

**SOUND AND IMAGE ENGINEERING**  
**B. Eng.**

**ELECTIVE COURSES TYPE B**

## **Table of Contents**

Analog Electronics I.....	3
Analog Electronics.....	5
Advanced Application Programming .....	7
Microprocessor-based Systems .....	9
Digital Design I.....	11
Communications Electronics I.....	13
Wave Transmission and Propagation .....	15
Transmission Systems .....	17
Mobile Communications Networks .....	19
Production Technologies of Electronics Systems .....	21
Communications Electronics II.....	23
Networks and Services Security .....	25

**Year 2015/16**

<b>Course Name:</b>	Analog Electronics I	<b>Course Code:</b>	595021023
<b>Year:</b>	3	<b>Semester:</b>	6
<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>	Sound and Image Engineering Telecommunication Systems Engineering Telematics 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 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 11 Skills for the use of Information and Communication Technologies.

CE CE05 Ability to design circuits of analogical and digital electronics, circuits of analogical-digital and digital-analogical conversion, radiofrequency circuits and conversion of electric power for applications of telecommunication 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>	Analog Electronics	<b>Course Code:</b>	595021322
<b>Year:</b>	3	<b>Semester:</b>	6
<b>Credits (ECTS):</b>	6	<b>Credit Hours:</b>	4
<b>Area:</b>	Elective	<b>Type:</b>	Elective / Type B
<b>Term:</b>	Spring	<b>Language:</b>	Spanish
<b>Prerequisites / Co-requisites:</b>		Circuits Analysis I Electronics I	
<b>Coordinator:</b>		Francisco José Arqués	
<b>Bachelor Engineering Program:</b>		Sound and Image Engineering Communications Electronics Engineering Telematics Engineering	

### Course Contents

1. Introduction to electronic components
2. Polarizing techniques
3. Equivalent models of transistors
4. Middle frequency and small signal amplifiers
5. Frequency Response
6. Introduction to feedback 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 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 11 Skills for the use of Information and Communication Technologies.
- CE B1 Ability to solve mathematic problems that may come up in engineering. Ability to apply knowledge on: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations, partial-differential

	equations, numeric methods, numeric algorithmics, statistics and optimization.
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 to solve engineering problems.
CE CE04	Ability to apply electronic as support technology in other fields and activities, not only in the field of Information Technologies and Communications.
CE CE05	Ability to design circuits of analogical and digital electronics, circuits of analogical-digital and digital-analogical conversion, radiofrequency circuits and conversion of electric power for applications of telecommunication and computing.
CE CE08	Ability to specify and use electronic instrumentation and measurement systems.
CE ST03	Capacity of analyzing components and their specifications for communications systems, guided and non-guided.

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

- 1.- Understand the characteristics of the diodes, bipolar and unipolar transistors used in electronic circuits.
- 2.- Understand the usefulness of the simulation of analog circuits based on diodes, transistors and operational amplifiers.
- 3.- Applying basic circuit analysis techniques to analyze the functioning of basic circuits with transistors.
- 4.- Understand the model behavior of bipolar and unipolar transistors, in working conditions of small signal level.
- 5.- Understanding bipolar and unipolar transistors graphically and analytical in continuous.
- 6.- Meet the Thevenin and Norton theorems, the simplifications which they give place and know to determine the equivalent which they generate.

### **Bibliography**

"Electrónica" ALLAN R. HAMBLEY , PEARSON EDUCACION, 2001.

ELECTRONICA DE POTENCIA: CIRCUITOS, DISPOSITIVOS Y APLICACIONES". MUHAMMAD H. RASHID , PRENTICE HALL MEXICO, 2005

"Principles of Transistor Circuits". S W Amos. ELSEVIER.

"Intuitive Analog Circuit Design", Marc Thompson. ELSEVIER.

