COMMUNICATIONS ELECTRONICS ENGINEERING B. Eng.

ELECTIVE COURSES TYPE B

Table of Contents

Course Name:	Sound and Image Fundamentals	**Course Code:**	595020122
Year:	3	**Semester:**	6
Credits (ECTS):	6	**Credit Hours:**	4
Area:	Elective	**Type:**	Elective / Type B
Term:	Spring	**Language:**	Spanish
Prerequisites / Co-requisites:		None	
Coordinator:		Danilo Simón	
Bachelor Engineering Program:		Communications Electronics Engineering Telecommunication Systems Engineering Telematics Engineering	

Course Contents

1. Signals, systems, and Acoustic measurements. Review of concepts

2. Voice and hearing

3. Plane and spherical waves

4. Standing Waves

5. Features of the light and the human eye

6. Colorimetry applied to the presentation of images

7. Signals which are used for the representation of images

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)

CE SO 01   Ability to construct, take advantage and manage services and telecom

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

CE SO 02   Ability to analyze, specify, implement and support systems, equipment, heads and facilities of television, Sound and Image, both fixed and mobile environments.

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

1.-   Ability to analyze the phenomenology associated with oscillations.

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

3.-   Ability to analyze plane and spherical acoustic waves in limited and unlimited surroundings.

4.-   Identify, characterize, and use capture and playback devices of Sound and Image: (microphones, speakers, cameras, monitors and projectors).

Bibliography

Moodle Web Resources

Course Name:	Analog Electronics	Course Code:	595020322
Year:	3	Semester:	6
Credits (ECTS):	6	Credit Hours:	4
Area:	Elective	Type:	Elective / Type B
Term:	Spring	Language:	Spanish
Prerequisites / Co-requisites:		Circuits Analysis I Electronics I	
Coordinator:		Francisco José Arqués	
Bachelor Engineering Program:		Communications Electronics Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. Introduction to electronic components

2. Polarizing techniques

3. Equivalent models of transistors

4. Middle frequency and small signal amplifiers

5. Frequency Response

6. Introduction to feedback amplifiers.

ABET Student Outcomes

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

(d)   An ability to function on multidisciplinary teams

(g)   An ability to communicate effectively

(h)   The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(j)   A knowledge of contemporary issues

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

Study Outcomes (according to the Spanish program definition)

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

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

CG 11	Skills for the use of Information and Communication Technologies.
CE B1	Ability to solve mathematic problems that may come up in engineering. Ability to apply knowledge on: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations, partial-differential equations, numeric methods, numeric algorithmics, statistics and optimization.
CE B2	Basic knowledge on using and programming computers, operating systems, databases and software used in engineering.
CE B4	Knowledge and command of basic concepts on linear systems and related functions and transforms, theory of electrical circuits, electronic circuits, physical principles of semiconductors and logic families, electronic and photonic devices, materials technohnology and its application for solving problems of engineering.
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 EC08	Ability to specify and use electronic instrumentation and measurement systems.
CE ST03	Capacity of analyzing components and their specifications for communications systems, guided and non-guided.

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

1.- Understand the characteristics of the diodes, bipolar and unipolar transistors used in electronic circuits.

2.- Understand the usefulness of the simulation of analog circuits based on diodes, transistors and operational amplifiers.

3.- Applying basic circuit analysis techniques to analyze the functioning of basic circuits with transistors.

4.- Understand the model behavior of bipolar and unipolar transistors, in working conditions of small signal level.

5.- Understanding bipolar and unipolar transistors graphically and analytical in continuous.

6.- Meet the Thevenin and Norton theorems, the simplifications which they give place and know to determine the equivalent which they generate.

Bibliography

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

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

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

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

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

de la Universidad de Cantabria

Course Name:	Advanced Application Programming	Course Code:	595020222
Year:	3	Semester:	6
Credits (ECTS):	6	Credit Hours:	4
Area:	Elective	Type:	Elective / Type B
Term:	Spring	Language:	Spanish
Prerequisites / Co-requisites:		Programming I Programming II	
Coordinator:		Pablo Ramírez	
Bachelor Engineering Program:		Communications Electronics Engineering Telecommunication Systems Engineering Sound and Image Engineering	

Course Contents

1. Multilayer Architectures

2. Graphic User Applications Development

3. Java Server Applications for Web

ABET Student Outcomes

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

(d)   An ability to function on multidisciplinary teams

(j)   A knowledge of contemporary issues

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

Study Outcomes (according to the Spanish program definition)

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

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

CE TM04   Ability to describe, programme, validate and optimize protocols and interfaces of communication in the different levels of networks' architecture.

