ELECTIVE COURSES TYPE A

Table of Contents

Course Name:	Industrial Automation	**Course Code:**	595010041
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Spring	**Language:**	Spanish
Prerequisites / Co-requisites:			
Bachelor Engineering Program:		Communications Electronics Engineering	

Course Contents

1. Introduction to the automatic
2. Programmable Automatons
3. Development of SCADA applications
4. Industrial Communications

ABET Student Outcomes

(a) An ability to apply knowledge of mathematics, science, and engineering

(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

(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 EC03 Ability to specify, implement, document and adjust equipment and electronic systems for instrumentation and control, considering both technical and regulatory aspects.

CE EC04 Ability to apply electronics as a support technology in other fields and activities, not just in the field of Information and Communication Technologies.

CE EC06 Ability to understand and use the feedback theory and electronic control systems.

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

1.- Apply a commercial tool for the development of SCADA applications.

2.- Understand the need for the standardization of industrial buses and analyze different types.

3.- Describe the operation of an industrial communications protocol.

4.- The use of a microprocessor-based system as a solution to the industrial control and its application as a solution to the industrial control systems.

5.- Develop control programs in Contact Diagram graphic language..

6.- Learn about the architecture, hardware, operating system and programming of a next-generation programmable software.

7.- Analyze the architecture of a system of control supervision and data acquisition (SCADA) and solutions employed usually to develop them.

Bibliography

Ingeniería de la Automatización Industrial. 2º edición. Ramón Piedrafita Moreno. Editorial RA-MA. ISBN 84 7897 604 3. 2004.

Introducción a LabVIEW. M. Ruiz y G. Arcas. Dpto. Publicaciones EUIT Telecomunicación.

Allen Bradley. Reference Manual: Logix5000TM Controllers General Instructions. Rockwell Automation. Publication 1756-RM003G-EN-P -June 2003.

Course Name:	Photovoltaic Engineering	**Course Code:**	595010042
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Spring	**Language:**	Spanish
Prerequisites / Co-requisites:			
Bachelor Engineering Program:		Communications Electronics Engineering	

Course Contents

1. Introduction
2. Solar cell and photovoltaic module
3. Solar Radiation
4. Photovoltaic systems connected to network
5. Autonomous Photovoltaic Systems

ABET Student Outcomes

(a) An ability to apply knowledge of mathematics, science, and engineering

(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

(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 EC03 Ability to specify, implement, document and adjust equipment and electronic systems for instrumentation and control, considering both technical and regulatory aspects.

CE EC04 Ability to apply electronics as a support technology in other fields and activities, not just in the field 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.- Understand the characteristic curve of the cell and analyze the influence of the different parameters which affect the characteristic curve.

2.- Sizing up a photovoltaic system connected to network and evaluate its production.

3.- Understand the different functionalities of elements of a photovoltaic system connected to network.

4.- Learn about the regulations related to photovoltaic solar installations.

5.- Understand the photovoltaic effect and apply the knowledge to the operation of a solar cell.
6.- Understand the importance of solar PV in the current energy system.
7.- Sizing up an autonomous photovoltaic system.
8.- Understand and manage the data sheet of the manual of a photovoltaic module.

Bibliography

Ingeniería Fotovoltaica. E. Lorenzo. Editorial Progensa

Course Name:	Embedded Systems Design with Raspberry Pi	**Course Code:**	595010047
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Spring	**Language:**	English
Prerequisites / Co-requisites:			
Bachelor Engineering Program:		Communications Electronics Engineering	

Course Contents

1. Description of the architecture and the hardware resources of the RaspBerry-PI
2. Installation of a Linux operating system in RPI. Raspbian installation and verification of its operation. Basic Linux tutorial
3. Description of software applications for the RaspBerry PI
4. Pooling. Presentation in class by the students of the commissioning of the RPI. Evaluation activity
5. Creation of a distribution tailored to Linux using Buildroot
6. Development of software applications in C for RPI using Eclipse
7. Development of applications for RPI

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

(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.

CE EC01 Ability to build, utilize and manage systems for the acquisition, transport, representation, processing, storage, management and presentation of multimedia information, from the point of view of electronic systems.

CE EC03 Ability to specify, implement, document and adjust equipment and electronic systems for instrumentation and control, considering both technical and

regulatory aspects.

CE EC04 Ability to apply electronics as a support technology in other fields and activities, not just in the field 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.

CE EC07 Ability to design devices for interfacing, data acquisition and storage, and terminals for telecommunication services and systems.

CE EC08 Ability to specify and use electronic instrumentation and measurement systems.

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

1.- Know the basic hardware features of an electronic system embedded as RaspBerry IP based on a System On Chip.

2.- Identify the functionality of each of the digital and analog interfaces included in the RaspBerry-PI.

3.- Install a Linux operating system and software applications in the RaspBerry Pi.

4.- Learn about the elements of a distribution of Linux for an embedded system.

5.- Configure and build a distribution of the Linux operating system using the Buildroot for the RaspBerry-IP platform.

6.- Connect a basic electronic circuit to one of the RaspBerry IP digital interfaces.

7.- Develop a basic software application using RaspBerry IP interfaces.

8.- Document the development of an application with RaspBerry-PI and present it in public.

9.- Present and defend in public proposed techniques to solve problems.

10.- Write technical papers presenting the steps followed and the conclusions obtained in the implementation of an application.

Bibliography

Moodle Web resources

Course Name:	Advanced Digital Design	**Course Code:**	595010043
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Fall	**Language:**	Spanish
Prerequisites / Co-requisites:		Digital Design I Digital Design II	
Bachelor Engineering Program:		Communications Electronics Engineering	

Course Contents

1. Advances applications with VHDL language
2. Introduction to System Verilog language
3. Random tests of functional coverage
4. UVM

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

(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 07 Ability to design, manage, and direct projects.

CE EC01 Ability to build, utilize and manage systems for the acquisition, transport, representation, processing, storage, management and presentation of multimedia information, from the point of view of electronic systems.

CE EC03 Ability to specify, implement, document and adjust equipment and electronic systems for instrumentation and control, considering both technical and regulatory aspects.

CE EC04 Ability to apply electronics as a support technology in other fields and

activities, not just in the field 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.

CE EC07 Ability to design devices for interfacing, data acquisition and storage, and terminals for telecommunication services and systems.

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

1.- Apply techniques of auto verification of tests using SVA.
2.- Use the object oriented programming for the accomplishment of tests with SystemVerilog language.
3.- Perform tests of digital systems using the classes of UVM libraries .
4.- Apply CAD tools to capture, simulate and make digital systems .
5.- Carry out random tests controlled by functional coverage with SystemVerilog language..
6.- Use advanced techniques for carrying out tests and models with VHDL language .
7.- Define the functional coverage of the SystemVerilog language system.
8.- Make models and tests with SystemVerilog language .

Bibliography

Moodle Resources

Course Name:	Product Engineering	**Course Code:**	595010044
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Fall	**Language:**	Spanish
Prerequisites / Co-requisites:			
Bachelor Engineering Program:		Communications Electronics Engineering	

Course Contents

1. Introduction
2. Product and System Design.
3. Life cycle of the product (LCA).
4. Reliability of products and systems.
5. Theoretical bases of environmental, electrical, mechanical, optical testing and EMC.
6. Test plans for the qualification and validation of 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

(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 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 EC03 Ability to specify, implement, document and adjust equipment and electronic systems for instrumentation and control, considering both technical and regulatory aspects.