Electrónica Básica para Ingenieros. Gustavo A. Ruiz Robredo. Servicio de Publicaciones de la Universidad de Cantabria

**Year 2015/16**

<b>Course Name:</b>	Advanced Application Programming	<b>Course Code:</b>	595021222
<b>Year:</b>	4	<b>Semester:</b>	6
<b>Credits (ECTS):</b>	6	<b>Credit Hours:</b>	4
<b>Area:</b>	Elective	<b>Type:</b>	Elective / Type B
<b>Term:</b>	Spring	<b>Language:</b>	Spanish
<b>Prerequisites / Co-requisites:</b>		Programming I Programming II	
<b>Coordinator:</b>		Pablo Ramírez	
<b>Bachelor Engineering Program:</b>		Sound and Image Engineering Communications Electronics Engineering Telecommunication Systems Engineering	

### Course Contents

1. Multilayer Architectures
2. Graphic User Applications Development
3. Java Server Applications for Web

### 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
- (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 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 TE04 Ability to describe, programme, validate and optimize protocols and interfaces of communication in the different levels of networks' architecture.
- CE TEL07 Knowledge and use of the principles of programming in telecommunication networks, systems and services.

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

- 1.- Indicate and describe the existing regulation regarding the approval of cryptographic systems.
- 2.- Establish a comparison between public key and symmetric key cryptosystems.
- 3.- Set the advanced capabilities of the X509 certification.

- 4.- Describe the basic security services in telematic networks.
- 5.- Describe algorithms commonly used in secret-key and public-key cryptosystems.
- 6.- Describe the mathematical foundations of modern cryptology.
- 7.- Describe the elements, structure and capacities of key distribution infrastructure.

### **Bibliography**

Ken Arnold, James Gosling y David Holmes. El lenguaje de programación Java. Addison Wesley. 2001. 3ª Edición.

Bruce Eckel. "Thinking in Java". Ed. Prentice Hall.



**Year 2015/16**

<b>Course Name:</b>	Microprocessor-based Systems	<b>Course Code:</b>	595021028
<b>Year:</b>	4	<b>Semester:</b>	7
<b>Credits (ECTS):</b>	6	<b>Credit Hours:</b>	4
<b>Area:</b>	Digital Electronics	<b>Type:</b>	Engineering Topic / Required
<b>Term:</b>	Fall	<b>Language:</b>	Spanish
<b>Prerequisites / Co-requisites:</b>		Programming I Programming II Microprocessors	
<b>Coordinator:</b>		Fernando Pescador	
<b>Bachelor Engineering Program:</b>		Sound and Image Engineering Telecommunication Systems Engineering Telematics Engineering	

### Course Contents

1. Block 0: Review
2. Block 1: External devices management
3. Block 2: Timers
4. Serial Communications
5. Medium complexity application design

### 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
- (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
- (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 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 08	Ability to organize, plan and make decisions.
CG 11	Skills for the use of Information Technologies and Communications
CE TEL10	Ability to analyze and design combinational and sequential circuits, synchronous and asynchronous, and to use microprocessors and integrated circuits.
CE CE04	Ability to apply electronic as support technology in other fields and activities, not only in the field of Information Technologies and Communications.
CE CE07	Ability to design interface devices, data capture and storage, and terminals for services and systems of telecommunication.
CE CE08	Ability to specify and use electronic instrumentation and measurement systems.
CE EC10	Being able to perform engineering projects of professional character in the field of specific technologies of telecommunication.

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

1. - Handle specific electronic instrumentation for the development of systems based on microprocessor, such as the Logic Analyzer.
2. - Development of applications in working groups
3. - Interpret the specifications of a system based on microcontroller of medium complexity...
4. - Write the code needed to develop an application based on microcontroller.
5. - Connect a peripheral to a microcontroller using interfaces based on standard protocols.
6. - Manage the initialization (reset) and clock sources in a microcontroller.
7. - Establish and manage a serial asynchronous communication between two systems.
8. - Learn how to handle any peripheral of medium complexity of a microcontroller from the documentation provided by the manufacturer.
9. - Send and receive data between two devices using serial synchronous communications
10. - Generate tensions and analogue wave forms, with sufficient accuracy, using a microcontroller's analogue converters.
11. - Design the logic necessary to control a peripheral not included in the microcontroller through accesses to specific memory map addresses.
12. - Produce a report which justifies and describes the taking of decisions on the development of a project and defending it orally with accuracy and detail.
13. - Manage timers and counters, along with the modules of capture and comparison to develop applications based on the precise control of timing between events.
14. - Discuss software and hardware architecture of medium complexity microcontroller-based systems.
15. - Handle CAD environments for the coding, compilation, and debugging of applications based on microcontroller.
16. - Develop systems based on microprocessors from different fields of application

