectives

The goal is to provide students with ability to analyze, simulate and design systems in which input signals are processed or cause these systems to respond interacting with the physical environment. This is to familiarize students with some of the tools and / or basic methodologies of signal processing such as spectral analysis, convolution and correlation, signal sampling, filtering, and an introduction to analog and pulse modulation.

## Competences

### Degree-specific competences

- Applied knowledge of electronic instrumentation.
- Knowledge of the principles and applications of analogical electronics

#### Objectives

- - Signal processing an analogical system study

- Applied knowledge of high-power electronics.
- Knowledge of the principles and applications of digital electronics and microprocessors.

#### Objectives

- -Computer simulation of an analogical system.

### Degree-transversal competences

- Ability to resolve problems and elaborate and defend arguments inside their field of study.

#### Objectives

- - Distinguish and choices in a system, the possibility of processing time or processing in frequency. - Relate the expressions in time and frequency of these systems. - Review and develop systems block diagrams of modulators and demodulators. - Estimate the viability of these diagrams by calculating expressions of the signals involved in these blocks

- Ability to analyse and synthesize.

#### Objectives

- - Understand the concept of convolution of two signals and their extent in analysis, design and systems simulation. - Understand the spectral meaning of the Fourier Transform and its reach in

signal processing. - Relate correlation and convolution. - Understand the relationship between sampling time and spectrum of a signal

