

# COMMUNICATIONS ELECTRONICS ENGINEERING B. Eng.

## SEMESTER 4

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**Year 2015/16**

<b>Course Name:</b>	Science, Technology and Society	<b>Course Code:</b>	595000018
<b>Year:</b>	2	<b>Semester:</b>	4
<b>Credits (ECTS):</b>	3	<b>Credit Hours:</b>	2
<b>Area:</b>	Common UPM Skills	<b>Type:</b>	Basic / Required
<b>Term:</b>	Spring	<b>Language:</b>	Spanish
<b>Prerequisites / Co-requisites:</b>		None	
<b>Coordinator:</b>		Eloy Portillo	
<b>Bachelor Engineering Program:</b>		Communications Electronics Engineering Telecommunications Systems Engineering Sound and Image Engineering Telematics Engineering	

**Course Contents**

1. Printing, Renaissance and first globalization
2. Scientific spirit and ingenuity Machinist
3. The scientific revolution
4. The revolutions of the 18th century
5. Progress and development capitalists
6. Technological determinism and ethics in engineering
7. Telecommunications economy
8. Environmental crisis and "grey ecology"
9. Sociology of telecommunications
10. Critical theory of postmodernism

**ABET Student Outcomes**

- (d) An ability to function on multidisciplinary teams
- (f) An understanding of professional and ethical responsibility
- (g) An ability to communicate effectively
- (h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (i) A recognition of the need for, and an ability to engage in life-long learning

**Study Outcomes. (according to the Spanish program definition)**

CG 02 Ability to search and select information, develop critical thinking and produce

and defend arguments within the area..

- CG 03 Ability to express oneself in oral and written form, and to convey information through documents and public presentations.
- CG 05 Ability for teamwork in multidisciplinary environments.
- CG 06 Ability for adaptability, negotiation, conflict resolution and leadership.
- CG 09 Ability to analyze and assess the social and environmental impact of technical solutions.
- CE B3 Knowledge and command of basic concepts on the general laws of Mechanics, Thermodynamics, electromagnetic fields and waves, and its application to solve engineering problems.
- CE TEL 03 Ability to use computer tools of search of bibliographical resources or of information related to the telecommunications and the electronics.
- CE TEL 16 Knowledge of telecommunication legislation and regulations at the National, European and International levels.

### **Specific outcomes of instruction (according to the Spanish program definition)**

- 1.- Locate the required information correctly.
- 2.- Analyze the information found and discard the irrelevant.
- 3.- Process the information from different sources and synthesize it properly.
- 4.- Contrast the ideas contributed by different sources.
- 5.- -Make an assessment about the rigor of the source of origin of information.
- 6.- Relate the scientific and technological aspects with a social environment of increasing complexity: social, economic, political, legal, ethical and environmental aspects.

### **Bibliography**

“Ciencia, tecnología y sociedad. Una introducción al estudio social de la ciencia y la tecnología”, González, M. I.; López Cerezo, J. A. y Luján, J. L., 1996.

**Year 2015/16**

<b>Course Name:</b>	Wave Propagation	<b>Course Code:</b>	595000019
<b>Year:</b>	2	<b>Semester:</b>	4
<b>Credits (ECTS):</b>	4,5	<b>Credit Hours:</b>	3
<b>Area:</b>	Physics	<b>Type:</b>	Basic / Required
<b>Term:</b>	Fall / Spring	<b>Language:</b>	Spanish
<b>Prerequisites / Co-requisites:</b>		Calculus I Lineal Algebra Calculus II Electromagnetism and Waves	
<b>Coordinator:</b>		Emma Acosta	
<b>Bachelor Engineering Program:</b>		Communications Electronics Engineering Telecommunications Systems Engineering Sound and Image Engineering Telematics Engineering	

### Course Contents

1. Vector operators
2. Plane acoustic waves
3. Spherical acoustic waves
4. Stationary acoustic waves
5. Maxwell equations. Wave equation. Energy
6. Propagation of electromagnetic waves in a dielectric medium
7. Propagation of electromagnetic waves in conductive media
8. Reflection and refraction
9. Guided waves
10. Radiation of electromagnetic waves

### ABET Student Outcomes

- (a) An ability to apply knowledge of mathematics, science, and engineering
- (b) An ability to design and conduct experiments, as well as to analyze and interpret data
- (d) An ability to function on multidisciplinary teams

### Study Outcomes (according to the Spanish program definition)

CG 03 Ability to express oneself in oral and written form, and to convey

information through documents and public presentations.