### **Bibliography**

Moodle Web Resources

**Year 2015/16**

<b>Course Name:</b>	Digital Design I	<b>Course Code:</b>	595021027
<b>Year:</b>	4	<b>Semester:</b>	7
<b>Credits (ECTS):</b>	4,5	<b>Credit Hours:</b>	3
<b>Area:</b>	Digital Electronics	<b>Type:</b>	Engineering Topic / Required
<b>Term:</b>	Fall	<b>Language:</b>	Spanish
<b>Prerequisites / Co-requisites:</b>		Electronics II	
<b>Coordinator:</b>		Matías Garrido	
<b>Bachelor Engineering Program:</b>		Sound and Image Engineering Telecommunication Systems Engineering Telematics Engineering	

### Course Contents

1. CAD+VHDL+Technology
2. Subsystems

### 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
- (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 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..
- CE TEL10 Ability to analyze and design combinational and sequential circuits, synchronous and asynchronous, and to use microprocessors and integrated circuits.
- CE TEL11 Knowledge and application of the fundamentals of hardware description languages  
 CE EC01 Ability to construct, take advantage and manage feedback

systems, transport, representation, processing, storage, management and presentation of multimedia information, from the point of view of the electronic systems.

- CE CE05 Ability to design circuits of analogical and digital electronics, circuits of analogical-digital and digital-analogical conversion, radiofrequency circuits and conversion of electric power for applications of telecommunication and computing.
- CE CE07 Ability to design interface devices, data capture and storage, and terminals for services and systems of telecommunication.
- CE CE08 Ability to specify and use electronic instrumentation and measurement systems.

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

- 1.- Analysis, design, test and prototyping of simple digital subsystems (single-shot records, accumulators, frequency dividers, benches, counters BCD of several digits, counters programmable module, adding BCD and combinations of them) using VHDL.
2. - Apply CAD tools to capture, simulate and make digital systems.
3. - Search, select and use the relevant information provided by the manufacturers of configurable integrated circuits of average complexity.
4. - Perform analysis, design, test and prototyping of simple combinational and sequential systems using VHDL.
5. - Perform hierarchical descriptions of digital circuits using structural VHDL modeling.
6. - Know and use the configurable integrated circuits of different complexity for wired digital systems.
7. - Work in pairs with another student, planning weekly working hours and resolving small conflicts which may arise during the course.
8. - Use the oscilloscope to carry out and correctly interpret digital signal measures (logic levels, frequencies, indirect measures of current) in simple digital circuits.

### **Bibliography**

Moodle Web Sources.

**Year 2015/16**

<b>Course Name:</b>	Communications Electronics I	<b>Course Code:</b>	595021328
<b>Year:</b>	4	<b>Semester:</b>	7
<b>Credits (ECTS):</b>	6	<b>Credit Hours:</b>	4
<b>Area:</b>	Elective	<b>Type:</b>	Elective / Type B
<b>Term:</b>	Fall	<b>Language:</b>	Spanish
<b>Prerequisites / Co-requisites:</b>		None	
<b>Coordinator:</b>		Miguel Ángel del Casar	
<b>Bachelor Engineering Program:</b>		Sound and Image Engineering Communications Electronics Engineering Telematics Engineering	

### Course Contents

- 1.- Introduction to the study of the oscillators.
- 2.- LC Autocontrolled Oscillators
- 3.- Crystal Oscillators
- 4.- Analogue direct frequency synthesizers
- 5.- Indirect frequency synthesizers
- 6.- Direct Digital Synthesizers