CE TEL07   Knowledge and use of the principles of programming in telecommunication networks, systems and services.

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

1.-   Indicate and describe the existing regulation regarding the approval of cryptographic

systems.

2.- Establish a comparison between public key and symmetric key cryptosystems.

3.- Set the advanced capabilities of the X509 certification.

4.- Describe the basic security services in telematic networks.

5.- Describe algorithms commonly used in secret-key and public-key cryptosystems.

6.- Describe the mathematical foundations of modern cryptology.

7.- Describe the elements, structure and capacities of key distribution infrastructure.

Bibliography

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

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

Course Name:	Audio Engineering I	Course Code:	595020126
Year:	4	Semester:	7
Credits (ECTS):	4,5	Credit Hours:	3
Area:	Elective	Type:	Elective / Type A
Term:	Fall	Language:	Spanish
Prerequisites / Co-requisites:		Sound and Image Fundamentals Signals and Systems Communication Theory	
Coordinator:		Francisco Javier Tabernero	
Bachelor Engineering Program:		Communications Electronics Engineering Telecommunication Systems Engineering Telematics Engineering	

Course Contents

1. Psychoacoustic basis for Audio Engineering

2. Multichannel sound techniques

3. Audio Engineering equipment

4. Mixing consoles

ABET Student Outcomes

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

(d)   An ability to function on multidisciplinary teams

(g)   An ability to communicate effectively

(h)   The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(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 TEL 01   Ability to independently learn new knowledge and skills adequate for the design, development or utilization of telecommunication systems and

services.

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

1.- Ability to understand and analyze the characteristics of the different equipment and processors used in audio engineering.

2.- Ability to understand and analyze the characteristics of different mixing consoles used in audio systems.

Bibliography

Moodle Web Resources

Course Name:	Image and Video Technologies	Course Code:	595020128
Year:	4	Semester:	7
Credits (ECTS):	6	Credit Hours:	4
Area:	Elective	Type:	Elective / Type B
Term:	Fall	Language:	Spanish
Prerequisites / Co-requisites:		Signals and Systems Sound and Image Fundamentals Communication Theory Digital Signal Processing	
Coordinator:		Martina Eckert	
Bachelor Engineering Program:		Communications Electronics Engineering Telecommunication Systems Engineering Telematics Engineering	

Course Contents

1. Basic features of Sound and Image signals

2. Digitalization and Encoding

3. Image and Video Compression

4. Advanced Video Encoding

ABET Student Outcomes

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

(d)　An ability to function on multidisciplinary teams

(g)　An ability to communicate effectively

(h)　The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i)　A recognition of the need for, and an ability to engage in life-long learning

(j)　A knowledge of contemporary issues

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

Study Outcomes (according to the Spanish program definition)

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

CG 03	Ability to express oneself in oral and written form, and to convey information through documents and public presentations.
CG 04	Ability to abstract, analyze, and synthesize, and to solve problems.
CG 05	Ability for teamwork in multidisciplinary environments.
CG 11	Skills for the use of Information and Communication Technologies.
CG 13	Learning skills with a high degree of autonomy.
CE SI01	Ability to construct, take advantage and manage services and telecom applications, understood these as systems of captation, analogical and digital treatment, codification, transmission, representation, processing, storage, reproduction, management and presentation of audiovisual services and multimedia information.
CE SI05	Ability to create, encode, manage, transmit and distribute multimedia contents, according to usability and accesibility criteria of audiovisual, transmitting and interactive services.
CE TEL01	Ability to independently learn new knowledge and skills adequate for the design, development or utilization of telecommunication systems and services.

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

1.- Ability to understand some advanced video encoding processes.
2.- Ability to understand the process of compressing video signals and auxiliary signals.
3.- Ability to understand the processes of digitization and encoding of images.
4.- Ability to understand the different formats of the video signal, for the various resolutions used in initial format, uncompressed.

Bibliography

Moodle Web Resources.