- CG 04 Ability to abstract, analyze, and synthesize, and to solve problems.
- CG 13 Learning skills with a high degree of autonomy.
- CE B3 Knowledge and command of basic concepts on the general laws of Mechanics, Thermodynamics, electromagnetic fields and waves, and its application to solve engineering problems.
- CE TEL 09 Ability to understand the mechanisms of electromagnetic and acoustic wave propagation and transmission, as well as corresponding transmitters and receivers.

### **Specific outcomes of instruction (according to the Spanish program definition)**

1. Analyze fundamental characteristics of wave propagation.
2. Analyze the phenomenology associated with the electrostatic field.
3. Analyze the propagation of electromagnetic waves in media dielectrics and conductors.
4. Understand and analyze the meaning of Maxwell's equations and its consequences.
5. Understand the basic properties of materials that are based on devices.
6. Analyze the key characteristics of the magnetic field.
7. Analyze the phenomenology associated with oscillations.
8. Analyze fundamental characteristics of electromagnetic fields and electromagnetic waves.
9. Analyze the effect of boundary conditions, as well as the guided electromagnetic wave propagation.
10. Analyze the phenomena associated with radiation.
11. Analyze flat and spherical acoustic waves in media limited and unlimited.

### **Bibliography**

“Elementos de electromagnetismo”, Matthew N. O., Sadiku Edición 3ª, Editorial Oxford University Press.

“Fundamentos de la teoría electromagnética”, Reitz, Milford y Christy, Editorial Pearson Educación.

“Campos y ondas electromagnéticos”, P. Lorrain y D.R: Corson, Editorial Selecciones Científicas.

“Fundamentos de Acústica”, L.E. Kinsler, A.R. Frey, A.B. Coppens y J.V., Sanders. Editorial Limusa.

**Year 2015/16**

<b>Course Name:</b>	Microprocessors	<b>Course Code:</b>	595000021
<b>Year:</b>	2	<b>Semester:</b>	4
<b>Credits (ECTS):</b>	6	<b>Credit Hours:</b>	4
<b>Area:</b>	Fundamentals of Electronics	<b>Type:</b>	Basic / Required
<b>Term:</b>	Fall / Spring	<b>Language:</b>	Spanish
<b>Prerequisites / Co-requisites:</b>		Programming I Electronics I	
<b>Coordinator:</b>		Juan Manuel López	
<b>Bachelor Engineering Program:</b>		Communications Electronics Engineering Telecommunications Systems Engineering Sound and Image Engineering Telematics Engineering	

### Course Contents

1. Introduction to microprocessor systems
2. Processor Cortex M0
3. Programming techniques

### ABET Student Outcomes

- (b) An ability to design and conduct experiments, as well as to analyze and interpret data
- (d) An ability to function on multidisciplinary teams
- (e) An ability to identify, formulate, and solve engineering problems
- (f) An understanding of professional and ethical responsibility
- (g) An ability to communicate effectively
- (h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (i) A recognition of the need for, and an ability to engage in life-long learning
- (j) A knowledge of contemporary issues
- (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### Study Outcomes (according to the Spanish program definition)

- CG 02 Ability to search and select information, develop critical thinking and produce and defend arguments within the area..

CG 03	Ability to express oneself in oral and written form, and to convey information through documents and public presentations.
CG 04	Ability to abstract, analyze, and synthesize, and to solve problems.
CG 05	Ability for teamwork in multidisciplinary environments.
CG 11	Skills for the use of Information and Communication Technologies.
CG 13	Learning skills with a high degree of autonomy.
CE B2	Basic knowledge on using and programming computers, operating systems, databases and software used in engineering.
CE B4	Knowledge and command of basic concepts on linear systems and related functions and transforms, theory of electrical circuits, electronic circuits, physical principles of semiconductors and logic families, electronic and photonic devices, materials technology and its application for solving problems of engineering.
CE TEL10	Ability to analyze and design combinational and sequential circuits, synchronous and asynchronous, and to use microprocessors and integrated circuits.