### 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
- (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
- (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 09	Ability to analyze and assess the social and environmental impact of technical solutions.
CG 10	Ability to handle specifications, rules and regulations and to apply them in the practice of the profession.
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 to solve engineering problems.
CE ST03	Capacity of analyzing components and their specifications for communications systems, guided and non-guided.
CE ST04	Capacity for the selection of circuits, subsystems and systems of radiofrequency, microwave, broadcasting, radiolinks and radiolocalization.
CE ST07	Ability to design and development of telecommunications networks for industrial applications
CE TEL01	Ability to independently learn new knowledge and skills adequate for the design, development or utilization of telecommunication systems and services.
CE TEL02	Ability to use communication and computer applications (office automation, databases, advanced calculus, project management, visualization...) to support the development and utilization of networks, services and telecommunication and electronics applicatiectronics.
CE TEL03	Ability to use computer tools of search of bibliographical resources or of information related to the telecommunications and the electronics.

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

1. Analyze the characteristics of transistors by means of models.
2. Analyzing and designing basic electronic circuits.
3. Analyze, design, build and measure radio frequency oscillator circuits.
4. Analyze, design, build and measure indirect frequency synthesizers circuits.
5. Select components, circuits and commercial subsystems in the field of radio frequency generators.
6. Analyze and design electronic communications circuits.
7. Analyze and design electronic communications subsystems.
8. Manage electronic automated design tools.
9. Select the most appropriate signal generator circuit for each application.
10. Select the most appropriate oscillator technology for each application of communications

### **Bibliography**

- M. Sierra Pérez y otros, *Electrónica de Comunicaciones*, Pearson Education, 2003  
G. González, *Foundations of Oscillators Circuit Design*, Artech House, 2006  
R. Rhea, *Oscillator Design and Computer Simulation*, McGraw- Hill, 1995  
J. Smith, *Modern Communication Circuits*, McGraw-Hill, 1998  
F.M. Gardner, *Phaselock Techniques*, Wiley, 2005  
R. Best, *Phase Locked Loop ? Design, Simulation and Applications*, McGraw-Hill, 2007  
Rohde, *Microwave and Wireless Synthesizers ? Analysis and Design*, Wiley, 1997  
A. Chenakin, *Frequency Synthesizers: Concept to Product*, Artech House, 2010  
B.G. Goldberg, *Digital Frequency Synthesis Demystified*, Ed. Newmes, 1999

**Year 2015/16**

<b>Course Name:</b>	Wave Transmission and Propagation	<b>Course Code:</b>	595021327
<b>Year:</b>	4	<b>Semester:</b>	7
<b>Credits (ECTS):</b>	6	<b>Credit Hours:</b>	4
<b>Area:</b>	Elective	<b>Type:</b>	Elective / Type B
<b>Term:</b>	Fall	<b>Language:</b>	Spanish
<b>Prerequisites / Co-requisites:</b>	Calculus I Calculus II Linear Algebra Electromagnetism and Waves Waves Propagation		
<b>Coordinator:</b>	Jose María Rodríguez		
<b>Bachelor Engineering Program:</b>	Sound and Image Engineering Communications Electronics Engineering Telematics Engineering		

### Course Contents

1. Transmission Lines
2. S Parameters
3. Conductive Guides
4. Dielectric guides and fiber optic

### 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
- (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 13	Learning skills with a high degree of autonomy.
CE ST03	Capacity of analysing components and their specifications for communications systems, guided and non-guided.
CE ST05	Capacity for the selection of aerials, equipments and systems of transmission, wave propagation guided and non-guided by electromagnetic, radiofrequency or optical ways and related radioelectric space management and assignment of frequencies.
CE TEL03	Ability to use computer tools of search of bibliographical resources or of information related to the telecommunications and the electronics.
CE TEL09	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.- Characterize a transmission line by its electromagnetic parameters.
- 2.- Understand and handle impedance matching techniques.
- 3.- Interpret the mechanisms of propagation of electromagnetic waves in confined media: conductive guides and fiber optics.
- 4.- Interpret the techniques used in high frequency circuits and subsystems.
- 5.- Design and characterize high frequency circuits and subsystems.
- 6.- Handling of the instrumentation used in microwave and high frequency technologies.

