

COMMUNICATIONS ELECTRONICS ENGINEERING B. Eng.

ELECTIVE COURSES TYPE C

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Year 2015/16

Course Name:	Introduction to Professional and Academic Communication I	Course Code:	595030063
Year:	3	Semester:	6
Credits (ECTS):	3	Credit Hours:	2
Area:	Elective	Type:	Elective / Type C
Term:	Fall / Spring	Language:	English
Prerequisites / Co-requisites:		None	
Coordinator:		Consuelo Lucía Regidor	
Bachelor Engineering Program:		Communications Electronics Engineering Telecommunication Systems Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. English in International Communication
2. Reading Techniques in University
3. Student's Life Planning
4. Informal Conversations
5. Use of language for efficient communication

ABET Student Outcomes

- (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

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 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.- Recognize and use typical expressions in English in different situations.
- 2.- Recognize main ideas from texts of intermediate level of complexity.
- 3.- Take notes of oral as conferences, meetings, discussions and documentaries presentations in English language.
- 4.- Expressed in English language with grammatical correctness.
- 5.- Use the bilingual and monolingual dictionary.
- 6.- Organize information from short texts.

Bibliography

Global intermediate student´s book + e workbook. Lindsay Clanfield , Macmillan Childrens Books, 2010

Moodle Resources

Year 2015/16

Course Name:	Discrete Mathematics	Course Code:	595030072
Year:	3	Semester:	6
Credits (ECTS):	3	Credit Hours:	2
Area:	Elective	Type:	Elective / Type C
Term:	Spring	Language:	Spanish
Prerequisites / Co-requisites:		None	
Coordinator:		Juana Sendra	
Bachelor Engineering Program:		Communications Electronics Engineering Telecommunication Systems Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. Combinatorial
2. Number Theory
3. Diophantine equations and congruencies
4. Graphs

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
- (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 algorithmics, statistics and optimization.

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

- 1.- Resolve and formulate problems whose solution strategy requires relationships and properties of natural, integer and rational numbers and their operations.

- 2.- Know and solve Diophantine equations and congruences.
- 3.- Formulate and solve problems by applying concepts of primes, multiples, etc. in real and mathematical contexts.
- 4.- Acquire ability of ordering and relating ideas with the help of mathematical methods.
- 5.- Make conjectures about properties and relationships of the numbers.
- 6.- Capability of ordering and relating ideas with the help of mathematical methods, as well as precision in the expressions using the notation, the method and vocabulary.
- 7.- Generate possible groupings distinguishing them according to certain characteristics.
- 8.- Use computer tools to propose, solve and explain problems of the subject.
- 9.- To link the theory of graphs with problems from other disciplines.
- 10.- Understand and manage the concepts and basic problems of graph theory.
- 11.- Be able to apply some special problems of graph theoretical results.
- 12.- Acquire operational skills in the resolution of exercises and problems that involve the number of different groupings.

Bibliography

Bujalance, E.; Bujalance, J.A.; Costa, A.F.; Martinez, E. (1993). Elementos de Matemática discreta. Ed. Sanz y Torres

Dorronsoro, J.; E. Hernández. (1996). Números, grupos y anillos, Addison- Wesley Iberoamericana S.A.

Grimaldi, R.L. (1989). Matemática discreta y combinatoria, Addison-Wesley Iberoamericana

Rosen, H.K. (2004). Matemática discreta y sus aplicaciones, 5a edición. Ed. McGraw-Hill.

Year 2015/16

Course Name:	ICT in Defense Applications	Course Code:	595030074
Year:	3	Semester:	6
Credits (ECTS):	3	Credit Hours:	2
Area:	Elective	Type:	Elective / Type C
Term:	Spring	Language:	Spanish
Prerequisites / Co-requisites:		None	
Coordinator:		Vicente González	
Bachelor Engineering Program:		Communications Electronics Engineering Telecommunication Systems Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. Platforms and ICTs
2. Communication Systems in Armed Forces
3. Dual Technologies in Defense
4. Cyber Defense

ABET Student Outcomes

- (a) An ability to apply knowledge of mathematics, science, and engineering
- (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 05 Ability for teamwork in multidisciplinary environments.
- CG 09 Ability to analyze and assess the social and environmental impact of technical solutions.
- CG 14 An attitude of Ethics and professional responsibility, as well as respect for

human rights and cultural diversity.

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

- 1.- Critical analysis of the Technique and Defense
- 2.- Relate the technical aspects with the social environment. Aspects of market, regulatory environment

Bibliography

Moodle Resources

Year 2015/16

Course Name:	Renewable Energy	Course Code:	595030060
Year:	4	Semester:	7
Credits (ECTS):	3	Credit Hours:	2
Area:	Elective	Type:	Elective / Type C
Term:	Fall	Language:	Spanish
Prerequisites / Co-requisites:		None	
Coordinator:		Manuel Vázquez	
Bachelor Engineering Program:		Communications Electronics Engineering Telecommunication Systems Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. Energy and Power
2. Actual Energetic System
3. Renewable Energy
4. Hydraulic, Aeolic and Sea Energy
5. Thermal Solar Energy
6. Photovoltaic Solar Energy

ABET Student Outcomes

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

engineering practice.