Course Name:	Communications Electronics I	Course Code:	595020328
Year:	4	Semester:	7
Credits (ECTS):	4,5	Credit Hours:	3
Area:	Elective	Type:	Elective / Type B
Term:	Fall	Language:	Spanish
Prerequisites / Co-requisites:		None	
Coordinator:		Miguel Ángel del Casar	
Bachelor Engineering Program:		Communications Electronics Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

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

ABET Student Outcomes

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

(c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) An ability to function on multidisciplinary teams

(g) An ability to communicate effectively

(h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i) A recognition of the need for, and an ability to engage in life-long learning

(j) A knowledge of contemporary issues

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

Study Outcomes (according to the Spanish program definition)

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

CG 03	Ability to express oneself in oral and written form, and to convey information through documents and public presentations.
CG 04	Ability to abstract, analyze, and synthesize, and to solve problems.
CG 05	Ability for teamwork in multidisciplinary environments.
CG 09	Ability to analyze and assess the social and environmental impact of technical solutions.
CG 10	Ability to handle specifications, rules and regulations and to apply them in the practice of the profession.
CE B4	Knowledge and command of basic concepts on linear systems and related functions and transforms, theory of electrical circuits, electronic circuits, physical principles of semiconductors and logic families, electronic and photonic devices, materials technohnology and its application for solving problems of engineering.
CE ST03	Capacity of analysing components and their specifications for communications systems, guided and non-guided.
CE ST04	Capacity for the selection of circuits, subsystems and systems of radiofrecuency, microwave, broadcasting, radiolinks and radiolocalization.
CE ST07	Ability to design and development of telecommunications networks for industrial applications
CE TEL01	Ability to independently learn new knowledge and skills adequate for the design, development or utilization of telecommunication systems and services.
CE TEL02	Ability to use communication and computer applications (office automation, databases, advanced calculus, project management, visualization...) to support the development and utilization of networks, services and telecommunication and electronics applicatiectronics.
CE TEL03	Ability to use computer tools of search of bibliographical resources or of information related to the telecommunications and the electronics.

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

1. Analyze the characteristics of transistors by means of models.

2. Analyzing and designing basic electronic circuits.

3. Analyze, design, build and measure radio frequency oscillator circuits.

4. Analyze, design, build and measure indirect frequency synthesizers circuits.

5. Select components, circuits and commercial subsystems in the field of radio frequency generators.

6. Analyze and design electronic communications circuits.

7. Analyze and design electronic communications subsystems.

8. Manage electronic automated design tools.

9. Select the most appropriate signal generator circuit for each application.

10. Select the most appropriate oscillator technology for each application of communications

Bibliography

M. Sierra Pérez y otros, Electrónica de Comunicaciones, Pearson Education, 2003
G. González, Foundations of Oscillators Circuit Design, Artech House, 2006
R. Rhea, Oscillator Design and Computer Simulation, McGraw- Hill, 1995
J. Smith, Modern Communication Circuits, McGraw-Hill, 1998

F.M. Gardner, Phaselock Techniques, Wiley, 2005
R. Best, Phase Locked Loop ? Design, Simulation and Applications, McGraw-Hill, 2007
Rohde, Microwave and Wireless Synthesizers ? Analysis and Design, Wiley, 1997
A. Chenakin, Frequency Synthesizers: Concept to Product, Artech House, 2010
B.G. Goldberg, Digital Frequency Synthesis Demystified, Ed. Newmes, 1999

Course Name:	Wave Transmission and Propagation	Course Code:	595020327
Year:	4	Semester:	7
Credits (ECTS):	6	Credit Hours:	4
Area:	Elective	Type:	Elective / Type B
Term:	Fall	Language:	Spanish
Prerequisites / Co-requisites:		Calculus I Calculus II Linear Algebra Electromagnetism and Waves Waves Propagation	
Coordinator:		Jose María Rodríguez	
Bachelor Engineering Program:		Communications Electronics Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. Transmission Lines

2. S Parameters

3. Conductive Guides

4. Dielectric guides and fiber optic

ABET Student Outcomes

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

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

(d)   An ability to function on multidisciplinary teams

(g)   An ability to communicate effectively

(h)   The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i)   A recognition of the need for, and an ability to engage in life-long learning

(j)   A knowledge of contemporary issues

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

Study Outcomes (according to the Spanish program definition)

CG 02	Ability to search and select information, develop critical thinking and produce and defend arguments within the area..
CG 04	Ability to abstract, analyze, and synthesize, and to solve problems.
CG 13	Learning Skills with a high degree of autonomy
CE ST03	Capacity of analysing components and their specifications for communications systems, guided and non-guided.
CE ST05	Capacity for the selection of aerials, 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 TEL03	Ability to use computer tools of search of bibliographical resources or of information related to the telecommunications and the electronics.
CE TEL09	Ability to understand the mechanisms of electromagnetic and acoustic wave propagation and transmission, as well as corresponding transmitters and receivers.