### **Bibliography**

D.M. Pozar. Microwave Engineering. 4th edition. Ed. Wiley. 2011

S. Ramo, J.R. Whinnery and T. Van Duzer. Fields and Waves in Communication Electronics. Ed. John Wiley & Sons. New York, 1984.

D.K. Cheng. Fundamentos de Electromagnetismo para Ingeniería. Ed. Addison-Wesley Iberoamericana. Washington, Delaware, 1996.

C.T.A. Johnk. Teoría electromagnética. Principios y aplicaciones. Ed. John Wiley & Sons. 1994.

F.T. Ulaby, E. Michielsen and U. Ravaioli. Fundamentals of Applied Electromagnetics 6th edition Ed. Pearson. 2010.

C.A. Balanis. Advanced Engineering Electromagnetics Ed. John Wiley & Sons. New York, 1989.

J. M. Senior. Optical Fiber Communications. Principles and Practice. 2nd edition. Ed. Prentice-Hall. 1992.



**Year 2015/16**

<b>Course Name:</b>	Transmission Systems	<b>Course Code:</b>	595021228
<b>Year:</b>	4	<b>Semester:</b>	7
<b>Credits (ECTS):</b>	6	<b>Credit Hours:</b>	4
<b>Area:</b>	Elective	<b>Type:</b>	Elective / Type B
<b>Term:</b>	Fall	<b>Language:</b>	Spanish
<b>Prerequisites / Co-requisites:</b>		Communication Theory	
<b>Coordinator:</b>		Antonio Da Silva	
<b>Bachelor Engineering Program:</b>		Sound and Image Engineering Communications Electronics Engineering Telecommunication Systems Engineering	

### Course Contents

1. Introduction to Transmission Systems
2. 2 Mb/s Multiplex Systems
3. Digital Plesiochronous Hierarchy
4. Synchronous Digital Hierarchy (SDH): multiplexing structure
5. Fiber optic based Line Systems
6. Synchronous digital hierarchy: network structure

### 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 identify, formulate, and solve engineering problems
- (d) A broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (e) A knowledge of contemporary issues
- (f) 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 10   | Ability to handle specifications, rules and regulations and applying them in the development of the profession                                                                                                                          |
| CE TE01 | Ability to build, take advantage and manage networks, services, processes and telecom applications, understood these as systems of captation, transport, representation, processing, storage, management and presentation of multimedia |

information, from the point of view of telematic services.

- CE TE02 Ability to apply techniques in which nets, services and telematic applications are based, like systems of management, signalisation and commutation, routing, security (cryptographic protocols, tunnelling, firewall, mechanisms to collect, authenticate and protect contents), traffic engineering (graphs theory, queuing theory, teletraffic), tariffication and reliability and service quality, in environments fixed, mobile, personal, local or long-distanced, with different bandwidths, including telephony and data.
- CE TE05 Ability to follow the technologic progress of transmission, commutation and process to improve the networks and telematic services.
- CE TE08 Ability to carry out professional projects in the area of technologies specific to telecommunication engineering, where competencies acquired in the degree need to be synthesized and integrated

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

- 1.- Analyze the structure and quality of standardized at 2 MB/s systems.
- 2.- Use the appropriate laboratory equipment for measurement of defects, abnormalities, and quality of the signal transmission in normalized structures according to the European synchronous digital hierarchy.
- 3.- Calculate the bandwidths used in telephony and data communications.
- 4.- Understand the operation of the transmitter and receiver at different levels of the European plesiochronous digital hierarchy .
- 5.- Understand the rules used in the multiplexes of plesiochronous digital hierarchy.
- 6.- Learn about other international standards equivalent to the European ones, relating to the plesiochronous digital hierarchy. .
- 7.- Distinguish the elements that constitute a wide area network .
- 8.- Know the parameters that define the quality of line systems by optical fiber.
- 9.- Understand the problems arising in the integration of plesiochronous digital hierarchy networks with synchronous digital hierarchy networks. .
- 10.- Contextualise a transmission system model applied to a network at a great distance .
- 11.- Use the appropriate laboratory equipment to verify the proper functioning of the European plesiochronous digital hierarchy standard operating systems.
- 12.- Understand the rules used in the multiplex of synchronous digital hierarchy.