CE EC04 Ability to apply electronics as a support technology in other fields and activities, not just in the field of Information and Communication

Technologies.

CE EC09 Ability to analyze and solve interference and electromagnetic compatibility problems.

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

1.- Undertake the design of a test plan of a team for a sector-specific application.
2.- Know the tests for the qualification of systems and equipment.
3.- Carry out a study of prediction of reliability of an electronic equipment.
4.- Learn about and plan the lifecycle and prediction of reliability of components and systems.
5.- Learn about the interaction of the product design and manufacturing process chains.
6.- Learn about new products of high added value from technology-based strategies.

Bibliography

Moodle Resources

Course Name:	Automatic Test Equipments	**Course Code:**	595010045
Year:	4	**Semester:**	7
Credits (ECTS):	4,5	**Credit Hours:**	3
Area:	Elective	**Type:**	Elective / Type A
Term:	Fall	**Language:**	Spanish
Prerequisites / Co-requisites:		Microprocessors Digital Signal Processing Industrial Automatic Programming I Computer Networks	
Coordinator:		Eduardo Barrera	
Bachelor Engineering Program:		Communications Electronics Engineering	

Course Contents

1. Introduction to the ATE (Automatic Test Equipment)
2. Standard bus used in ATEs
3. Description and analysis of the ATE
4. The ATE control software
5. The ATE equipment control
6. The ATE-oriented software architecture
7. Development of an ATE for the realization of the functional test of a voltmeter

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 03 Ability to express oneself in oral and written form, and to convey information through documents and public presentations.

CE EC01	Ability to build, utilize and manage systems for the acquisition, transport, representation, processing, storage, management and presentation of multimedia information, from the point of view of electronic systems.
CE EC04	Ability to apply electronics as a support technology in other fields and activities, not just in the field of Information and Communication Technologies.
CE EC07	Ability to design devices for interfacing, data acquisition and storage, and terminals for telecommunication services and systems.
CE EC08	Ability to specify and use electronic instrumentation and measurement systems.
CE TEL01	Ability to independently learn new knowledge and skills adequate for the design, development or utilization of telecommunication systems and services.
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.- Perform searches on the characteristics of one or several of the standard bus used in ATEs, extract the most relevant information, develop a rigorous technical documentation in this regard and a technical presentation of the key features.

2.- Develop a modular software architecture, ATEs-oriented, enabling development in parallel of the different modules, the participation of a multidisciplinary team, the independence of the system of the equipment used and the realization of simply-oriented future modifications or extensions.

3.- Learn about the development environment of LabVIEW as a tool for control of an ATE.

4.- Develop basic applications of control of instruments and/or DAQ cards on different communication buses.

5.- Learn about the main features of an automatic measurement system: architecture, types of instruments, used buses, control software and application areas.

6.- Know the parameters, protocols and basic performance characteristics of the standard buses used in ATEs and be able to perform qualitative and quantitative comparisons between them.

7.- Parse a document of specifications of an ATE and consider different solutions for their implementation, evaluating the advantages and disadvantages of each one of them.

8.- Develop, starting from minimum specifications, and applying the knowledge obtained previously, an ATE which performs the functional test of a hand voltmeter.

Bibliography

Slides and documentation. Moodle resources

Course Name:	Power Electronics	**Course Code:**	595010046
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Spring	**Language:**	Spanish
Prerequisites / Co-requisites:			
Bachelor Engineering Program:		Communications Electronics Engineering	

Course Contents

1. Introduction to Power Electronics
2. Magnetic components in power electronics
3. Isolated DC/DC converters
4. DC/AC Inversors
5. Electronic and electrical power techniques

ABET Student Outcomes

(d) An ability to function on multidisciplinary teams

(e) An ability to identify, formulate, and solve engineering problems

(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.

CE EC04 Ability to apply electronics as a support technology in other fields and activities, not just in the field 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.- Develop design solutions based on isolated switching converters.

2.- Learn the techniques of inversion of voltage using sinusoidal PWM modulation.

3.- Know the relationships between topology, control and function of power converter circuits.
4.- Know the methodology of design of magnetic components used in electronic power conversion systems.
5.- Select the appropriate topology, mode of conduction and control of switched converters with galvanic isolation.
6.- Learn practical solutions of circuits or power systems, by selecting the appropriate ones in an electrical or electronic loads power project.
7.- Learn the main concepts, techniques and circuitry necessary to understand, specify and design electronic power conversion systems.

Bibliography

Diseño de bobinas y transformadores con núcleo de ferrita. Antonio Pérez Ballaltas, Manuel Vázquez Rodríguez.

Fuentes de alimentación conmutadas. Antonio Pérez Ballaltas, Manuel Vázquez Rodríguez.

Moodle Web Resources.

Course Name:	Signal Processing In Communications II	**Course Code:**	595010346
Year:	3	**Semester:**	6
Credits (ECTS):	4,5	**Credit Hours:**	3
Area:	Elective	**Type:**	Elective / Type A
Term:	Spring	**Language:**	Spanish
Prerequisites / Co-requisites:		Signal Processing In Communications	
Coordinator:		José Enrique González	
Bachelor Engineering Program:		Telecommunication Systems Engineering	

Course Contents

1. Low computational load basic algorithms
2. Finite arithmetic problems
3. Block filtering
4. Analog Modulations: demodulators
5. Digital Modulations: demodulators

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

(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 ST06 Ability to analyze, encode, process and transmit multimedia information using analog and digital signal processing techniques.

CE TEL08 Ability to apply analysis and treatment of signals and modeling system tools

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 10 Ability to handle specifications, rules and regulations and to apply them in the practice of the profession.

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

1.- Choice of digital techniques of processing, usually based on the Discrete Fourier Transform (DFT), for efficient signal filtering using FIR filters .

2.- Capacity for the implementation of communications systems from signal digitalization.

3.- Capacity to implement, verify and compare algorithms of filtering, coding, analysis, etc.

4.- Capacity for programming of simulations of systems and subsystems in communications, including the generation of signal transfer channel, and analysis of the quality of the received signal (once demodulated or decoded), as for instance: carrier to noise, signal to noise, energy per bit to noise spectral density, ratio of bits or erroneous symbols , etc.

Bibliography

Moodle Web Resources

Course Name:	Global Navigation Satellite Systems	**Course Code:**	595010347
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Spring	**Language:**	Spanish
Prerequisites / Co-requisites:		Communication Theory	
Bachelor Engineering Program:		Telecommunication Systems Engineering	

Course Contents

1. Introduction
2. GNSS Description
3. GNSS Functioning
4. GNSS Precision and errors
5. GPS
6. Other GNSS
7. Applications

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

(e) An ability to identify, formulate, and solve engineering problems

(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 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 algorithmic, statistics and optimization.
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 TEL01	Ability to independently learn new knowledge and skills adequate for the design, development or utilization of telecommunication systems and services.
CE TEL04	Ability to analyze and specify the fundamental parameters of a communication system.
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.