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

1.- Characterize a transmission line by its electromagnetic parameters.
2.- Understand and handle impedance matching techniques.
3.- Interpret the mechanisms of propagation of electromagnetic waves in confined media: conductive guides and fiber optics.
4.- Interpret the techniques used in high frequency circuits and subsystems.
5.- Design and characterize high frequency circuits and subsystems.
6.- Handling of the instrumentation used in microwave and high frequency technologies.

Bibliography

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

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

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

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

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

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

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

Year 2015/16

Course Name:	Transmission Systems	Course Code:	595020228
Year:	4	Semester:	7
Credits (ECTS):	6	Credit Hours:	4
Area:	Elective	Type:	Elective / Type B
Term:	Fall	Language:	Spanish
Prerequisites / Co-requisites:		Communication Theory	
Coordinator:		Antonio Da Silva	
Bachelor Engineering Program:		Communications Electronics Engineering Telecommunication Systems Engineering Sound and Image Engineering	

Course Contents

1. Introduction to Transmission Systems

2. 2 Mb/s Multiplex Systems

3. Digital Plesiochronous Hierarchy

4. Synchronous Digital Hierarchy (SDH): multiplexing structure

5. Fiber optic based Line Systems

6. Synchronous digital hierarchy: network structure

ABET Student Outcomes

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

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

(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 10   Ability to handle specifications, rules and regulations and applying them in the development of the profession

CE TM01   Ability to build, take advantage and manage networks, services, processes and telecom applications, understood these as systems of captation, transport, representation, processing, storage, management and presentation of multimedia information, from the point of view of telematic services.

CE TM02   Ability to apply techniques in which nets, services and telematic aplications are based, like systems of management, signalisation and commutation, routing, security (cryptographic protocols, tunnelling, firewall, mechanisms to collect, authenticate and protect contents), traffic engineering (graphs theory, queuing theory, teletraffic), tarification and reliability and service quality, in environments fixed, mobile, personal, local or long-distanced, with different bandwidths, including telephony and data.

CE TM05   Ability to follow the technologic progress of transmission, commutation and proccess to improve the networks and telematic services.

CE TM08   Ability to carry out professional projects in the area of technologies specific to telecommunication engineering, where competencies acquired in the degree need to be synthesized and integrated

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

1.-   Analyze the structure and quality of standardized at 2 MB/s systems.

2.-   Use the appropriate laboratory equipment for measurement of defects, abnormalities, and quality of the signal transmission in normalized structures according to the European synchronous digital hierarchy.

3.-   Calculate the bandwidths used in telephony and data communications.

4.-   Understand the operation of the transmitter and receiver at different levels of the European plesiochronous digital hierarchy .

5.-   Understand the rules used in the multiplexes of plesiochronous digital hierarchy.

6.-   Learn about other international standards equivalent to the European ones, relating to the plesiochronous digital hierarchy. .

7.-   Distinguish the elements that constitute a wide area network .

8.-   Know the parameters that define the quality of line systems by optical fiber.

9.-   Understand the problems arising in the integration of plesiochronous digital hierarchy networks with synchronous digital hierarchy networks. .

10.- Contextualise a transmission system model applied to a network at a great distance .

11.- Use the appropriate laboratory equipment to verify the proper functioning of the European plesiochronous digital hierarchy standard operating systems.

12.- Understand the rules used in the multiplex of synchronous digital hierarchy.

Bibliography

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

SISTEMAS DE TRANSMISIÓN, ETSIST Publicaciones

Course Name:	Mobile Communications Networks	Course Code:	595020234
Year:	4	Semester:	7
Credits (ECTS):	6	Credit Hours:	4
Area:	Elective	Type:	Elective / Type B
Term:	Fall	Language:	Spanish
Prerequisites / Co-requisites:		Telecommunication Networks and Services Computer Networks Signaling and Switching Advanced Networks and Services	
Coordinator:		Carlos Ramos Nespereira	
Bachelor Engineering Program:		Communications Electronics Engineering Telecommunication Systems Engineering Sound and Image Engineering	

Course Contents

1. Introduction to cellular mobile systems

2. GSM Systems: GSM, GPRS, EDGE

3. 3G Systems: UMTS, HSDPA, HSUPA

4. Introduction to 4G mobile systems

ABET Student Outcomes

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

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

(d)   An ability to function on multidisciplinary teams

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

(g)   An ability to communicate effectively

(h)   The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(j)   A knowledge of contemporary issues