### **Bibliography**

Connection-oriented networks : SONET/SDH, ATM, MPLS and optical networks, Perros, Harry G. John Wiley & Sons, 2005

SISTEMAS DE TRANSMISIÓN, ETSIST Publicaciones

**Year 2015/16**

<b>Course Name:</b>	Mobile Communications Networks	<b>Course Code:</b>	595021234
<b>Year:</b>	4	<b>Semester:</b>	7
<b>Credits (ECTS):</b>	6	<b>Credit Hours:</b>	4
<b>Area:</b>	Elective	<b>Type:</b>	Elective / Type B
<b>Term:</b>	Fall	<b>Language:</b>	Spanish
<b>Prerequisites / Co-requisites:</b>	Telecommunication Networks and Services Computer Networks Signaling and Switching Advanced Networks and Services		
<b>Coordinator:</b>	Carlos Ramos Nespereira		
<b>Bachelor Engineering Program:</b>	Sound and Image Engineering Communications Electronics Engineering Telecommunication Systems Engineering		

### Course Contents

1. Introduction to cellular mobile systems
2. GSM Systems: GSM, GPRS, EDGE
3. 3G Systems: UMTS, HSDPA, HSUPA
4. Introduction to 4G mobile systems

### 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
- (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
- (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 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 10 Ability to handle specifications, rules and regulations and applying them in the

development of the profession

- CE TE01 Ability to build, take advantage and manage networks, services, processes and telecom applications, understood these as systems of captation, transport, representation, processing, storage, management and presentation of multimedia information, from the point of view of telematic services.
- CE TE02 Ability to apply techniques in which nets, services and telematic applications are based, like systems of management, signalization and commutation, routing, security (cryptographic protocols, tunneling, firewall, mechanisms to collect, authenticate and protect contents), traffic engineering (graphs theory, queuing theory, teletraffic), tarification and reliability and service quality, in environments fixed, mobile, personal, local or long-distanced, with different bandwidths, including telephony and data.
- CE TE05 Ability to follow the technologic progress of transmission, commutation and process to improve the networks and telematic services.
- CE TE08 Ability to carry out professional projects in the area of technologies specific to telecommunication engineering, where competencies acquired in the degree need to be synthesized and integrated

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

- 1.- Ability to describe the basic characteristics of cellular mobile systems.
- 2.- Ability to identify emerging technological alternatives in 4G.
- 3.- Ability to explain the structures of protocols on GSM/GPRS/EDGE interfaces.
- 4.- Ability to justify functional improvements between 2G technologies.
- 5.- Ability to detail the functionality of the elements of architecture in the 3G network: UMTS/HSDPA/HSUPA.
- 6.- Ability to establish a chronological classification comparison of mobile communications systems.
- 7.- Ability to relate messages signaling with the services of the level of link and the logical channels defined in the networks GSM/GPRS/EDGE radio interface.
- 8.- Ability to explain technical and functional improvements among the 3G technologies.
- 9.- Ability to identify the functionality of control messages exchanged in the networks GSM/GPRS/EDGE radio interface

### **Bibliography**

Hernando Rábanos, José M. Comunicaciones móviles (2ª edición). Ed. Centro de Estudios Ramón Areces, 2004.

Cox, Christopher. Essentials of UMTS. Ed. Cambridge University Press, New York, 2008.

Kreher, Ralf. UMTS signaling: UMTS interfaces, protocols, message flows and procedures analyzed and explained? (2nd Ed.). Ed. John Wiley & Sons, 2007.

Huidobro Moya, José Manuel. Comunicaciones móviles: GSM, UMTS, LTE?. Ed. Ra-Ma Madrid, 2012.