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

1.- Acquire sufficient theoretical and practical knowledge to understand the functioning of a GNSS system

2.- Acquire sufficient theoretical and practical knowledge to understand a GNSS system utilities as well as applications that can be used.

3.- Acquire sufficient theoretical and practical knowledge to employ, user-level, the data resulting

Bibliography

Moodle Web Resources

Course Name:	Communication System Architecture	**Course Code:**	595010341
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Fall	**Language:**	Spanish
Prerequisites / Co-requisites:			
Bachelor Engineering Program:		Telecommunication Systems Engineering	

Course Contents

1. Communications Systems Basic Concepts

2. Features of intelligent transport

3. Signalling and control systems

ABET Student Outcomes

(a) An ability to apply knowledge of mathematics, science, and engineering

(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

(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 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 algorithmic, statistics and optimization.

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

CE CE10 Being able to perform engineering projects of professional character in the field of specific technologies of telecommunication.

CE ST02 Ability to apply techniques on which telecommunication networks, services and applications are based, whether in fixed or mobile environments,

personal, local or long distance areas, with different bandwidths, including telephony, radio broadcasting, television and data, from the point of view of transmission systems.

CE ST04 Ability to select radiofrequency, microwave, radio broadcasting, radio link and radio localization circuits, subsystems and systems.

CE SI05 Ability to create, encode, manage, transmit and distribute multimedia contents, according to usability and accessibility criteria of audiovisual, transmitting and interactive services.

CE TEL04 Ability to analyze and specify the fundamental parameters of a communication system.

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.- Relate the scientific and technological aspects with a social environment of increasing complexity: social, economic, political, legal, ethical and environmental aspects.

2.- Analyze the process of modulation and demodulation, analog and digital

3.- Design and planning of mobile communication systems and networks

4.- Knowledge about the management and control of unmanned autonomous vehicles

5.- Interpret the techniques used in circuits and subsystems for high frequency

6.- Ability to learn, understand and use the concepts of architecture of network, communication interfaces and protocols, specific packages and Internet switching networks

7.- Knowledge of the peculiarities of the telecommunication project

Bibliography

Moodle Web Resources

Course Name:	Optical Communication Systems	**Course Code:**	595010343
Year:	4	**Semester:**	7
Credits (ECTS):	4,5	**Credit Hours:**	3
Area:	Elective	**Type:**	Elective / Type A
Term:	Fall	**Language:**	Spanish
Prerequisites / Co-requisites:		Analog Electronics Wave Transmission and Propagation	
Coordinator:		Miguel Ángel del Casar	
Bachelor Engineering Program:		Telecommunication Systems Engineering	

Course Contents

1. Introduction to Optical Fiber communications systems
2. Optical Generators
3. Attenuation and dispersion in optical fibers.
4. Photodetector.
5. Optical Amplifiers.

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

(e) An ability to identify, formulate, and solve engineering problems

(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)

CE CE02 Ability to select circuits and electronic specialized devices for transmitting, routing and terminal equipment, both fixed and mobile environments.

CE CE08 Ability to specify and use electronic instrumentation and measurement systems.

CE ST01 Ability to build, utilize and manage telecommunication services and applications for the acquisition, transport, representation, processing, storage, management and presentation of multimedia information, from the point of view of transmission systems.

CE ST02 Ability to apply techniques on which telecommunication networks, services and applications are based, whether in fixed or mobile environments, personal, local or long distance areas, with different bandwidths, including

telephony, radio broadcasting, television and data, from the point of view of transmission systems.

CE ST03 Ability to analyze components and their specifications for guided and non-guided communication systems.

CE ST04 Ability to select radiofrequency, microwave, radio broadcasting, radio link and radio localization circuits, subsystems and systems.

CE ST05 Ability to select aerials, equipment and transmission systems for guided and non-guided wave propagation, through electromagnetic, radiofrequency or optical channels. Ability to manage the associated radio electric space and frequency allocation.

CE ST06 Ability to analyze, encode, process and transmit multimedia information using analog and digital signal processing techniques.

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

1.- Ability to analyze fundamental characteristics of wave propagation.

2.- Ability to analyze the propagation of electromagnetic waves in dielectrics and conductors.

3.- Ability to understand the basic properties of materials in which devices are based on.

4.- Be able to characterize different types of systems depending on their frequency discrimination

5.- Ability to design, configure, and manage networks, systems services and infrastructures of telecommunications in specific contexts (residential, business and institutional)

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

7.- Analyze and plan communication systems employing guided communication methods, cables and fiber optic.

8.- Calculate the losses of propagation, signal levels, link & balance determination of the quality of the radio communication systems

9.- Learn about the different elements of a system of optical communications (fibre, source, photodetector, EDFA, WDM devices, other devices).

10.- Familiarize yourself with the basic procedures of measurement in optical communications.

11.- Be able to design and evaluate optical communication systems, with balances of power and dispersion, with BER calculations, and the necessary adaptations for WDM.

12.- Learn about the elements of a system of telecommunications, in a block diagram, understanding the role of each party.

Bibliography

G. Keiser. Optical Fiber Communications. 3ª edición. Ed. Mac-Graw Hill. (2000)

J. Senior. Optical Fiber Communications. Principles and Practice. Ed. Prentice-Hall. (1992)

J. Gowar. Optical Communications Systems. Ed. Prentice-Hall International. (1984)

J.A. Martín Pereda. Sistemas y Redes Ópticas de Comunicaciones. Ed. Pearson Educación. (2004)

Course Name:	High Frequency Microelectronic Design	**Course Code:**	595010348
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Spring	**Language:**	Spanish
Prerequisites / Co-requisites:			
Bachelor Engineering Program:		Telecommunication Systems Engineering	

Course Contents

1. Introduction to the MMIC with III-v materials
2. Passive elements in MMIC and its modeling .
3. Active elements in MMIC and its modeling.
4. Introduction to the harmonic balance method and the method of moments.
5. The MMIC circuit design
6. Obtaining the Layout and LVS, DRC

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

(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)

CE EC05 Ability to design circuits of analogical and digital electronics, circuits of analogical-digital and digital-analogical conversion, radiofrequency circuits and conversion of electric

CE ST04 Capacity for the selection of circuits, subsystems and systems of radiofrecuency, microwave, broadcasting, radiolinks and radiolocalization.

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

1.- The acquisition of theoretical and practical knowledge enough to deal with the initial design of a monolithic integrated circuit of microwave and millimeter-wave using III-V materials .

2.- The acquisition of theoretical and practical knowledge enough to use the techniques of simulation and tools associated to allow the study and design of monolithic microwave integrated circuits and millimeter using III-v materials.

Bibliography

Moodle Web Resources

Course Name:	Wireless Communications	**Course Code:**	595010342
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Spring	**Language:**	Spanish
Prerequisites / Co-requisites:		Radiocommunication Systems Telecommunication Systems	
Bachelor Engineering Program:		Telecommunication Systems Engineering	

Course Contents

1. Mobile Communications Systems
2. 2nd Generation GSM Cellular Systems
3. 3rd Generation GSM Cellular Systems: UMTS
4. 4th Generation GSM. LTE
5. Wireless Local Area Networks

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

(e) An ability to identify, formulate, and solve engineering problems

(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)

CE ST02 Ability to apply techniques on which telecommunication networks, services and applications are based, whether in fixed or mobile environments, personal, local or long distance areas, with different bandwidths, including telephony, radio broadcasting, television and data, from the point of view of transmission systems.