### **Specific outcomes of instruction (according to the Spanish program definition)**

1. Use the microprocessor peripherals to develop applications which solve problems of medium complexity.
2. Design the logic necessary to connect memory and peripherals for input/output in a digital system based on microprocessor, respecting the timing established in their machine cycles.
3. Perform simple programs in Assembly language and high level for a commercial microprocessor Language:.
4. Understand the functionality and interface subsystems combinational, sequential, and memories.
5. Understand the principles of operation of some basic peripherals: serial port, parallel port, timers, etc.
6. Learn about the architecture, features, and operation of a commercial microprocessor.
7. Understand the different techniques of input/output for the exchange of data between a microprocessor-based system and other systems.
8. Understand the principles of operation of a microprocessor, the basic elements that make up its architecture, and digital circuits comprising a microprocessor-based system.

### **Bibliography**

"Manual del procesador Cortex-M0"



**Year 2015/16**

<b>Course Name:</b>	Communication Theory	<b>Course Code:</b>	595000022
<b>Year:</b>	2	<b>Semester:</b>	4
<b>Credits (ECTS):</b>	6	<b>Credit Hours:</b>	4
<b>Area:</b>	Communication Systems	<b>Type:</b>	Basic / Required
<b>Term:</b>	Fall / Spring	<b>Language:</b>	Spanish
<b>Prerequisites / Co-requisites:</b>		Signals and Systems	
<b>Coordinator:</b>		Pedro García	
<b>Bachelor Engineering Program:</b>		Communications Electronics Engineering Telecommunications Systems Engineering Sound and Image Engineering Telematics Engineering	

### Course Contents

1. Model of a communication system
2. Signals
3. Noise
4. Distortion
5. Analog Modulation
6. A/D Conversion. MIC System
7. Filtered Base-band digital transmission
8. Base band Digital transmission with noise
9. Digital Modulation

### ABET Student Outcomes

- (b) An ability to design and conduct experiments, as well as to analyze and interpret data
- (c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- (e) An ability to identify, formulate, and solve engineering problems
- (g) An ability to communicate effectively
- (h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

- (i) A recognition of the need for, and an ability to engage in life-long learning
- (j) A knowledge of contemporary issues
- (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

**Study Outcomes (according to the Spanish program definition)**

- CG 02 Ability to search and select information, develop critical thinking and produce and defend arguments within the area..
- CG 04 Ability to abstract, analyze, and synthesize, and to solve problems.
- CG 05 Ability for teamwork in multidisciplinary environments.
- CG 09 Ability to analyze and assess the social and environmental impact of technical solutions.
- CG 11 Skills for the use of Information and Communication Technologies.
- CE TEL 01 Capacidad para aprender de manera autónoma nuevos conocimientos y técnicas adecuados para la concepción, el desarrollo o la explotación de sistemas y servicios de telecomunicación.
- CE TEL 03 Ability to use computer tools of search of bibliographical resources or of information related to the telecommunications and the electronics.
- CE TEL 04 Ability to analyze and specify the fundamental parameters of a communication system.
- CE TEL 05 Ability to weigh up the advantages and disadvantages of different technological alternatives to deploy or implement communication systems, from the point of view of signal space, perturbations and noise, and analog and digital modulation systems.
- CE TEL10 Ability to analyze and design combinational and sequential circuits, synchronous and asynchronous, and to use microprocessors and integrated circuits.
- CE TEL 16 Knowledge of telecommunication legislation and regulations at the National, European and International levels.