Holma, Harri. WCDMA for UMTS: HSPA Evolution and LTE. 5ª Ed. Ed. Wiley, 2010

**Year 2015/16**

<b>Course Name:</b>	Production Technologies of Electronics Systems	<b>Course Code:</b>	595021033
<b>Year:</b>	4	<b>Semester:</b>	8
<b>Credits (ECTS):</b>	4,5	<b>Credit Hours:</b>	3
<b>Area:</b>	Systems Engineering and Electronic Products	<b>Type:</b>	Engineering Topic / Required
<b>Term:</b>	Spring	<b>Language:</b>	Spanish
<b>Prerequisites / Co-requisites:</b>	Electronics I; Electronics II Microprocessors		
<b>Coordinator:</b>	Eduardo Nogueira Díaz		
<b>Bachelor Engineering Program:</b>	Sound and Image Engineering Telecommunication Systems Engineering Telematics Engineering		

### Course Contents

1. Introduction to the technologies of production of electronic systems.
2. Design of printed circuit boards and design rules.
3. Materials, manufacturing processes and types of printed circuit board.
4. Improvement of noise and electromagnetic compatibility, CE marking.
5. Thermal analysis of printed circuit board's power.
6. Evaluation of quality and reliability of circuits.

### 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
- (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 04 Ability to abstract, analyze, and synthesize, and to solve problems.
- CG 10 Ability to handle specifications, rules and regulations and to apply them in the

practice of the profession.

CG 13 Learning skills with a high degree of autonomy..

CE CE04 Ability to apply electronic as support technology in other fields and activities, not only in the field of Information Technologies and Communications.

CE CE09 Ability to analyze and solve interference problems and electromagnetic compatibility.

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

- 1.- Knowing the rules of design and analysis for a circuit of high frequency or high power density.
- 2.- Know the properties, capabilities and limitations of each interconnect technology.
- 3.- Learn about the encapsulated and parameters selection of the components.
- 4.- Understand the application of the physical and electrical design rules depending on the application.
- 5.- Perform CAD-CAM (Computer Aided Design - Manufacturing) design of a circuit.
- 6.- Understand the processes for the realization of a printed circuit board and apply them in a printed circuit board manufacturing laboratory.

### **Bibliography**

Tecnología Microelectrónica Vol 2: Circuitos Impresos. Ramiro Álvarez Santos. Editorial Ciencia.

Printed Circuits Handbook. C.F. Coombs. McGraw Hill Handbooks

Complete PCB Design Using OrCAD® Capture and PCB Editor. Kraig Mitzner. Ed Newnes

**Year 2015/16**

<b>Course Name:</b>	Communications Electronics II	<b>Course Code:</b>	595021331
<b>Year:</b>	4	<b>Semester:</b>	8
<b>Credits (ECTS):</b>	6	<b>Credit Hours:</b>	4
<b>Area:</b>	Elective	<b>Type:</b>	Elective / Type B
<b>Term:</b>	Spring	<b>Language:</b>	Spanish
<b>Prerequisites / Co-requisites:</b>		Communication Electronics I	
<b>Coordinator:</b>		Federico Javier Ortega	
<b>Bachelor Engineering Program:</b>		Sound and Image Engineering Communications Electronics Engineering Telematics Engineering	

### Course Contents

1. Transmitters and receivers
2. Small signal amplifiers
3. Conventional power amplifiers
4. Switched power amplifiers
5. Amplifier Design
6. Linearization
7. Frequency Mixers

### 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
- (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
- (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

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

CE ST01 Ability to construct, take advantage and manage services and telecom

applications, understood these as systems of captation, analogical and digital treatment, codification, transmission, representation, processing, storage, reproduction, management and presentation of audiovisual services and multimedia information.

CE ST05 Ability to create, encode, manage, transmit and distribute multimedia contents, according to usability and accesibility criteria of audiovisual, transmitting and interactive services.

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

1.- Handling of the instrumentation and procedures for a basic laboratory of communication systems, (generator/oscilloscope and Spectrum Analyzer RF modulator).

