

TELECOMMUNICATIONS SYSTEMS ENGINEERING B. Eng.

SEMESTER 1

Table of Contents

Introductory Workshop on Engineering 3

Linear Algebra 5

Calculus I 7

Circuit Analysis I 9

Programming I..... 11

Introduction to Telecommunications 13

Year 2015/16

Course Name:	Introductory Workshop on Engineering	Course Code:	595000300
Year:	1	Semester:	1
Credits (ECTS):	3	Credit Hours:	2
Area:	Mathematics / Physics	Type:	Basic / Required
Term:	Fall	Language:	Spanish
Prerequisites / Co-requisites:		None	
Coordinator:		César Sanz	
Bachelor Engineering Program:		Telecommunications Systems Engineering Communications Electronics Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. Exponential, logarithmic and trigonometric functions
2. Complex Numbers
3. Derivation
4. Integration
5. Vectorial magnitudes and vectorial calculus
6. Simple harmonic movement
7. Waves
8. Linear and logarithmic scales. dB's
9. Electrostatics
10. Electric current

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
- (j) A knowledge of contemporary issues

Study Outcomes (according to the Spanish program definition)

- 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 algorithms, statistics and optimization.

CE B3 Acceptable knowledge of the concept of company, institutional and juridical frame of the company. Organization and management of companies.

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

- 1.- Calculate and represent exponential, logarithmic and trigonometric functions.
- 2.- Apply the differential and integral calculus to solve simple problems of engineering.
- 3.- Efficiently manage ICT tools in the field of core topics of mathematics and physics.
- 4.- Solve basic problems in the field of basic mathematics and physics.
- 5.- Calculating currents and voltages in DC circuits by applying Ohm's law.
- 6.- Use complex numbers in the calculation phase of electric circuits.
- 7.- Apply the Vector calculus and the laws of conservation of energy to solving problems of mechanics.
- 8.- Understand the main laws of electromagnetism.
- 9.- Operate with complex numbers.
- 10.- Express with precision quantities and units.
- 11.- Understand the main parameters of mechanical and electromagnetic waves.
- 12.- Identify and model examples of simple harmonic motion.

Bibliography

Moodle Resources

Year 2015/16

Course Name:	Linear Algebra	Course Code:	595000301
Year:	1	Semester:	1
Credits (ECTS):	6	Credit Hours:	4
Area:	Mathematics	Type:	Basic / Required
Term:	Fall / Spring	Language:	Spanish
Prerequisites / Co-requisites:		None	
Coordinator:		Gerardo Pérez	
Bachelor Engineering Program:		Telecommunications Systems Engineering Communications Electronics Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. Systems of linear equations
2. Linear combinations
3. Matrices algebra
4. Determinants
5. Linear transformations
6. \mathbb{R}^n subspaces
7. Vectorial spaces
8. Diagonalization
9. Orthogonality
10. Symmetric matrices diagonalization
11. Differential linear equations

ABET Student Outcomes

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

Study Outcomes (according to the Spanish program definition)

CG 04 - Skilled for abstraction, analysis and synthesis and problem solving

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 algorithms, statistics and optimization.

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

- 1.- Solve a linear differential equation of second order with constant coefficients.
- 2.- Study when a linear transformation is *suprayectiva* and when it is *inyectiva*.
- 3.- Calculate determinants.
- 4.- Compute the inverse of a matrix and a linear transformation.
- 5.- Identify a vector space and manage vector spaces of matrices, signals, polynomials and functions in general.
- 6.- Consider whether a matrix is diagonalizable and diagonalize arrays.
- 7.- Using mathematical software find dimensions, bases, coordinates, orthogonal projections and distances.
- 8.- Calculate the solution least-squares system.
- 9.- Know and apply the different characterizations of a non-singular matrix.
- 10.- Find the matrix of a linear transformation with the composition of linear applications.
- 11.- Compute the orthogonal projection of a vector of a vector subspace.
- 12.- Orthogonally diagonalize a symmetrical matrix and applying the spectral theorem.
- 13.- Compute an orthogonal basis using the Gram-Schmidt process.
- 14.- Calculate dimensions and bases of subspaces, in particular of kernels and images of linear applications.
- 15.- Learn ways to define and calculate the rank of a matrix.
- 16.- Calculate the matrix of a linear transformation with respect to arbitrary bases.
- 17.- Calculate coordinates on orthogonal bases by orthogonal matrices.
- 18.- Calculate the regression line.
- 19.- Know and calculate the ratio of similarity between different arrays of an endomorphism.
- 20.- Analyze and solve systems of linear equations using the reduced stepped form of the matrix of the system
- 21.- Characterize when a set of vectors form a set of generators, when they are independent and form a basis.
- 22.- Demonstrate and apply the range theorem.
- 23.- Using mathematical software study systems linear, sets of vectors and linear applications.