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

Study Outcomes (according to the Spanish program definition)

CG 03	Ability to express oneself in oral and written form, and to convey information through documents and public presentations.
CG 05	Ability for teamwork in multidisciplinary environments.
CG 10	Ability to handle specifications, rules and regulations and applying them in the development of the profession
CE TM01	Ability to build, take advantage and manage networks, services, processes and telecom applications, understood these as systems of captation, transport, representation, processing, storage, management and presentation of multimedia information, from the point of view of telematic services.
CE TM02	Ability to apply techniques in which nets, services and telematic applications are based, like systems of management, signalization and commutation, routing, security (cryptographic protocols, tunneling, firewall, mechanisms to collect, authenticate and protect contents), traffic engineering (graphs theory, queuing theory, teletraffic), tarification and reliability and service quality, in environments fixed, mobile, personal, local or long-distanced, with different bandwidths, including telephony and data.
CE TM05	Ability to follow the technologic progress of transmission, commutation and process to improve the networks and telematic services.
CE TM08	Ability to carry out professional projects in the area of technologies specific to telecommunication engineering, where competencies acquired in the degree need to be synthesized and integrated

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

1.-   Ability to describe the basic characteristics of cellular mobile systems.

2.-   Ability to identify emerging technological alternatives in 4G.

3.-   Ability to explain the structures of protocols on GSM/GPRS/EDGE interfaces.

4.-   Ability to justify functional improvements between 2G technologies.

5.-   Ability to detail the functionality of the elements of architecture in the 3G network: UMTS/HSDPA/HSUPA.

6.-   Ability to establish a chronological classification comparison of mobile communications systems.

7.-   Ability to relate messages signaling with the services of the level of link and the logical channels defined in the networks GSM/GPRS/EDGE radio interface.

8.-   Ability to explain technical and functional improvements among the 3G technologies.

9.-   Ability to identify the functionality of control messages exchanged in the networks GSM/GPRS/EDGE radio interface

Bibliography

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

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

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

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

Madrid, 2012.

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

Course Name:	Audio Engineering II	Course Code:	595020131
Year:	4	Semester:	8
Credits (ECTS):	6	Credit Hours:	4
Area:	Elective	Type:	Elective / Type B
Term:	Spring	Language:	Spanish
Prerequisites / Co-requisites:		Audio Engineering I Sound and Image Fundamentals	
Coordinator:		Antonio Mínguez	
Bachelor Engineering Program:		Communications Electronics Engineering Telecommunication Systems Engineering Telematics Engineering	

Course Contents

1. Digitalization of the audio signal

2. Interconnection

3. Digital Audio Workstations (DAW)

4. Digital storage of audio signal

5. Optical audio storage media

6. Audio coding. Binary system reduction techniques

ABET Student Outcomes

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

(d)   An ability to function on multidisciplinary teams

(g)   An ability to communicate effectively

(h)   The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i)   A recognition of the need for, and an ability to engage in life-long learning

(j)   A knowledge of contemporary issues

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

Study Outcomes (according to the Spanish program definition)

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

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

CE SI01   Ability to construct, take advantage and manage services and telecom applications, understood these as systems of captation, analogical and digital treatment, codification, transmission, representation, processing, storage, reproduction, management and presentation of audiovisual services and multimedia information.

CE SI02   Ability to analyze, specify, implement and support systems, equipment, heads and facilities of television, Sound and Image, both fixed and mobile environments.

CE SI03   Ability to perform projects of places and facilities destined to the production and recording of Sound and Image signals.

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

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

1.- Recognize devices and terminals of communication, data capture and playback of Sound and Image, and its main parameters.

2.- Understand and analyze the characteristics of the different environments in audio installations.

3.- Know and understand in detail the audio coding techniques that reduce the bit rate.

4.- Understanding the techniques used in the storage of the audio signal and the most important optical systems.

5.- Ability to understand and analyze the characteristics of different mixing consoles used in audio systems

6.- Understand and analyze the characteristics of different mixing consoles used in audio systems.

7.- Know the specific aspects in the digitalization of the audio signal.

8.- Analyze the characteristics and design of interconnection between audio equipment.

9.- Ability to understand and analyze the characteristics of the different equipment and processors used in audio engineering.