CE ST05 Capacity for the selection of aerials, equipment 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 TEL01 Ability to independently learn new knowledge and skills adequate for the design, development or utilization of telecommunication systems and services.

CE TEL16 Knowledge of telecommunication legislation and regulations at the National, European and International levels.

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 10 Ability to handle specifications, rules and regulations and to apply them in the practice of the profession.

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

1.- Design and planning of mobile communication systems and networks.

2.- Use of the procedures and techniques of measurement and characterization of these systems and the elements of communications involved.

3.- Description and comparison of the major European digital mobile communications systems (TETRA, GSM/GPRS, UMTS, LTE), including architecture, services, interfaces, the different layers, and especially for the radio interface.

4.- Analysis of structure of bursts and plots and used procedures for coding and modulation.

5.- Analysis and simulation of the mobile channel and propagation models.

6.- Calculation of the balance sheets of link and the quality of mobile communications systems.

Bibliography

Comunicaciones móviles digitales. Rafael Herradón, EUITT, 2007.

Comunicaciones Móviles José M. Hernando., 2ª ed. C.E. Ramón Areces, 2004

Wireless and cellular telecommunications, Lee, William. McGraw Hill 2006

Essentials of LTE and LTE-A A. Ghosh, R Ratasuk. Cambridge University Press. 2011

Course Name:	Radar Technology	**Course Code:**	595010345
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Spring	**Language:**	Spanish
Prerequisites / Co-requisites:			
Bachelor Engineering Program:		Telecommunication Systems Engineering	

Course Contents

1. Introduction to Radar Technologies
2. Radar Equation
3. Signal Processing and Treating. Radar Data
4. Technologic Aspects

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

(e) An ability to identify, formulate, and solve engineering problems

(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 ST04 Ability to select radiofrequency, microwave, radio broadcasting, radio link and radio localization circuits, subsystems and systems.

CE ST05 Ability to select aerials, equipment and transmission systems for guided and non-guided wave propagation, through electromagnetic, radiofrequency or optical channels. Ability to manage the associated radio electric space and frequency allocation.

CE TEL04 Ability to analyze and specify the fundamental parameters of a communication system.

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

1.- Design, simulate and plan a Radar System.

Bibliography

Moodle Web Resources

Course Name:	Biomedical Digital Signal Processing	**Course Code:**	595010349
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Spring	**Language:**	English
Prerequisites / Co-requisites:		Statistics and Stochastics Processes Digital Signal Processing	
Bachelor Engineering Program:		Telecommunication Systems Engineering	

Course Contents

1. Introduction to biomedical signals.
2. Electrocardiographic (ECG) and electroencephalographic (EEG) signal processing.
3. Main types of biomedical signals currently used for health assessment, their main characteristics and how they are recorded.
4. Introduction to the digital signal processing of these signals: denoising, cancellation of artifacts and extraction of some relevant features for diagnostic applications from the signals.
5. Simulation laboratory using Matlab.
6. Work with real-world signals downloaded from the PhysioNet database.

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 function on multidisciplinary teams

(d) An ability to identify, formulate, and solve engineering problems

(e) A knowledge of contemporary issues

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

(g) An ability to communicate effectively

Study Outcomes (according to the Spanish program definition)

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 algorithmic, statistics and optimization.

CE B2 Basic knowledge on using and programming computers, operating systems, databases and software used in engineering.

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 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 TEL08 Ability to apply analysis and treatment of signals and modeling system tools

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

CG 03 Skilled for public speaking and in written and communicating information throughout documents and public speeches.

CG 04 Ability to abstract, analyze, and synthesize, and to solve problems.

CG 11 Skills for the use of Information and Communication Technologies.

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

1. Writing a report.
2. Discussing work and final results.
3. Connecting the problem with others.
4. Information management.
5. Performing a frequency analysis of discrete time signals.
6. To order and relate ideas with the help of mathematical methods.
7. Analysis and characterization of signals in discrete time.
8. Perform basic operations with signals and functions.
9. To use mathematical tools for analysis and design of discrete time systems.
10. Management of the numerical and graphical tools for statistical data analysis.
11. Performing a frequency analysis of continuous time signals.
12. Description of a block diagram in a digital real-time signal processing system listing the significant parameters of each block.
13. Analysis of a problem in different levels of abstraction.

Bibliography

Leif Sörnmo y Pablo Laguna, "Bioelectrical Signal Processing in Cardiac and Neurological Applications", Academic Press, 2005.

Joseph D. Bronzino, "Biomedical engineering handbook (Vols. 1 y 2)" CRC Press, 1999.

Gari D. Clifford, Francisco Azuaje y Patrick E. McSharry, "Advanced Methods and Tools for ECG Data Analysis", Artech House, 2006.

Saeid Sanei y Jonathan A. Chambers, "EEG Signal Processing", John Wiley & Sons, 2007.

Luca Mainardi, Leif Sörnmo y Sergio Cerutti, "Understanding atrial fibrillation: The signal

processing contribution (Partes I y II)", Synthesis Lectures on Biomedical Engineering, 2008.

https://www.physionet.org/

Tompkins, 2000 Bibliografía Willis J. Thompkins, "Biomedical Digital Signal Processing", Prentice Hall, 2000.

Course Name:	Audio Engineering III	**Course Code:**	595010141
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Fall	**Language:**	Spanish
Prerequisites / Co-requisites:		Sound and Image Fundamentals Audio Engineering I Audio Engineering II	
Bachelor Engineering Program:		Sound and Image Engineering	

Course Contents

1. Specific Aspects of Audio Installations
2. Cables and Connectors
3. Electricity Grid Network Aspects
4. Audio Equipment Interconnection
5. Auxiliary Audio Equipment
6. Examples of Installations and Associated Elements

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

(e) An ability to identify, formulate, and solve engineering problems

(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 SI01 Ability to build, utilize and manage telecommunication services and applications for the purpose of acquiring, treating analogically and digitally, encoding, transporting, representing, processing, storing, reproducing, managing and presenting audiovisual services and multimedia information.

CE SI02 Ability to analyze, specify, implement and support television, audio and video systems, equipment, headers and facilities, both in fixed and mobile environments.

CE SI03 Ability to carry out projects for studios and facilities which will be used for audio and video signal production and recording.

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

1.- Comprehend and analyze the characteristics of different equipment used in audio engineering for a concrete use.

2.- Analyze the characteristics of the different working environments in audio installations.

Bibliography

Moodle Web resources

Course Name:	Advanced Signal Processing	**Course Code:**	595010142
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Spring	**Language:**	Spanish
Prerequisites / Co-requisites:		Audio Engineering I Digital Signal Processing Signals and Systems	
Bachelor Engineering Program:		Sound and Image Engineering	

Course Contents

1. Adaptive Systems
2. Audio Effects Algorithms
3. Transmission Systems in Underwater Acoustics
4. Musical Signal Analysis and Synthesis
5. Pattern Detection

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

(e) An ability to identify, formulate, and solve engineering problems

(g) An ability to communicate effectively

(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 SI01 Ability to build, utilize and manage telecommunication services and applications for the purpose of acquiring, treating analogically and digitally, encoding, transporting, representing, processing, storing, reproducing, managing and presenting audiovisual services and multimedia information.

