TELECOMMUNICATIONS SYSTEMS ENGINEERING B. Eng.

SEMESTER 5

Table of Contents

Course Name:	Audiovisual Systems	Course Code:	595000319
Year:	3	**Semester:**	5
Credits (ECTS):	4,5	**Credit Hours:**	3
Area:	Communication Systems	**Type:**	Engineering Topic / Required
Term:	Spring	**Language:**	Spanish
Prerequisites / Co-requisites:		Wave Propagation Signals and System Communication Theory	
Coordinator:		Elena Blanco	
Bachelor Engineering Program:		Telecommunications Systems Engineering Communications Electronics Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. Capture and playback of sound and image devices

2. Sound and Image signals and formats

3. Introduction to streaming video and audio systems

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

(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 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.

CE TEL 04 Ability to analyze and specify the fundamental parameters of a communication

system.

CE TEL 05   Ability to weigh up the advantages and disadvantages of different technological alternatives to deploy or implement communication systems, from the point of view of signal space, perturbations and noise, and analog and digital modulation systems.gical and digital modulation.

CE TEL 16   Knowledge of telecommunication legislation and regulations at the National, European and International levels.

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

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

2.-   Select from technical specifications device capture video and playback most suitable for a specific use.

3.-   Describe the scheme of connection of a simple video system.

4.-   Describe the process of digitalization of the video signal.

5.-   Identify the formats of storage and transmission of video signals.

6.-   Identify and recognize the technical specifications of capture and audio playback devices.

7.-   Select most suitable capture and audio playback device from technical specifications for a specific use.

8.-   Describe the connection scheme of a simple audio system.

9.-   Describe the process of digitalization of the audio signal.

10.- Identify the storage formats and transmission of audio signals.

11.- Recognize the basic characteristics of by cable, fiber optic, radio link and satellite transmission system.

12.- Calculate the basic settings (bandwidth, power and s/n) of satellites, radio link, optical fiber and cable communications system.

Bibliography

"Transmisión por radio", Hernando Rábanos, J.M., Centro de estudios Ramón Areces.

"Micrófonos", Sánchez Bote, J.L. Dpto. Publicaciones EUITT.

Course Name:	Economics and Business Management	Course Code:	595000323
Year:	3	Semester:	5
Credits (ECTS):	4,5	Credit Hours:	3
Area:	Organization Engineering	Type:	Basic / Required
Term:	Fall	Language:	Spanish
Prerequisites / Co-requisites:		None	
Coordinator:		Waldo Pérez	
Bachelor Engineering Program:		Telecommunications Systems Engineering Communications Electronics Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. Enterprise theory and markets
2. Behavior, specialization and exchange
3. Democratic governance and contractual process
4. Company and entrepreneur
5. Legal status and company governance
6. Financial information I
7. Financial information II
8. The strategic process: objectives and analysis
9. Strategies and business model

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

through documents and public presentations..

CG 05   Ability for teamwork in multidisciplinary environments.

CG 06   Ability for adaptability, negotiation, conflict resolution and leadership.

CG 08   Ability to organize, plan and make decisions.

CE B5   Acceptable knowledge of the concept of company, institutional and juridical frame of the company. Companies Organization and management.

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

CE TEL 02   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 TEL 06   Ability to design, deploy, organize and manage telecommunication networks, systems, services and infrastructures in residential (home, city and digital communities), business or institutional contexts, including setup, continuous improvement, and understantinuous improvement, as well as knowing their economic and social impact.

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

1.-   Recognize memory and other financial documents that are part of the annual accounts

2.-   Distinguish the main features of the other corporations

3.-   Recognize the main tools for external strategic analysis

4.-   Extending the model of behavior of economic agents as utility maximizers for situations where operating with imperfect information

5.-   Approaching the issue of company governance

6.-   Explain a model of behavior of economic agents as utility maximizers that have perfect information

7.-   Interpret the market, political and organizational solutions as various complementary solutions to the economic problem

8.-   Conceptualize the organization as complex form of hiring

9.-   Become familiar with the different meanings of businessman

10.-   Know the main characteristics of the individual entrepreneur and unincorporated partnerships

11.-   Recognizing the level of debt and working capital from financial information

12.-   Analyze the profitability of a company from the information provided in the annual accounts

13.-   Identify the model of behavior of the final consumer

14.-   Describe the model of company behavior characterized by a transformation function, both from the point of view of production and costs

15.-   Recognize the pattern of market behavior in perfect competition and monopoly, with interest in their differences

Bibliography

"Economía y Empresa para Ingenieros", Martinez Núñez, M.; Pérez Aguiar, W. S., Dpt. Publicactions, 2014.

