Universidad de Alcalá

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GUÍA DOCENTE

SYSTEMS AND COMMUNICATIONS

Bachelor's Degree in Computer Engineering

Universidad de Alcalá

2019/2020

3rd Year – 1st Semester

GUÍA DOCENTE

Subject:	**Signals and Systems**
Code:	**591001**
Study:	**Degree in Computer Engineering**
Department and knowledge area:	**Teoría de la Señal y Comunicaciones. Teoría de la Señal. Ingeniería Eléctrica.**
Type:	**Obligatory of specific technology**
Credits ECTS:	**6**
Year and semester:	**3rd Year – 1st Semester**
Teachers:	Roberto López Sastre
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

General skills:

CG8 Knowledge of basic materials and technologies that enable learning and development of new methods and technologies, as well as to equip them with great versatility to adapt to new situations.

CG9 Ability to solve problems with initiative, decision making, autonomy and creativity. Ability to communicate and transmit knowledge and skills of the profession of Technical Engineer.

CG10 Knowledge to perform measurements, calculations, assessments, appraisals, surveys, studies, reports, scheduling and similar work computer, according to the knowledge acquired as provided in paragraph 5 of resolution BOE-A-2009 -12,977.

Specific skills:

CIC4 Ability to design and implement software and communications system.

Learning outcomes:

● RA1: Understand and manage the basic mathematical tools for the follow-up of the subject.
● RA2: Identify the properties of signals and systems, know and manipulate basic signals. Calculate the response of an LTI system to an input signal. Sum and integral of convolution.
● RA3: Know how to analyze signals and systems of continuous time in the frequency domain using the series and Fourier transform.
● RA4: Perform the sampling of signals and identify their effects in the frequency domain: Nyquist theorem.
● RA5: Understand the fundamental concepts of communications systems: channel models, transmission, and reception.
● RA6: Understand the fundamental concepts of digital communications: source coding, channel coding, multiplexing, line coding, types of digital modulation, channel capacity.

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..	6 hours • 4h Theory • 2h Practices
2. **Introduction to the basic concepts of signals and communications.** 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. Introduction to digital communication systems. Introduction to communication systems. Advantages of the digitalization. Structure of digital communication systems. Line coding. Inter-symbol interference. Signal space. Constellations. Modulated digital communication systems (ASK, FSK, QAM, and PSK). Introduction to the detection/demodulation of symbols in digital communications. Types of digital receivers. Theorem of Shannon.	16 hours • 8h Theory • 8h Practices

4. TEACHING-LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credit distribution

Number of on-site hours:	Theory 28 hours + Lab 28 hours + 4 hours of assessment
Number of hours of student work:	90 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 students should preferably take the continuous-evaluation system with the features of formative evaluation, so that a feedback can be found in the teaching-learning process. The next evaluation procedures are established:

Assessment evaluation

- Ordinary call. The assessment in the ordinary call must be inspired in the criteria of continuous evaluation (Regulation Rules in the Teaching-Learning Processes, NRPEA, article 3), taking always into account the acquisition of the competencies specified in the subject. We propose two processes:
  - Continuous Assessment: It consists in the making and passing of the midterm examsFinal Assessment: It will consist in the making and passing of a final exam
- Extraordinary call. It will consist in the making and passing of a final exam.-

If the final-assessment process is desired, the student must apply to the center dean during the first two weeks of his/her taking-on, exposing the reasons by which the continuous-evaluation system is not desired. The center dean will provide a resolution in a term of 15 days. In the case of an absence of a response, the request will be accepted.

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 model of a communication system, by identifying each of its shaping blocks, and by understanding its operation and performance.

Marking tools

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

1. Partial Assessment Exercises (PEP): It consists in the resolution of practice problems during the course.
2. Final Exam (PEF): It consists in the resolution of practice problems at the end of the course.

Marking Criteria

This section quantifies the assessment criteria to pass the subject:

Ordinary Call, Continuous Assessment

The relation among criteria, tools and marking for the ordinary call (continuous assessment) is the next one

Competency		Learning output	Assessment criteria	Assessment tool	Marking percentage
CG8 CG9 CG10		RA1	CEV1	PEP 1	20%
		RA2	CEV2, CEV3	PEP 2	20%
		RA3 RA4	CEV4, CEV5	PEP 3	40%
	CIC4	RA5 RA6	CEV6	PEP 4	20%
	CIC4	RA1-RA6	CEV1-CEV6	PEF(Optional)	100%

General criteria for the ordinary call with continuous assessment:

- Those students in the ordinary call who do not complete any PEPs, or the PEF will be considered as “Not sited”.

Ordinary Call with Final Assessment and Extraordinary Call

For this option, one single exam is proposed.

Competency	Learning output	Assessment criteria	Assessment tool	Marking percentage
CG8,CG9,CG10, CIC4	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.
- Analog and digital communications, . Hwei P. Hsu. Schaum Outline Series. Mcgraw-Hill, 2003.
- Contemporary communication systems using matlab. J. G. Proakis, M. Salehi, G. Bauch, Nelson Engineering, 2003
- Fundamentals of Communication Systems. J. G. Proakis, M. Salehi, Pearson Education Limited, 2014.
- 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

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