**Specific outcomes of instruction (according to the Spanish program definition)**

- 1.- Relate the technical aspects with the social environment. Aspects of market, regulatory environment.
- 2.- Analyze the process of modulation and demodulation, analog and digital.
- 3.- Interpret and characterize the signal parameters in terms of power, wide bandwidth and quality of telecommunication systems (relations signal to noise or interference, distortion and error probability).
- 4.- Analyze the structure, performance and applications of telecommunication systems.
- 5.- Characterizing elements and technologies of transit, distribution, access and user networks.
- 6.- Understand and manage base-band and modulated signals.

**Bibliography**

“Apuntes de Teoría”, Dpto. Publicaciones.

“Manual de Practicas”, Dpto. Publicaciones.

“Libro de Problemas”, Dpto. Publicaciones.

**Year 2015/16**

<b>Course Name:</b>	Analog Electronics I	<b>Course Code:</b>	595000023
<b>Year:</b>	2	<b>Semester:</b>	4
<b>Credits (ECTS):</b>	6	<b>Credit Hours:</b>	4
<b>Area:</b>	Analog Electronics	<b>Type:</b>	Basic / Required
<b>Term:</b>	Spring	<b>Language:</b>	Spanish
<b>Prerequisites / Co-requisites:</b>		Circuit Analysis I Electronics I Circuit Analysis II	
<b>Coordinator:</b>		Sergio López	
<b>Bachelor Engineering Program:</b>		Communications Electronics Engineering	

### Course Contents

1. Circuits with diodes
2. Circuits with transistors
3. Circuits with operational amplifiers

### ABET Student Outcomes

- (b) An ability to design and conduct experiments, as well as to analyze and interpret data
- (d) An ability to function on multidisciplinary teams
- (g) An ability to communicate effectively
- (h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (j) A knowledge of contemporary issues
- (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### Study Outcomes (according to the Spanish program definition)

- CG 02 Skilled to searching and selecting information, critical reasoning and writing and defending the reasonings within the defined area.
- CG 03 Ability to express oneself in oral and written form, and to convey information through documents and public presentations.
- CG 04 Ability to abstract, analyze, and synthesize, and to solve problems.
- CG 11 Skills for the use of Information and Communication Technologies.

CE EC05 Ability to design analog and digital electronic circuits, analog-to-digital and digital-to-analog conversion circuits, radiofrequency circuits, and electric power supply and conversion circuits for applications in telecommunications and computing.

**Specific outcomes of instruction (according to the Spanish program definition)**

- 1.- Use basic circuit analysis techniques to analyze the operation of linear and nonlinear circuits based on operational amplifiers.
- 2.- Design, from specifications, circuits of low complexity based on diodes, transistors (bipolar and unipolar) and operational amplifiers.
- 3.- Implement circuits of low complexity based on diodes, transistors (bipolar and unipolar) and operational amplifiers.
- 4.- Interpret the basic information in the datasheets of the diodes, transistors (bipolar and unipolar) and operational amplifiers.
- 5.- Use of analog circuit simulation programs to analyze and design circuits based on diodes, transistors (bipolar and unipolar) and operational amplifiers.
- 6.- Understand the behavior, at the level of model, diodes, transistors, bipolar and unipolar in working conditions of small-signal.
- 7.- Graphical and analytical understanding of bipolar and unipolar transistors.
- 8.- Use the techniques of analysis of circuits to analyze the functioning of basic circuits with diodes.
- 9.- Use the techniques of analysis of circuits to analyze the functioning of basic circuits with bipolar and unipolar transistors.

**Bibliography**

HAMBLEY, Allan R. Electrónica. 2ª Edición

FRANCO, Sergio. Design with Operational Amplifiers and Analog Integrated Circuits. 3ª Edición

PLEITE, J., VERGAZ, B y RUIZ, J.M. Electrónica Analógica para Ingenieros. Madrid: McGraw Hill, 2009