10.- Understanding and handling of Sound and Image signals (digitization, formats and coding systems).

11.- Understand and analyze the characteristics of the different equipment used in audio engineering for a specific use.

Bibliography

Pohlmann, Ken C. Principios de audio digital. McGraw Hill, 2002.

Watkinson, J. The Art of Digital Audio. Focal Press, 2001.

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

Course Name:	Communications Electronics II	Course Code:	595020331
Year:	4	Semester:	8
Credits (ECTS):	6	Credit Hours:	4
Area:	Elective	Type:	Elective / Type B
Term:	Spring	Language:	Spanish
Prerequisites / Co-requisites:		Communication Electronics I	
Coordinator:		Federico Javier Ortega	
Bachelor Engineering Program:		Communications Electronics Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. Transmitters and receivers

2. Small signal amplifiers

3. Conventional power amplifiers

4. Switched power amplifiers

5. Amplifier Design

6. Linearization

7. Frequency Mixers

ABET Student Outcomes

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

(c)   An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d)   An ability to function on multidisciplinary teams

(g)   An ability to communicate effectively

(h)   The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i)   A recognition of the need for, and an ability to engage in life-long learning

(j)   A knowledge of contemporary issues

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

engineering practice.

Study Outcomes (according to the Spanish program definition)

CE ST01   Ability to construct, take advantage and manage services and telecom applications, understood these as systems of captation, analogical and digital treatment, codification, transmission, representation, processing, storage, reproduction, management and presentation of audiovisual services and multimedia information.

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

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

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

Bibliography

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

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

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

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

Course Name:	Networks and Services Security	Course Code:	595020231
Year:	4	Semester:	8
Credits (ECTS):	6	Credit Hours:	4
Area:	Elective	Type:	Elective / Type B
Term:	Spring	Language:	Spanish
Prerequisites / Co-requisites:		Programming II Computer Networks Telecommunication Networks and Services	
Coordinator:		Ana Gómez	
Bachelor Engineering Program:		Communications Electronics Engineering Telecommunication Systems Engineering Sound and Image Engineering	

Course Contents

1. General approaches on the security of networks and services

2. Security Infrastructures

3. Spanish legislation on information security. Recommendations and safety audits

4. Cybersecuriy Applications

ABET Student Outcomes

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

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

(g)   An ability to communicate effectively

(h)   The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(j)   A knowledge of contemporary issues

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

Study Outcomes (according to the Spanish program definition)

CG 02   Ability to search and select information, develop critical thinking and
                 produce and defend arguments within the area..
CG 05   Skilled for teamwork in multidisciplinary environments

CE TM01   Ability to build, take advantage and manage networks, services, processes and telecom applications, understood these as systems of captation, transport, representation, processing, storage, management and presentation of multimedia information, from the point of view of telematic services.

CE TM02   Ability to apply techniques in which nets, services and telematic aplications are based, like systems of management, signalisation and commutation, routing, security (cryptographic protocols, tunnelling, firewall, mechanisms to collect, authenticate and protect contents), traffic engineering (graphs theory, queuing theory, teletraffic), tarification and reliability and service quality, in environments fixed, mobile, personal, local or long-distanced, with different bandwidths, including telephony and data.

CE TM05   Ability to follow the technologic progress of transmission, commutation and proccess to improve the networks and telematic services.

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

1.- Set the advanced capabilities of the X 509 certification.

2.- Designing and defining the most optimal solution for a specific telematics system that meets its security requirements.

3.- Indicate and describe the existing regulation regarding the approval of cryptographic systems.

4.- Describe the elements, structure and capabilities of the cryptographic tokens.

5.- Analyze the risks and vulnerabilities of networks and their systems.

6.- Describe the most commonly used security mechanisms for protecting networks and systems-level transport.

7.- Describe traditional security services used in telematics mechanisms such as email and Web service.

8.- Indicate the most significant aspects in relation to the standards for smart cards.

9.- Describe the most commonly used security mechanisms for the protection of networks and network-level systems.

10.- Define the protocols of action for efficient management of the security of networks and systems in accordance with standards and recommendations in force.

11.- Describe the basic security services in telematics networks.

12.- Describe the mathematical foundations of modern cryptology.

13.- Describe algorithms commonly used in secret-key and public-key cryptosystems.

14.- Establish a comparison between public-key and symmetric-key cryptosystems.

15.- Describe the elements, structure and capacities of key distribution infrastructure.

Bibliography

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

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