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 10 Ability to handle specifications, rules and regulations and to apply them in the practice of the profession.

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

1.- Manipulate the spectrum (spectral compression-expansion) by interpolating or decimating the numerical sequences.

2.- Designing algorithms that perform some kind of effect on the audio signal: reverberation, equalization, dynamic range compression-expansion, time scale

adjustment, setting the tone, etc.

3.- Apply sorting techniques to sound and image patterns recognition. Study the biometric applications that are handled biometric features, such as: fingerprint, iris, face and voice.

4.- Understand the general concepts and techniques of classification of patterns.

5.- Establish a discreet propagation medium model for acoustic waves in the sea, for the calculation of paths and the determination of acoustic transmission channels.

6.- Recognize the number sequences basic carriers of any information.

7.- Learn the techniques of musical signals analysis and synthesis.

8.- Design adaptive systems and apply to practical situations as active control of acoustic noise.

9.- Discern between FIR and IIR algorithms (advantages, disadvantages).

10.- Manage the time-frequency duality of the numerical sequences and discrete systems domain. Know the relationships between the two domains.

11.- Learn about active and passive underwater acoustic transmission systems.

12.- Modify the spectrum of sequences, through digital filters, to remove any information or to enhance it or attenuate it.

13.- Represent discrete, linear and invariant, systems through differences equations and recognize its own characteristics.

Bibliography

Moodle Web resources

Course Name:	Noise and Vibration Control	**Course Code:**	595010143
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Fall	**Language:**	Spanish
Prerequisites / Co-requisites:		Room Acoustics Sound and Image Fundamentals Acoustic Engineering	
Bachelor Engineering Program:		Sound and Image Engineering	

Course Contents

1. Noise Effects
2. Systematic Approach to Noise Control
3. Noise Generators
4. Aerodynamic Noise
5. Noise produced by vibrating structures
6. Vibration Control
7. Impact Noise Isolation
8. Noise Legislation

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

(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 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.

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

1.- Know the parameters that assess the sources of noise and vibration.

2.- Know the behavior of the structures against vibrations.

3.- Know how aerodynamic noise is produced, spreaded and controlled.

4.- Know how the specific legislation on noise.is structured, developed and applied

5.- Learn about the physical phenomena that give rise to the appearance of noise sources.

6.- Know the physical behaviour of noise sources, considered individually and in group.

7.- Assess specific effects of noise and vibration on people.

8.- Know how the noise generated by vibrating structures is produced, spreaded and controlled.

9.- Know how structure-borne noise is produced, transmitted and controlled.

Bibliography

Gil, C., Control de Ruido, Dpto. Publicaciones de la E.T.S. de Ingeniería y Sistemas de Telecomunicación, Madrid, 2002

Beranek, L. L. y Ver, I. L., Noise and Vibration Control Engineering: Principles and Applications, New York, McGraw Hill, 1992

Fahy, F., Sound and Structural Vibration (Radiation, Transmission and Response) Academic Press, London, 1985

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Dowling, A. P. y Flowcs Williams, J. E., Sound and Sources of Sound, Jhon Wiley & Sons, Inc, England, 1983

Wilson, C. E., Noise Control, Harper & Row, Publishers Ltd, New York, 1989

Course Name:	Audio Engineering IV	**Course Code:**	595010144
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Fall	**Language:**	Spanish
Prerequisites / Co-requisites:		Sound and Image Fundamentals Audio Engineering I Audio Engineering II	
Bachelor Engineering Program:		Sound and Image Engineering	

Course Contents

1. Musical Timing
2. Audio Restoring
3. Sonority Measurement in Audio
4. Digital Multitrack Editing in Audio
5. Audio Signal Mixing
6. Audio Mastering

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

(e) An ability to identify, formulate, and solve engineering problems

(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 B2 Basic knowledge on using and programming computers, operating systems, databases and software used in engineering.

CE SI01 Ability to build, utilize and manage telecommunication services and applications for the purpose of acquiring, treating analogically and digitally, encoding, transporting, representing, processing, storing, reproducing, managing and presenting audiovisual services and multimedia information.

CE SI02 Ability to analyze, specify, implement and support television, audio and video systems, equipment, headers and facilities, both in fixed and mobile environments.

CE SI03 Ability to carry out projects for studios and facilities which will be used for audio and video signal production and recording.

CE SI05 Ability to create, encode, manage, broadcast and distribute multimedia content, taking into account usability and accessibility criteria for audiovisual, broadcast and interactive services.

CE TEL08 Ability to apply analysis and treatment of signals and modeling system tools

CE TEL16 Knowledge of telecommunication legislation and regulations at the National, European and International levels.

CG 04 Ability to abstract, analyze, and synthesize, and to solve problems.

CG 12 Skills for interpersonal relations and work in a national and international context, with the ability to express in oral and written English.

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

1.- Each and every one of the learning outcomes are totally linked in direct and essential way with the specific content that is imparted in the subject, being, essential that the generic competences are settled efficiently since your domain will improve teacher-student communication and, no doubt, will contribute to the better use of the subject. Since each of the learning outcomes are associated with specific competencies, each and every one of the specific contents of the subject become, in turn, indicators of achievement that will be subject to the criteria of evaluation of equal form and relevance.

Bibliography

Alten, Stanely R. Audio in Media. Thomson Publishing

Katz, Bob. Mastering Audio. Focal Press, 2002

Bogh Brixen, Eddy. Audio Metering. Focal Press, 2011

Course Name:	Image Synthesis and Computer Animation	**Course Code:**	595010145
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Spring	**Language:**	Spanish
Prerequisites / Co-requisites:		Sound and Image Fundamentals Image and Video Technologies	
Bachelor Engineering Program:		Sound and Image Engineering	

Course Contents

1. Introduction
2. Modelling
3. Cameras and Illumination
4. Texturing and Environment
5. Animation
6. Interactivity and Sound
7. Complexity, quality and efficiency

ABET Student Outcomes

(a) An ability to apply knowledge of mathematics, science, and engineering

(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

(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 SI01 Ability to build, utilize and manage telecommunication services and applications for the purpose of acquiring, treating analogically and digitally, encoding, transporting, representing, processing, storing, reproducing, managing and presenting audiovisual services and multimedia information.

CE SI05 Ability to create, encode, manage, broadcast and distribute multimedia content, taking into account usability and accessibility criteria for audiovisual, broadcast and interactive services.

CG 07 Ability to design, manage, and direct projects.

CG 08 Ability to organize, plan and make decisions.

CG 11 Skills for the use of Information and Communication Technologies.

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

1.- Generate interactive 3D applications with synchronized audio.

2.- Generate 3D models with controlled appearance, animation and interactive behavior.

3.- Generate 3D environments by integrating the created models and controlling lighting, cameras, and other elements of environment.

4.- Generate 3D synthetic video with audio and composition with real video.

Bibliography

Merce Galan. "Blender: Curso de iniciacion", Infor Book S Ediciones, 2007.

Tony Mullen. "Animación de personajes con Blender (Diseño y creatividad)", Anaya Multimedia,

2007.

Joaquin Riezu Gonzalez. "Entendiendo el Game Engine de Blender", Junio 2011.