Bibliography

Moodle Resources

Year 2015/16

Course Name:	Calculus I	Course Code:	595000302
Year:	1	Semester:	1
Credits (ECTS):	6	Credit Hours:	4
Area:	Mathematics	Type:	Basic / Required
Term:	Fall / Spring	Language:	Spanish
Prerequisites / Co-requisites:		None	
Coordinator:		Rafael José Hernández	
Bachelor Engineering Program:		Telecommunications Systems Engineering Communications Electronics Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. Real functions of real variable.
2. Defined Integral.
3. First order ordinary differential equations.
4. Number successions and series.
5. Power Series.
6. Fourier series.

ABET Student Outcomes

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

Study Outcomes (according to the Spanish program definition)

- CG 03 - Ability to express oneself in oral and written form, and to convey information through documents and public presentations.
- CG 04 - Ability to abstract, analyze, and synthesize, and to solve problems.
- 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.

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

- 1.- Apply the basic properties and operate with real numbers.
- 2.- Identify and manage the elementary functions and those that are to operate with them (multiplication, addition, composition, etc.) and in particular of those often used in the

race (trigonometric, periodic, pulses, etc.).

- 3.- Calculate limits of real functions of a real variable. Understand the concept of limit.
- 4.- Analyze and apply the concepts of continuity and differentiation of real functions and associated fundamental theorems.
- 5.- Apply the Taylor theorem in the local study of a function.
- 6.- Express the concept of primitive function and its relationship to the derivative. Apply some basic integration methods.
- 7.- State and apply the properties of the Riemann integral and its geometrical interpretation and the fundamental theorem of integral calculus.
- 8.- Calculate simple improper integrals.
- 9.- Ordinary differential equations (ODE) to recognize and resolve the basic examples of ODEs using classical elementary methods.
- 10.- Convergence of numerical series to analyze and classify some types of numerical series.
- 11.- Calculate the RADIUS and interval of convergence and to integrate and to derive a series of powers.
- 12.- Develop functions in power series and apply them to the local study and the calculation of amounts of numerical series.
- 13.- Calculate the periodic functions Fourier series coefficients
- 14.- Analyze if a periodic function is developable in Fourier series by using the theorem of Dirichlet, applying them to the calculation of amounts of numerical series.

Bibliography

“Cálculo I”, Larson, R.; Hosteller, R.P.; Edwards, B.H.; E. Pirámide (2002)

“Calculus”, Spivak, , Ed. Reverté (2012)

“Cálculo de una variable Stewart”, J., Ed Thomson (2002)

“Ecuaciones Diferenciales Ross”, S.L., Ed. Reverté (1984)



Year 2015/16

Course Name:	Circuit Analysis I	Course Code:	595000303
Year:	1	Semester:	1
Credits (ECTS):	6	Credit Hours:	4
Area:	Physics	Type:	Basic / Required
Term:	Fall / Spring	Language:	Spanish
Prerequisites / Co-requisites:		Workshop on Introductory Engineering	
Coordinator:		Juana María Gutiérrez	
Bachelor Engineering Program:		Telecommunications Systems Engineering Communications Electronics Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. Basic laws
2. Analysis of resistive circuits
3. AC analysis

ABET Student Outcomes

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

Study Outcomes (according to the Spanish program definition)

- CG 02 Ability to search and select information, develop critical thinking and produce and defend arguments within the area.
- CG 03 Ability to express oneself in oral and written form, and to convey information through documents and public presentations.
- CG 04 Ability to abstract, analyze, and synthesize, and to solve problems.
- CE B4 Knowledge and command of basic concepts on linear systems and related functions and transforms, theory of electrical circuits, electronic circuits, physical principles of semiconductors and logic families, electronic and photonic devices, materials technology and its application for solving problems of engineering.

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

1. Express correctly the magnitudes measured in electrical circuits using properly their units
2. Understand and apply the basic laws of circuits. (Ohm, Joule, Kirchhoff).

3. Calculate the power put into play in a circuit of active and passive elements.
4. Consider relations volt-ampere in passive components (RLC) with different senses in the voltage and current.
5. Learn about the different types of generators and the equivalence between them.
6. Determine the minimum number of equations needed to analyze a circuit.
7. Apply the methods of analysis of a circuit for voltages and currents.
8. Analyze circuits in sinusoidal steady-state, phasors and impedances.
9. Know, represent and operate with sinusoidal functions
10. Know and apply the fundamental theorems of analysis of circuits: overlay, multiplication by a constant, Thevenin and Norton, maximum power transfer.
11. Mount basic circuits with resistors, coils and capacitors in the laboratory and measurements with instruments.
12. Measurements of current and voltage varying with time.