### **Bibliography**

Herbert L. Krauss, Charles W. Bostian, Frederick H. Raab, Solid state Radio Engineering, Wiley, 1980, ISBN: 978-0-471-03018-8

Andrei Grebennikov, Nathan O. Sokal, Marc J. Franco, Switchmode RF and Microwave Power Amplifiers, 2nd edition, Academic Press (Eselvier) 2012, ISBN: 978-0-12-415907-5

Guillermo González, Microwave Transistor Amplifiers: Analysis and Design, 2nd edition, Prentice Hall, 1996, ISBN: 978-0132543354

Francisco Javier Ortega González, Análisis y Diseño de Amplificadores de Potencia en Alta Frecuencia, Departamento de Publicaciones de la EUIT de Telecomunicación, UPM



**Year 2015/16**

<b>Course Name:</b>	Networks and Services Security	<b>Course Code:</b>	595021231
<b>Year:</b>	4	<b>Semester:</b>	8
<b>Credits (ECTS):</b>	6	<b>Credit Hours:</b>	4
<b>Area:</b>	Elective	<b>Type:</b>	Elective / Type B
<b>Term:</b>	Spring	<b>Language:</b>	Spanish
<b>Prerequisites / Co-requisites:</b>	Programming II Computer Networks Telecommunication Networks and Services		
<b>Coordinator:</b>	Ana Gómez		
<b>Bachelor Engineering Program:</b>	Sound and Image Engineering Communications Electronics Engineering Telecommunication Systems Engineering		

### Course Contents

1. General approaches on the security of networks and services
2. Security Infrastructures
3. Spanish legislation on information security. Recommendations and safety audits
4. Cybersecurity Applications

### ABET Student Outcomes

- (a) An ability to apply knowledge of mathematics, science, and engineering
- (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
- (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 05 Ability for teamwork in multidisciplinary environments.
- CE TE01 Ability to build, take advantage and manage networks, services, processes and telecom applications, understood these as systems of captation, transport, representation, processing, storage, management and presentation of multimedia information, from the point of view of telematic services.
- CE TE02 Ability to apply techniques in which nets, services and telematic applications are

based, like systems of management, signalisation and commutation, routing, security (cryptographic protocols, tunnelling, firewall, mechanisms to collect, authenticate and protect contents), traffic engineering (graphs theory, queuing theory, teletraffic), tarification and reliability and service quality, in environments fixed, mobile, personal, local or long-distanced, with different bandwidths, including telephony and data.

CE TE05 Ability to follow the technologic progress of transmission, commutation and process to improve the networks and telematic services.

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

- 1.- Set the advanced capabilities of the X 509 certification.
- 2.- Designing and defining the most optimal solution for a specific telematics system that meets its security requirements.
- 3.- Indicate and describe the existing regulation regarding the approval of cryptographic systems.
- 4.- Describe the elements, structure and capabilities of the cryptographic tokens.
- 5.- Analyze the risks and vulnerabilities of networks and their systems.
- 6.- Describe the most commonly used security mechanisms for protecting networks and systems-level transport.
- 7.- Describe traditional security services used in telematics mechanisms such as email and Web service.
- 8.- Indicate the most significant aspects in relation to the standards for smart cards.
- 9.- Describe the most commonly used security mechanisms for the protection of networks and network-level systems.
- 10.- Define the protocols of action for efficient management of the security of networks and systems in accordance with standards and recommendations in force.
- 11.- Describe the basic security services in telematics networks.
- 12.- Describe the mathematical foundations of modern cryptology.
- 13.- Describe algorithms commonly used in secret-key and public-key cryptosystems.
- 14.- Establish a comparison between public-key and symmetric-key cryptosystems.
- 15.- Describe the elements, structure and capacities of key distribution infrastructure.

### **Bibliography**

Carracedo, J. Seguridad en Redes Telemáticas. Mc Graw Hill. 2004

Stallings, William Network security essentials : applications and standards Pearson Prentice Hall, 2007