Sandra Moreno de Andrés. "Blender: Modelado y Animación para Aplicaciones Interactivas", Mayo 2012

Course Name:	Sound Reinforcement	**Course Code:**	595010146
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Spring	**Language:**	Spanish
Prerequisites / Co-requisites:		Room Acoustics Sound and Image Fundamentals Acoustic Engineering Electroacoustic Systems	
Bachelor Engineering Program:		Sound and Image Engineering	

Course Contents

1. Multichannel Sound in Cinema
2. Sound Reinforcement in large facilities

ABET Student Outcomes

(a) An ability to apply knowledge of mathematics, science, and engineering

(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

(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 SI03 Ability to carry out projects for studios and facilities which will be used for audio and video signal production and recording.

CE SI04 Ability to carry out acoustic engineering projects on: acoustic isolation and acoustic conditioning, PA installations; specification, analysis and selection of electroacoustic transductors; measurement, analysis and noise and vibration control systems; environmental acoustics; underwater acoustics systems.

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

1.- Know the current multichannel cinema sound systems specifications and future trends.

2.- Understand and design electroacoustic systems mounted in movie theaters.

3.- Designing and sizing an electroacoustic system for a movie theatre.

4.- Use simulation tools for the design of electroacoustic systems in movie theaters.

5.- Meet sound emission systems used in large installations.

6.- Propose equipment and diagrams of wiring systems of sound in movie theaters.

7.- Learn to interpret the technical characteristics of the electroacoustic systems mounted in theaters.

8.- Calculate the amplification of a multiple speaker system.

9.- Know and apply the techniques of grouping of sources used in large installations, clusters, and linear arrays of loudspeakers.
10.- Predicting the radiation and coverage of groups of speakers using professional tools.

Bibliography

Ahnert W, Steffen F, Sound Reinforcement Engineering: fundamentals and practice, E & F N Spon, London,1999.

Davis G., Jones R., Sound Reinforcement Handbook, Yamaha Corporation, Milwaukee, 1990.

Davis D, Davis C., Sound System Engineering, Howard W. Sams & Sons, Indianapollis, 1989.

Eargle J., Handbook of Sound System Design, ELAR Publishing Company Inc., New York, 1989.

Eargle, J. and Foreman, C., JBL Audio engineering for sound reinforcement, Hal Leonard Corporation, Milwaukee, 2002.

"Altavoces: Características, Filtros de Cruce y Bocinas", Sánchez Bote J.L., UPM, Madrid 2006

Moodle Web Resources

Course Name:	Digital Image Processing	**Course Code:**	595010147
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Spring	**Language:**	Spanish
Prerequisites / Co-requisites:		Sound and Image Fundamentals Digital Signal Processing Image and Video Technologies	
Bachelor Engineering Program:		Sound and Image Engineering	

Course Contents

1. Introduction to Digital Image Processing
2. Elements of Visual Perception and models to express chromatic images
3. Two-dimensional Sampling and Quantification
4. Statistic Valuation of Images
5. Image Transforms
6. Image Enhancement
7. Image Filtering
8. Image Analysis. Artificial Vision.
9. Image Restoring

ABET Student Outcomes

(b) An ability to design and conduct experiments, as well as to analyze and interpret data

(e) An ability to identify, formulate, and solve engineering problems

(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)

CE SI05 Ability to create, encode, manage, broadcast and distribute multimedia content, taking into account usability and accessibility criteria for audiovisual, broadcast and interactive services.

CE ST06 Ability to analyze, to codify, to process and to transmit multimedia information using processed techniques of analog and digital signal.

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

CG 11 Skills for the use of Information and Communication Technologies.

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

1.- Identify and recognize the technical specifications of image capture devices.

2.- Recognize the basic features of a system of digital image processing.

3.- Understand the methods of extracting information from an image and if its reused by artificial vision systems.

4.- Select from technical specifications which image capture device is most suitable for a specific use.

5.- Knowing the process of restoration of images whose purpose is the estimation of the original image from the degraded image.

6.- Describe the process of digitization of the image.

7.- Carry out operations of accentuation of certain characteristics of the image according to its future implementation.

8.- Describe the scheme of connection of an image processing system.

Bibliography

FUNDAMENTALS OF DIGITAL IMAGE PROCESSING. Anil K. Jain. Prentice Hall

DIGITAL IMAGE PROCESSING González R. C., Woods R. E., Addison-Wesley.

Moodle Web Resources.

Course Name:	Network and System Administration	**Course Code:**	595010242
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Spring	**Language:**	Spanish
Prerequisites / Co-requisites:			
Bachelor Engineering Program:		Telematics Engineering	

Course Contents

1. Unix Systems Basic Administration
2. Basic Network Services
3. NFS Network File Systems
4. DNS Domain Name Service
5. LDAP Directory Service
6. E-mail Service

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

(e) An ability to identify, formulate, and solve engineering problems

(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 TE 03 Ability to build, utilize, and manage telematic services, employing analytic planning, dimensioning, and analysis tools

CE TE 05 Ability to follow the technologic progress of transmission, commutation and proccess to improve the networks and telematic services.

CG 02 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 10 Ability to handle specifications, rules and regulations and to apply them in the practice of the profession.

CG 11 Skills for the use of Information and Communication Technologies..

CG 13 Learning skills with a high degree of autonomy.

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

1.- Implement a web server that handles multiple virtual sites.

2.- Share file systems on a LAN using NFS.

3.- Perform secure communications (session of terminal, remote execution, file transfer,

tunnels, generation and use of pairs of keys) using SSH tools.

4.- Synchronize the clock of a machine using an external NTP server.

5.- Get to know the components and operation of the DNS on the Internet service.

6.- Diagnose DNS problems using tools at a low level.

7.- Install a type LAMP web application on a web server.

8.- Define simple access controls to the contents of a web server.

9.- Generate X.509 certificates and use them to encrypt communications from a web server and mail server.

10.- Know the most common network and application level firewall architectures and implement network-level filters.

11.- Manage the most basic functions of a Unix server (create accounts, mounting file systems, configure startup services, information about the status and the implementation of services).

12.- Register and delegate a DNS domain on the Internet and deploy at least two servers authoritative DNS for that domain.

13.- Implementing and administering an LDAP server with a simple directory tree structure.

14.- Implement a service of SMTP Internet e-mail with a post and POP/IMAP access to mailbox.

15.- Learn the main techniques for filtering of spam and virus emails.

16.- Implement an FTP server both to access authenticated as anonymous.

17.- Learn how to attach generic LDAP clients to an LDAP server.

18.- Learn about the architecture of the Internet e-mail service.

19.- Design and implement a DHCP service to a local area network.

