Universidad de Alcalá

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GUÍA DOCENTE

SIGNALS AND SYSTEMS

Grado en Ingeniería de Computadores

Universidad de Alcalá

Teach out (only exams)

2019/2020

3rd Year – 1st Semester

Universidad de Alcalá

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Subject:	**Signals and Systems**
Code:	**59004**
Study:	**Grado en Ingeniería de Computadores**
Department and knowledge area:	**Teoría de la Señal y Comunicaciones. Teoría de la Señal. Ingeniería Eléctrica.**
Type:	**Mandatory**
Credits ECTS:	**6**
Year and semester:	**3rd Year – 1st Semester**
Teachers:	Roberto López Sastre José María Muñoz Ferreras
Office hours:	
Language:	English

1. INTRODUCTION

The generation, processing, analysis and exchange of information are becoming one of the foundations of modern society, as a result, the tools to perform information management are subject to continuous development. Ultimately, the information is encoded in the form of signals, and any mechanism that acts on a signal is called a system. To properly manage the information, it is necessary, therefore, to understand from a mathematical point of view the properties of signals and systems.

This course, Signals and Systems, has been designed as an introduction to the basic concepts of signals and systems, emphasizing their descriptions in both time and frequency domains. These two characterizations of the signals and systems play a special role for storage, processing and transmission of information.
In particular, within the Computer Engineering degree, this course is particularly relevant, because it enables students to understand the main methods of signal processing. This way, they can analyze, develop and implement software solutions for IT projects in the field of multimedia signal processing systems (e.g. audio and images) and information and communication systems.

To take this course, it is convenient that students are familiar with the algebra of complex numbers, linear algebra, trigonometry, and mathematical analysis tools, including: integration, derivation and summation of power series.

2. COMPETENCIES

Transversal competencies:

- TR1. Oral and written ability to communicate in English and Spanish through conventional audiovisual resources, and to work in multidisciplinary teams and international contexts.
- TR2. Ability to analyze and synthesize problems and their solutions.
- TR3. Ability to properly manage available information by creatively integrating knowledge to apply it to solve computer problems with the scientific method.

Specific/professional competencies:

- CE7. Know the features and fundamental properties of signals and systems of continuous and discrete time, and the relationship between these two domains (EC-DSP1).
- CE8: Conocer y saber aplicar la representación y análisis de circuitos, señales y sistemas en el dominio de Laplace.
- CE11. Learn how to get the response of a LTI system to an input signal. Convolution sum and integral (EC-DSP9).
- CE12. Learn how to represent signals in the frequency domain using the Fourier series and transform (EC-CSG7).
- CE13. Know how to obtain the frequency response of a system and understand its physical meaning (EC-CSG7).
- CE14. Understand the concept of signal filtering (EC-CSG8).
- CE15. Understand the concept of sampling and its effects in the time and frequency domains (EC-DSP1).

Specific/professional competencies:

- **RA1**. Understand the mathematical basic concepts and tools needed in the course.
- **RA2** Identify the properties of signals and systems, and know and handle basic signals.
- **RA3**. Calculate the response of a LTI system, given an input signal. Convolution sum and integral.
- **RA4**. Know how to analyze signals and systems in continuous time in the frequency domain through the Fourier series and the Fourier transform.
- **RA5**. Sample signals and identify its effects in the frequency domain.
- **RA6**. Know how to analyze signals and systems in the Laplace domain

3. CONTENTS

Content modules	Total number of hours
1. **Review of mathematics.** Trigonometry, complex numbers, real functions representation, complex functions representation, and geometric series, and basic integrals and derivatives..	10 hours • 4h Theory • 6h Practices
2. **Introduction to the basic concepts of signals and systems.** Definition of continuous and discrete time signal, Signals transformations. Examples of typical signals and its properties. Characterization of systems in in continuous and discrete time.	8 hours • 4h Theory • 4h Practices
3. **Characterization of linear and time-invariant systems.** Integral and convolution sum. Impulse response. Properties. Systems described by difference equations	8 hours • 4h Theory • 4h Practices
4.**Fourier analysis of continuous-time signals and systems.** System response to a complex exponential. Fourier Series and its properties. The Fourier transform: properties and periodic signals. Frequency response of a LTI system. Introduction to filtering. Introduction to sampling: ideal and real sampling.	14 hours • 6h Theory • 8h Practices
5. Laplace Transform System response to a complex exponential. Laplace transform, definition and Region of Convergence. Relation with the Fourier transform. Examples of transforms and inverse transforms. Application to LTI systems: systems defined by a differential equations. System interconnections.	14 hours • 6h Theory • 8h Practices