Bibliography

“Circuitos eléctricos” Séptima edición. J. W. Nilsson, S. A. Riedel. Ed. Pearson Prentice-Hall. 2005

“Análisis de circuitos en ingeniería” Séptima edición. W. H. Hayt, Jr., J. E. Kemmerly, S. M. Durbin. Ed. McGraw Hill Interamericana. 2007

“Fundamentos de circuitos eléctricos” Tercera edición. C. K. Alexander, M. N. O. Sadiku. Ed. McGraw-Hill. 2006

“Análisis básico de circuitos en ingeniería” Sexta edición. J. D. Irwing. Ed. Prentice-Hall. 2003

Year 2015/16

Course Name:	Programming I	Course Code:	595000304
Year:	1	Semester:	1
Credits (ECTS):	6	Credit Hours:	4
Area:	Informatics	Type:	Basic / Required
Term:	Fall / Spring	Language:	Spanish
Prerequisites / Co-requisites:		None	
Coordinator:		Gregorio Rubio	
Bachelor Engineering Program:		Telecommunications Systems Engineering Communications Electronics Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. Basic concepts
2. Functions
3. Data structures
4. Files

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 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. Understand the basic fundamentals of structured programming.
2. Be able to program in a high-level language, applications of complexity half according to the rules of structured programming.
3. Be able to perform a top-down design of an application from a medium complexity problem specification.
4. Be able to program in a high-level language, applications of average complexity high according to the rules of structured programming.
5. How to use standard application development tools for a general purpose operating system.
6. Define the concept of processor, design, environment and actions.
7. Handle input/output operations. Operate with files.
8. Use operators (arithmetic, relational, logical and bitwise), expressions.
9. Implement actions and judgments of allocation, selection and iteration algorithms and programming language respectively.
10. Identify kinds of parameters and their types. Determining the mechanisms of passing parameters in arguments and results of functions.
11. Structuring a program functions and the use of the pass functions as arguments to other functions.
12. Explain the concept of module: use functions of library with other modules.
13. Familiarize yourself with the basic operation of tools to develop programs: editor, compiler, linker, and debugger.
14. Manage integrated development environments and getting used to document programs.
15. Prepare and organize workshops.

Bibliography

- J. GARCÍA DE JALÓN y otros. “Aprenda lenguaje ANSI C como si estuviera en primero”. Universidad de Navarra.
- A. MARZAL e I. GRACIA. “Introducción a la programación con C”. Universitat Jaume I. <http://www.uji.es/bin/publ/edicions/c.pdf>
- A. MITTAL. “Programming in C: A Practical Approach. Pearson Education”. <http://www.upm.es/institucional/UPM/Biblioteca/RecursosInformacion/LibrosElectronicos/9aa6a0a13292e210VgnVCM10000009c7648aRCRD>)
- F. J. CEBALLOS. “C/C++. Curso de programación”. 3ª Edición. Ed. Ra-Ma.
- JOYANES, I. ZAHONERO, “Programación en C. Metodología, algoritmos y estructuras de datos”. 2ª edición, 2005. McGraw-Hill/Interamericana de España.
- BRIAN W. KERNIGHAN, DENNIS M. RITCHIE, “El lenguaje de programación C”. Ed. Prentice-Hall. 1985.

Year 2015/16

Course Name:	Introduction to Telecommunications	Course Code:	595000305
Year:	1	Semester:	1
Credits (ECTS):	3	Credit Hours:	2
Area:	Communication Systems	Type:	Basic / Required
Term:	Fall	Language:	Spanish
Prerequisites / Co-requisites:		None	
Coordinator:		Rafael Herradón	
Bachelor Engineering Program:		Telecommunications Systems Engineering Communications Electronics Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. Historical evolution of telecommunications
2. Telecommunications and the social environment
3. Systems and telecommunications networks
4. Technologies, services and applications

ABET Student Outcomes

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

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 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.
- CE TEL16 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 characterize the different means of transmission and storage of digital and multimedia signals.
- 2.- Understand the historical evolution of telecommunications and its major landmarks.
- 3.- Relate the technical aspects with the social environment. Aspects of market, regulatory environment.
- 4.- Identify the structure, performance and applications of telecommunication systems, and Multimedia systems.
- 5.- Understand the model of telecommunication system and the need for modulation and demodulation processes.
- 6.- Identification of the elements and the network of transit, distribution, access and user technologies.
- 7.- Identify, characterize, and use capture and playback of Sound and Image devices: (microphones, speakers, cameras, monitors and projectors).

Bibliography

- “Una Panorámica de las Telecomunicaciones”, Aníbal Figueiras. Ed. Prentice Hall 2001
- “Manual de Telecomunicaciones” José Manuel Huidobro. Editorial Ra-ma. 2003
- “Redes y Servicios de Telecomunicaciones. José Manuel Huidobro. Ed. Paraninfo, 2006