Bibliography

Administración de redes y sistemas II, J. Martín, F.J. Ramírez, Dpto. Publicaciones EUITT (2006)

Unix system administration handbook? (3ª edición), E. Nemeth, G. Snyder, S. Seebass, T.R. Hein, Ed. Prentice-Hall (2001)

TCP/IP Network Administration, 3rd Edition, C. Hunt, Ed. O'Reilly (2002)

The Practice of System and Network Administration. T.A.Limoncelli, C. Hogan. Ed. Addison-Wesley (2002)

Course Name:	Access Networks Technologies	**Course Code:**	5950100246
Year:	3	**Semester:**	6
Credits (ECTS):	4,5	**Credit Hours:**	3
Area:	Elective	**Type:**	Elective / Type A
Term:	Spring	**Language:**	Spanish
Prerequisites / Co-requisites:		Advanced Networks and Services Transmission Systems	
Coordinator:		Antonio Redondo	
Bachelor Engineering Program:		Telematics Engineering	

Course Contents

1. Introduction to Access Networks
2. Copper Pair Access Networks
3. Mixed access fiber-coaxial networks
4. Networks with wavelength multiplexing
5. Optical access networks

ABET Student Outcomes

(a) An ability to apply knowledge of mathematics, science, and engineering

(e) An ability to identify, formulate, and solve engineering problems

(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 TM02 Ability to apply techniques on which telematic networks, services and applications are based, such as management, signaling and switching, routing, security (cryptographic protocols, tunneling, firewalls, digital payment, authentication, and content protection), traffic engineering (graph theory, queuing theory, tele traffic), billing, reliability and quality of service, whether in fixed or mobile environments, local or long distance, with different bandwidths, including telephony and data.

CE TM06 Ability to design client-server and P2P architectures, and to adapt operating systems and virtual machines.

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

1.- Understand characteristics (with rules, network architectures, components, limitations and services) of access networks that use as carriers of pairs of copper wires.

2.- Dimension access networks that use pairs of copper wires as carriers of.

3.- Understand characteristics (with rules, network, components, limitations and services architecture) networks with multiplexing (WDM) wavelength.

4.- Dimension access networks using fiber optic cables as carriers.

5.- Sized networks with multiplexing (WDM) wavelength.

6.- Understand the basic concepts of access networks.

7.- Sized mixed access networks using fiber optic cables and coaxial cables as carriers.

8.- Understand characteristics (with rules, network, components, limitations and services architecture) of mixed access networks using fiber optic cables and coaxial cables as carriers.

9.- Understand characteristics (with rules, network, components, limitations and services architecture) of access networks that use as carriers of fiber optic cables.

Bibliography

John A.C. Bingham. ADSL, VDSL, and multicarrier modulation. John Wiley and Sons, 2000

Charles K. Summers. ADSL: standards, implementation, and architecture. CRC Press, 1999

Ashwin Gumaste. DWDM network designs and engineering solutions. Cisco Press, 2003

C. Siva Ram Murthy. WDM optical networks: concepts, design, and algorithms. Prentice Hall PTR, 2002

Course Name:	Mobile Applications Development	**Course Code:**	595010243
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Spring	**Language:**	Spanish
Prerequisites / Co-requisites:		Information Processing in Telematic Applications	
Bachelor Engineering Program:		Telematics Engineering	

Course Contents

1. Introduction to applications and services for mobile web
2. Cross-Platform Mobile Application Development with HTML5
3. Android Native Application Development

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

(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 TM02 Ability to apply techniques on which telematic networks, services and applications are based, such as management, signaling and switching, routing, security (cryptographic protocols, tunneling, firewalls, digital payment, authentication, and content protection), traffic engineering (graph theory, queuing theory, tele traffic), billing, reliability and quality of service, whether in fixed or mobile environments, local or long distance, with different bandwidths, including telephony and data.

CE TM07 Ability to program networked, distributed, or interactive services and applications, taking into account usability and accessibility criteria.

CG 04 Ability to abstract, analyze, and synthesize, and to solve problems.

CG 05 Ability for teamwork in multidisciplinary environments.

CG 13 Learning skills with a high degree of autonomy.

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

1.- Deploying mobile applications with a concrete platform.

2.- Learn about the problems related to the adaptation of existing WEB content to mobile devices features.

3.- Know the main platforms for designing and implementing applications for mobile devices.

4.- Understand the model of development of applications for mobile devices.

Bibliography

Programming the Mobile Web, M. Firtman, O'Reilly Media Inc

Android Cookbook, I. F. Darwin, O'Reilly Media Inc

Course Name:	Systems Engineering	**Course Code:**	595010245
Year:	4	**Semester:**	7
Credits (ECTS):	4,5	**Credit Hours:**	3
Area:	Elective	**Type:**	Elective / Type A
Term:	Fall	**Language:**	Spanish
Prerequisites / Co-requisites:		Modeling Languages Advanced Applications Programming Computer Networks	
Coordinator:		Jesús Moreno	
Bachelor Engineering Program:		Telematics Engineering	

Course Contents

1. Introduction to Systems Engineering
2. Project Management
3. Quality Management
4. Systems Engineering Techniques

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

(e) An ability to identify, formulate, and solve engineering problems

(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)

CE TEL02 Ability to use applications of communication and computer (office automation, databases, advanced calculus, management of projects, visualization...) to support the development and utilization of nets, services and applications of telecommunication and electronics.

CG 03 Skilled for public speaking and in written and communicating information throughout documents and public speeches.

CG 04 Ability to abstract, analyze, and synthesize, and to solve problems.

CG 08 Ability to organize, plan and make decisions.

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

1.- Learn techniques and methods that allow designing and developing high quality telematics applications and services.

2.- Understand the principles of systems engineering oriented to telematics projects.

3.- Learn the techniques of management of the quality of a product.

4.- Use techniques, methods, notations and models allowing to solve problems associated with the definition, design, implementation and deployment of a software product.

5.- To know the fundamentals to measure, estimate and plan the development of software products.

6.- Learn techniques and approaches to systems for the development of software product engineering.

Bibliography

Roger S. PRESSMAN. Software engineering: a practitioner's approach. 7th edition. McGraw-Hill

Ian SOMMERVILLE. Ingeniería del Software. Ed. Prentice Hall

Erich GAMMA, Richard HELM, Ralph JOHNSON y John VLISSIDES. Patrones de diseño: elementos de software orientado a objetos reutilizable. Ed. Pearson Educación

Semantic Web and Model-Driven Engineering. Fernando S. Parreiras. John Wiley & Sons 2012

Model driven architecture: applying MDA to enterprise computing. David Frankel. Wiley

Object-Oriented and Classical Software Engineering. 8th Edition. Stephen R Schach, VANDERBILT U NASHVILLE.

Course Name:	Applications for Raspberry Pi	**Course Code:**	595010247
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Fall	**Language:**	Spanish
Prerequisites / Co-requisites:			
Bachelor Engineering Program:		Telematics Engineering	

Course Contents

1. Description of the architecture and the hardware resources of the RaspBerry-PI
2. Installation of a Linux operating system in RPI. Raspbian installation and verification of its operation. Basic Linux tutorial
3. Description of software applications for the RaspBerry PI
4. Pooling. Presentation in class by the students of the commissioning of the RPI. Evaluation activity
5. Creation of a distribution tailored to Linux using Buildroot
6. Development of software applications in C for RPI using Eclipse
7. Development of applications for RPI

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

(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 express oneself in oral and written form, and to convey information through documents and public presentations..

CG 03 Skilled for public speaking and in written and communicating information throughout documents and public speeches.

CG 04 Ability to abstract, analyze, and synthesize, and to solve problems.

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 EC03 Ability to perform the specification, implementation, documentation and adjustment of equipment and electronic systems of instrumentation and control, considering both the technical aspects and the corresponding regulations.