## Subject contents

### CHAPTER 1

#### 1 SIGNALS AND FOURIER ANALYSIS

##### 1.1 INTRODUCTION

##### 1.2 SIGNALS

###### *1.2.1 COMPARISON OF SIGNALS*

##### 1.3 APPROXIMATION OF A FUNCTION BY A SET OF ORTHONORMAL FUNCTIONS.

##### 1.4 FOURIER SERIES EXPANSION

###### *1.4.1 PECULIARITIES OF DEVELOPMENT IN FOURIER SERIES*

### CHAPTER 2

#### 2 FOURIER TRANSFORM AND ITS APPLICATION

##### 2.1 FOURIER TRANSFORM

###### *2.1.1 CONVERSIONS AND SOME ALTERNATIVE VERSIONS*

##### 2.2 CONVOLVING TWO SIGNALS

##### 2.3 FOURIER TRANSFORMS OF SOME FEATURES OF INTEREST

##### 2.4 PROPERTIES OF THE FOURIER TRANSFORM

##### 2.5 PROPOSALS EXERCISES

### CHAPTER 3

#### 3 SPECTRAL DENSITY AND CORRELATION

##### 3.1 ENERGY OF A SIGNAL

##### 3.2 SPECTRAL DENSITY OF ENERGY

##### 3.3 POWER SPECTRAL DENSITY

##### 3.4 CORRELATION OF TWO FINITE ENERGY SIGNALS

##### 3.5 CORRELATION OF TWO FINITE MEAN POWER SIGNALS

###### *3.5.1 SOME PROPERTIES OF THE CORRELATION AND SPECTRAL DENSITY*

##### 3.6 HILBERT TRANSFORM AND ANALYTIC SIGNAL

###### *3.6.1 ANALYTIC SIGNAL*

###### *3.6.2 ENVELOPE, PHASE AND INSTANTANEOUS FREQUENCY OF A REAL SIGNAL*

## *3.6.3 PASS BAND REAL SIGNAL IN FUNCTION OF LOW PASS SIGNALS*

## 3.7 SAMPLING THEOREM

## 3.8 DISCRETE FOURIER TRANSFORM

## 3.9 DISCRETE CONVOLUTION AND CORRELATION

# CHAPTER 4

## 4 ANALOGICAL MODULATIONS

### 4.1 MODULATIONS

### 4.2 ANALOGICAL MODULATIONS OF AMPLITUDE

#### *4.2.1 DOUBLE SIDEBAND SUPPRESSED CARRIER MODULATION*

#### *4.2.2 QUADRATURE MODULATION OF DUAL SIDE BAND NO CARRIER*

#### *4.2.3 MODULATION IN DOUBLE SIDE BAND WITH CARRIER*

#### *4.2.4 FREQUENCY DIVISION MULTIPLEXING*

#### *4.2.5 SINGLE SIDEBAND MODULATION*

### 4.3. ANGULAR ANALOGICAL MODULATIONS

#### *4.3.1 SPECTRAL ANALYSIS*

#### *4.3.2 FM AND PM MODULATORS*

#### *4.3.3 FM AND PM DEMODULATION*

#### *4.3.4 THRESHOLD EXTENSION METHODS.*

# CHAPTER 5

## 5. PULSE MODULATIONS

### 5.1 INTRODUCTION

### 5.2 ANALOGICAL PULSE MODULATIONS

#### *5.2.1 AMPLITUDE PULSE MODULATION (PAM)*

#### *5.2.2 DURATION PULSE MODULATION (PDM)*

#### *5.2.3 POSITION PULSE MODULATION (PPM)*

### 5.3 CODED PULSE MODULATION

#### *5.3.1 QUANTIFICATION AND CODING*

#### *5.3.2 QUANTIZATION NOISE*

#### *5.3.3 ERROR THRESHOLDS*

## Methodology

Master class

Problem-based learning

Classroom Practices

## Development plan

Develops sequentially contents

## Evaluation

### Evaluation Method

During the semester, there shall be four assessments in the form of two written tests and two papers that account for the study and the work done in the labs. These documents will have a maximum score of 1 point each and not considered any improvement threshold. The two written tests will be held on dates determined by the EPS for this purpose.

In this course, by its nature, has little sense to evaluate parts of avoiding your stuff previous contents. Thus, each written test will be on all the stuff that has been given so far.

The first written test will have a maximum score of 3 points and be considered approved if the score is greater than or equal to 1.5 points. The second written test will have a maximum score of 5 points and will be considered approved if the score is greater than or equal to 2.5 points.

As the material is cumulative in each written test, if the second test is passed, then the first test will be compensated if the latter has not been surpassed, with half its maximum score (1.5 points).

-The total score is the sum of the notes of the 4 reviews. **(This is the first of the two possible pathways of qualifications that are contemplated).**

-If the second written test you get a lower score to 2.5 points, you must use the recovery activity, to be performed on the date set by the EPS. The written test will have a valuation recovery maximum 8 points and be deemed to have been passed if you get a note added to the laboratory practice notes and document preparation practices study is greater than or equal to 5 points. **(This is the second pathway)**

In addition:

Any person enrolled in this course, that have made the 2nd written test whether or not it has been overcome, be furnished to the recovery activity to increase the final grade. If the 2nd test had been overcome the final grade will never be lower than it would have obtained by the first approach.

## Bibliography

### REFERENCES

#### Señales y sistemas

Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab

(segunda edición, 1997)Ed. Prentice Hall.

#### Tratamiento de la señal utilizando matlab v.4

C. Sidney Burrus, James H. McClellan, Alan V. Oppenheim, Thomas W. Parks, Ronald W. Schafer, Hans W. Schuessler.

1997 Ed. Prentice Hall.

## **Tratamiento digital de señales**

John G. Proakis, Dimitris G. Manolakis

1997 Ed. Prentice Hall.

## **Procesamiento de señales analógicas y digitales**

Ashok Ambardar

2002 Ed. Tomson.

## **Introducción a los sistemas de comunicacion**

F.G. Stremler.

1993 Ed. Adison-Wesley Iberoamericana.

## **Señales y sistemas continuos y discretos**

Samir S. Soliman, Mandy D. Srinath

(segunda edición, 1999) Ed. Prentice Hall.

## **Sistemas de comunicacion**

A. Bruce Carlson.

1975 Ed. Mc.Graw-Hill.

## **Sistemas de comunicacion**

B.P. Lathi.

1974 Ed. Limusa.

## **Sistemas digitales y analógicos, transformadas de Fourier, estimación espectral.**

Athanasios Papoulis.

1978 Ed. Marcombo.

## **Introducción a las señales y a los sistemas**

Douglas K. Lindner.

2002 Ed. Mc.Graw-Hill.



## **Estadística Modelos y Métodos, II Modelos Lineales y Series Temporales.**

D. Peña

1989. Ed. Alianza Editorial

## **Probabilidad y Estadística.**

Louis Maisel

1973. Ed. Fondo Educativo Interamericano S.A.