**Year 2015/16**

<b>Course Name:</b>	Digital Signal Processing	<b>Course Code:</b>	595000025
<b>Year:</b>	2	<b>Semester:</b>	4
<b>Credits (ECTS):</b>	4,5	<b>Credit Hours:</b>	3
<b>Area:</b>	Communication Systems	<b>Type:</b>	Basic / Required
<b>Term:</b>	Fall / Spring	<b>Language:</b>	Spanish
<b>Prerequisites / Co-requisites:</b>		Calculus I, Lineal Algebra Calculus II, Signals and Systems	
<b>Coordinator:</b>		Juan Carlos Gonzalez de Sande	
<b>Bachelor Engineering Program:</b>		Communications Electronics Engineering Telecommunications Systems Engineering Sound and Image Engineering Telematics Engineering	

### Course Contents

1. Continuous digital signal processing
2. Design of digital filters
3. The transform discrete Fourier transform (DFT)

### ABET Student Outcomes

- (a) An ability to apply knowledge of mathematics, science, and engineering
- (b) An ability to design and conduct experiments, as well as to analyze and interpret data
- (c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- (d) An ability to function on multidisciplinary teams
- (g) An ability to communicate effectively
- (h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (i) A recognition of the need for, and an ability to engage in life-long learning
- (j) A knowledge of contemporary issues

### Study Outcomes (according to the Spanish program definition)

- CG 02 Ability to search and select information, develop critical thinking and produce and defend arguments within the area.
- CG 03 Ability to express oneself in oral and written form, and to convey information

- through documents and public presentations.
- CG 04 Ability to abstract, analyze, and synthesize, and to solve problems.
- CE B4 Knowledge and command of basic concepts on linear systems and related functions and transforms, theory of electrical circuits, electronic circuits, physical principles of semiconductors and logic families, electronic and photonic devices, materials technology and its application for solving problems of engineering.
- CE TEL04 Ability to analyze and specify the fundamental parameters of a communication system.
- CE TEL08 Ability to apply signal analysis and treatment and system modeling tools.

### **Specific outcomes of instruction (according to the Spanish program definition)**

- 1.- Perform the convolution of signals.
- 2.- An analysis on frequency of discrete time signals.
- 3.- Linking continuous time systems and systems of discrete time in the time domain.
- 4.- Performing basic operations with signals and functions.
- 5.- Be able to characterize LTI systems of discrete time in the time domain (response to the impulse and constant coefficients linear difference equation) and processed domains (frequency and function of system response).
- 6.- Describe the characteristics of the spectral estimation of sequences with the spectrum of the continuous-time signal from which they come.
- 7.- Characterize and describe mathematically FIR and IIR filters.
- 8.- Designing IIR filters using the bilinear transformation method.
- 9.- Apply the rational change of the sample rate to the solution of problems.
- 10.- Mathematical tools of analysis and design for discrete time systems .
- 11.- Represent the flowchart of digital filters in their basic forms.
- 12.- Determine the parameters of an interpolator.
- 13.- Characterize mathematically the operation of sampling of continuous-time signals.
- 14.- Analysis and characterization of discrete time signals.
- 15.- Calculate the ideally sampled signal spectrum.
- 16.- Relate time continuous signals and time discrete time-domain signals.
- 17.- Relate the linear convolution with the DFT.
18. Differentiate digital according to the characteristics of its impulse response filter types: FIR and IIR filters.
- 19.- Be able to describe the block diagram of a digital signal processing system in real time enumerating the significant parameters of each block.
- 20.- Describe the basic methods for the design of FIR filters.
- 21.- Describe linear phase FIR filters.
- 22.- Describe the principles of the method of sampling in frequency of FIR filter design and relate it to the DFT.
- 23.- Designing IIR filters by using the method of the invariant transformation of impulse.
- 24.- Determine the parameters of a decimator.
- 25.- Consider the solution to problems of sampling rate change.
- 26.- Relate the circular convolution with the DFT.

### **Bibliography**

"Señales y Sistemas", A.V. Oppenheim, A. S., Willsky y S. H. Nawab. Prentice Hall. 2000.  
"Tratamiento de Señales en Tiempo Discreto", Oppenheim, Schaffer, Buck., Prentice Hall, 2000.  
"Tratamiento digital de señales. Principios, algoritmos y aplicaciones", J.G. Proakis, D.G. Manolakis, , Prentice Hall, 1997