CE EC04 Ability to apply electronic as support technology in other fields and activities, not only in the field of Information Technologies and Communications.

CE EC05 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 EC07 Ability to design interface devices, data capture and storage, and terminals for services and systems of telecommunication.

CE EC08 Ability to specify and use electronic instrumentation and measurement systems.

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

1.- Know the basic hardware features of an electronic system embedded as RaspBerry IP based on a System On Chip.

2.- Identify the functionality of each of the digital and analog interfaces included in the RaspBerry-PI.

3.- Install a Linux operating system and software applications in the RaspBerry Pi.

4.- Learn about the elements of a distribution of Linux for an embedded system.

5.- Configure and build a distribution of the Linux operating system using the Buildroot for the RaspBerry-IP platform.

6.- Connect a basic electronic circuit to one of the RaspBerry IP digital interfaces.

7.- Develop a basic software application using RaspBerry IP interfaces.

8.- Document the development of an application with RaspBerry-PI and present it in public.

9.- Present and defend in public proposed techniques to solve problems.

10.- Write technical papers presenting the steps followed and the conclusions obtained in the implementation of an application.

Bibliography

Moodle Web resources

Course Name:	Web Based Telematic Applications	**Course Code:**	595010241
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Fall	**Language:**	Spanish
Prerequisites / Co-requisites:		Information Processing in Telematic Applications	
Bachelor Engineering Program:		Telematics Engineering	

Course Contents

1. Principles and Components of Web Technologies
2. Men-Machine Interaction in Web based Applications
3. Dynamic Information Generation
4. Access and Information Repositories Management

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

(e) An ability to identify, formulate, and solve engineering problems

(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)

CE TM03 Ability to build, utilize, and manage telematic services, including internet, web, architectural design (data and protocols), programming, distributed knowledge management, multimedia information management, using analytic tools for planning, dimensioning, and analysis.

CE TM07 Ability to program networked, distributed, or interactive services and applications, taking into account usability and accessibility criteria.

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

1.- Understand and apply techniques of design of web-based applications.

2.- Understand and use technology for the generation of dynamic information services through web servers.

3.- Use and manage platforms for deployment, support, and use of telematic applications based on web.

4.- Understand the basic concepts of architecture of web-based applications and components.

5.- Understand and use technology for the generation of web-based applications user interfaces.

6.- Understand the modeling of information systems supported by relational database management systems.

7.- Use database management systems for the generation and manipulation of information through web-based applications.

Bibliography

Chuck Musciano and Bill Kennedy. HTML and XHTML: the definitive guide. O´Really, 2002

Thomas A. Powell. HTML 4: manual de referencia. McGraw-Hill.

R. ELMASRI, S.B. NAVATHE, Sistemas de bases de datos: conceptos fundamentales, Addison Wesley Longman de México, 1997.

C.J. DATE, Introducción a los sistemas de bases de datos. Pearson Educación, 2001.

Course Name:	Distributed Systems Development	**Course Code:**	595010244
Year:	4	**Semester:**	8
Credits (ECTS):	4,5	**Credit Hours:**	3
Area:	Elective	**Type:**	Elective / Type A
Term:	Spring	**Language:**	Spanish
Prerequisites / Co-requisites:		Communications Software	
Coordinator:		Javier Martín	
Bachelor Engineering Program:		Telematics Engineering	

Course Contents

1. Problems of Distributed Systems
2. Event Temporary Ordering
3. Communication in Process Groups
4. Replication
5. The Internet of Things
6. P2P 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

(e) An ability to identify, formulate, and solve engineering problems

(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)

CE TM03 Ability to build, utilize, and manage telematic services, including internet, web, architectural design (data and protocols), programming, distributed knowledge management, multimedia information management, using analytic tools for planning, dimensioning, and analysis.

CE TM07 Ability to program networked, distributed, or interactive services and applications, taking into account usability and accessibility criteria.

CG 02 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 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.

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

1.- Learn techniques for the location of information and peer in P2P networks .

2.- Implement mechanisms for the transfer of State between replicated servers.

3.- Know the major architectures to design replicated and fault-tolerant distributed systems.

4.- Learn about the principles and the issue of the composition and orchestration of services.

5.- Know and apply reference models based on IoT.

6.- Study the implementation of basic distributed algorithms derived from consensus and evaluate its complexity.

7.- Develop distributed applications with concurrent access and synchronization between operations requirements.

8.- Know and apply mechanisms for the detection of faults in a distributed system .

9.- Learn about the fundamental problem in distributed systems.

10.- Learn the techniques used to temporarily order of events in a distributed system and common kinds of management (FIFO, causal, total).

11.- Know and apply mechanisms for the reliable radiated from messages and process groups temporary ordination.

12.- Discover the architecture and functioning of fundamental P2P applications .

13.- Understand the main components and strategies for the development of middleware for distributed systems.

14.- Learn about different architectures for distributed event-oriented solutions.

15.- Learn the techniques used to synchronize physical clocks in a distributed system, fundamentally NTP.

16.- Understand the principles of dissemination of information on P2P networks.

Bibliography

Distributed Systems: concepts and design (4ª edición), Coulouris G., Dollimore J., Kindberg T., Ed. Addison Wesley/Pearson Education (2005)

Distributed Systems: principles and paradigms (2ª edición), Tanenbaum A.S., van Steen M., Ed. Pearson Prentice-Hall (2007)

Reliable Distributed Systems, Birman K.P., Ed. Springer (2005)

Deliverable D1.5 - Final Architectural Reference Model for the IoT v3.0, Bauer, M.; Boussard, M.; Bui, M.; Carrez, F.; Jardak, C.; De Loof, J.; Magerkurth, C.; Meissner, S.; Nettsträter, A.; Olivereau, A.; et al.. [on-line] https://goo.gl/gLdQ8U

Course Name:	Interaction Systems for Social Robotics	**Course Code:**	595010248
Credits (ECTS):	4,5	**Credit Hours:**	3
Term:	Autumn	**Language:**	Spanish/English
Prerequisites / Co-requisites:		Advanced Application Programming	
Bachelor Engineering Program:		Telematics Engineering	

Course Contents

1. What is Social Robotics?
2. Artificial Intelligence. Neural Networks
3. Human-Robot Interaction
4. Robot-Robot Interaction

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

(e) An ability to identify, formulate, and solve engineering problems

(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)

CE TM07 Ability to program networked, distributed, or interactive services and applications, taking into account usability and accessibility criteria.

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 12 Skills for interpersonal relations and work in a national and international context, with the ability to express in oral and written English.

CG 13 Learning skills with a high degree of autonomy.

CG 14 Skills for ethics and professional responsibility, respect for Human Rights and cultural diversity.

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

1. Understanding of the role of the Human Factors in engineering.
2. Understanding of cutting-edge technologies related with Human-Robot and Robot-Robot interaction

Bibliography

Loving the Machine: The Art and Science of Japanese Robots. Timothy N. Hornyak. Ed. Kodansha International (2006)

Unity in Action: Multiplatform Game Development in C# with Unity 5, Hocking, Joe. Ed. Editorial: Manning Publications (2015)

Introducing Artificial Intelligence: A Graphic Guide. Brighton, Henry. Ed. Icon Books (2012)