Course Name:	Operating Systems	Course Code:	595000325
Year:	3	Semester:	5
Credits (ECTS):	4,5	Credit Hours:	3
Area:	Informatics	Type:	Engineering Topic / Required
Term:	Fall	Language:	Spanish
Prerequisites / Co-requisites:		Programming I Programming II Telecommunication Networks and Services Microprocessors	
Coordinator:		Javier Martín	
Bachelor Engineering Program:		Telecommunications Systems Engineering Communications Electronics Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. Concepts, objectives and components of the operating system
2. Processor management
3. Memory management
4. Concurrency
5. Input/output management
6. Files system

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

CG 05	Ability for teamwork in multidisciplinary environments.
CG 08	Ability to organize, plan and make decisions.
CG 11	Skills for the use of Information and Communication Technologies.
CG 13	Learning skills with a high degree of autonomy.
CE B2	Basic knowledge on using and programming computers, operating systems, databases and software used in engineering.
CE TEL 07	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.- Install and use a multi-programmed general purpose operating system.

2.- Learn general principles about general purpose and real time operating systems, as well as the basic mechanisms of resource management.

3.- Use Unix systems to develop applications in the field of telecommunications.

4.- Carry out a top-down design of an application from a medium complexity problem specification.

5.- Use the POSIX system calls.

6.- Program in a high-level language, applications of complexity half according to the rules of structured programming.

7.- Use standard application development tools for a general purpose operating system.

8.- Understand the specific problems of concurrent applications. Learn the basic tools for developing applications with these characteristics.

Bibliography

Moodle Resources

Course Name:	Signal Processing in Communications	Course Code:	595000326
Year:	3	Semester:	5
Credits (ECTS):	4,5	Credit Hours:	3
Area:	Telecommunication Systems and Technology	Type:	Engineering Topic / Required
Term:	Fall	Language:	Spanish
Prerequisites / Co-requisites:		Communication Theory Digital Signal Processing Programming I Signals and Systems Statistics and Stochastic Processes	
Coordinator:		Jose Manuel Pardo	
Bachelor Engineering Program:		Telecommunications Systems Engineering	

Course Contents

1. Real time spectral analysis of signals.

2. Monte Carlo simulation. Generation of pseudorandom sequences and numbers

3. Sampling of band-pass signals

4. Digital Signal Processors

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 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 ST04	Ability to select radiofrequency, microwave, radio broadcasting, radio link and radio localization circuits, subsystems and systems.
CE ST06	Ability to analyze, encode, process and transmit multimedia information using analog and digital signal processing techniques.
CE ST07	Ability to carry out professional projects in the specific field of telecommunication technologies in which competences attained in the program have to be synthesized and integrated.
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.
CE TEL06	Ability to design, deploy, organize and manage telecommunication networks, systems, services and infrastructures in residential (home, city and digital communities), business or institutional contexts, including setup, continuous improvement, and understantinuous improvement, as well as knowing their economic and social impact.
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 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.
CG 13	Learning skills with a high degree of autonomy.

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

1.- Simulation of systems and subsystems in communications, including the generation of the signal, modulation/demodulation, channel, and the analysis of the quality of the received signal

2.- Implementation of subsystems of signals under frequency conversion step band (modulated) using subsampling techniques.

3.- Use the different techniques of estimation of power, power spectral density, the signal-to-noise relationship, etc., of analog signals using digital techniques of processing based on the discrete transformed of Fourier.

4.- Interpret the specifications of all major systems and telecommunication services, the quality requirements, and the measures to be carried out to check these specifications.

5.- Implement, verify and compare filtering algorithms, coding, analysis, etc., in DSP-based evaluation boards

6.- Estimating error probability in digital communications and systems of detection or false alarm systems radar, through Monte Carlo simulation.

Bibliography

Moodle Web Resources

Course Name:	Wave Transmission and Propagation	Course Code:	595000327
Year:	3	Semester:	6
Credits (ECTS):	6	Credit Hours:	3
Area:	Applied Electromagnetism	Type:	Engineering Topic / Required
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:		Telecommunication Systems 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)

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

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.

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

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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.

Course Name:	Communications Electronics I	Course Code:	595000328
Year:	3	Semester:	5
Credits (ECTS):	6	Credit Hours:	4
Area:	Digital Electronics	Type:	Engineering Topic / Required
Term:	Fall	Language:	Spanish
Prerequisites / Co-requisites:		None	
Coordinator:		Miguel Ángel del Casar	
Bachelor Engineering Program:		Telecommunications Systems 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)

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 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

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radio localization circuits, subsystems and systems.

CE ST07   Ability to carry out professional projects in the specific field of telecommunication technologies in which competences attained in the program have to be synthesized and integrated.

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.

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.

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

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

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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

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V. Manassewitsch, Frequency Synthesizers: Theory and Desing, Wiley, 1987

A. Chenakin, Frequency Synthesizers: Concept to Product, Artech House, 2010

B.G. Goldberg, Digital Frequency Synthesis Demystified, Ed. Newmes, 1999