4. TEACHING-LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credit distribution

Number of on-site hours:	24 hours in large group 30 hours in small group for problem solving 4 hours of practice exam
Number of hours of student work:	92 hours of (among others) study of concepts, problem solving, making self-evaluation exercises, preparation of reports, search and elaboration of information, and participation in on-line activities.
Total hours	150

4.2. Methodological strategies, teaching materials and resources

The teaching strategy is based on a reflective learning model that facilitates the discovery and critical thinking of concepts, and their application to problems.

To this end, in large groups, there will be lecture sessions for summarizing the most important concepts and making out new needs on knowledge from a problem-based learning strategy. In these lectures transparencies or computer presentations will be used to facilitate learning.

In small groups, a participative and active strategy is proposed so as to enrich the concepts of the theory. These sessions will help to verify the student evolution in the teaching-learning process. These small groups are used for problem solving.-

May be used Information and Communications Technologies for supporting some of the training activities (Internet, forums, wikis and email, available materials in e-learning platforms, etc.) and as a mean in the process of teaching-learning.

5. ASSESSMENT

The annual evaluation process consists of two sessions: an ordinary call and an extraordinary call.

Both the ordinary and extraordinary calls will consist of one exam.

Assessment evaluation

- Ordinary and extraordinary call will consist in the making and passing of a final exam.

Assessment Criteria

The assessment criteria must meet the acquisition level of the student competencies. To that purpose, the next criteria are defined:

CEV1: The student is able to manage all the basic mathematical concepts and tools of the course.
CEV2: The student shows ability and disposition to analyze the characteristics of the signals and systems in the time domain.
CEV3: The student is able to obtain the response of a LTI system and to understand the effects of the system over an input signal.
CEV4: The student shows ability and disposition to analyze the characteristics of the continuous-time systems in the frequency domain.
CEV5: The student knows the effects of the conversion from continuous time to discrete time and understands its consequences in the frequency domain.
CEV6: The student shows ability and disposition to analyze the characteristics of the continuous-time systems in the Laplace domain

Marking tools

This section specifies the assessment tools which will be applied to each assessment criteria.

1. Final Exam (PEF): It consists in the resolution of practice problems at the end of the course.

Ordinary and extraordinary call

One single exam (PEF) is proposed.

Competency	Learning output	Assessment criteria	Assessment tool	Marking percentage
TR1,2,3 CE7,8,11,12,13, 14,15	RA1-RA6	CEV1-CEV6	PEF	100%

6. BIBLIOGRAPHY

Main Bibliography

- Señales y Sistemas (Segunda edición). A.V. Oppenheim, A.S. Willsky y S.H. Nawab. Pearson Educación, 1998.
- Signals and Systems. Hwei P. Hsu. Schaum Outline Series. Mcgraw-Hill, 1995
- Ejercicios de tratamiento de la señal: utilizando MATLAB v.4, C. Sidney Burrus...[et al.], [1a. ed. en español, Prentice Hall, 1998

Additional Bibliography

- Signals, Systems and Transforms. Leland B. Jackson. Addison-Wesley, 1991.
- Continuous And Discrete Signals and Systems (Segunda edición). S.S. Samir y M.D. Srinat. Prentice Hall, 1997.
- Signal Processing and Linear Systems. B. P. Lathi. Oxford University Press, 2000. ISBN: 9780195219173.

Interesting links:

- http://www.jhu.edu/~signals-
- http://mit.ocw.universia.net/6.003/OcwWeb/Electrical-Engineering-and-Computer-Science/6-003Fall-2003/CourseHome/index.htm
- http://www.mathworks.es/matlabcentral/