Study Outcomes (according to the Spanish program definition)

- CG 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.
- CE TEL12 Ability to use different energy sources and especially solar photovoltaic and thermal, as well as the foundations of the electrotechnics and power electronics.

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

- 1.- Understand the concepts of energy and work.
- 2.- Understand the global energy problem from social, environmental and sustainability point of view.
- 3.- Understand the different ways of generating renewable energy: thermal energy, kinetic energy, potential energy, photovoltaic solar energy...
- 4.- Learn about the regulations related to the different renewable energies.
- 5.- Know the different elements of a solar heating system.
- 6.- Learn about different renewable energy technologies that generate electricity from kinetic energy: wind, hydraulic, tidal or wave.
- 7.- Know and sizing solar heating systems.
- 8.- Know and sizing solar photovoltaic systems.

Bibliography

Radiación solar y dispositivos fotovoltaicos. Eduardo Lorenzo. Editorial Progensa.
Energías Renovables Jaime González Velasco. Editorial Reverté

Year 2015/16

Course Name:	Smart Home	Course Code:	595030061
Year:	4	Semester:	7
Credits (ECTS):	3	Credit Hours:	2
Area:	Elective	Type:	Elective / Type C
Term:	Fall	Language:	Spanish / English
Prerequisites / Co-requisites:		Telecommunication Networks and Services	
Coordinator:		Iván Pau	
Bachelor Engineering Program:		Communications Electronics Engineering Telecommunication Systems Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. Introduction to concepts of Digital and Smart Home
2. Technologies at the Digital Home
3. Ambient Intelligence at the Digital Home

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
- (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 08 Ability to organize, plan and make decisions.
- CG 09 Ability to analyze the social and environmental impact of technical solutions.
- 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 An attitude of Ethics and professional responsibility, as well as respect for human rights and cultural diversity.
- CE B2 Basic knowledge on using and programming computers, operating systems, databases and software used in engineering.
- 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 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 understantuous improvement, as well as knowing their economic and social impact.
- CE TEL07 Knowledge and use of the principles of programming in telecommunication networks, systems and services.
- CE TEL13 Knowledge and use of the concepts of network architecture, protocols and communication interfaces.
- CE TEL14 Ability to difference the concepts of access networks and transport, switching nets of circuits and packages, fixed and mobile networks, distributed systems and net applications, services of voice, data, audio, video, and interactive systems.
- 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.- Make the design of a complete solution in a residential environment.
- 2.- Understanding of the role of the Human Factors in engineering.
- 3.- Understanding of the smart home concept and its implications.

Bibliography

AENOR. "Código de prácticas del proyecto SmartHouse. UNE-CWA 50487 IN". AENOR ediciones, 2009. ISBN: 978-84-8143-639-6

European Telecommunications Standards Institute (ETSI). Human Factors. User

Experience Guidelines. Telecare Services (eHealth). ETSI EG 202 487. V.1.1.2., 2008.

Valero MA, Sánchez JA y Bermejo AB. Servicios y tecnologías de teleasistencia: tendencias y retos en el hogar digital. Dirección Gral. de Universidades e Investigación. Comunidad de Madrid, 2007

Nakashima H, Aghajan H y Augusto JC, Handbook of Ambient Intelligence and Smart Environments?. Ed. Springer, 2010.

Year 2015/16

Course Name:	Telecommunications Common Infrastructures	Course Code:	595030062
Year:	4	Semester:	7
Credits (ECTS):	3	Credit Hours:	2
Area:	Elective	Type:	Elective / Type C
Term:	Fall	Language:	Spanish
Prerequisites / Co-requisites:		None	
Coordinator:		Jose Luis Rodríguez	
Bachelor Engineering Program:		Communications Electronics Engineering Telecommunication Systems Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. Introduction to ICT
2. Basic Concepts
3. Transmission Lines
4. Device Study
5. ICT Implementation

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
- (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 05	Ability for teamwork in multidisciplinary environments.
CG 07	Ability to design, manage, and direct projects.
CG 10	Ability to handle specifications, rules and regulations and applying them in the development of the profession
CE ST02	Ability to apply techniques in which nets are based, telecommunications services and applications in both fixed and mobile environments, personal, local or long distance, with different bandwidths, including telephony, broadcasting, television and data from the point of view of transmission systems.
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 TEL05	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.
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 understanding their economic and social impact.
CE TEL09	Ability to understand the mechanisms of electromagnetic and acoustic wave propagation and transmission, as well as corresponding transmitters and receivers.
CE TEL16	Knowledge of telecommunication legislation and regulations at the National, European and International levels.
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.- Handling of the instrumentation and procedures for a basic laboratory of communication systems, (generator/oscilloscope and Spectrum Analyzer RF modulator).
- 2.- Identify the rules and regulations of application to engineering projects in a determined field.
- 3.- Knowledge of the peculiarities of the telecommunication project.
- 4.- Work on shared projects.
- 5.- Representation of the frequency response.
- 6.- Ability to design, analyze and measure a wireline access network in residential environments.
- 7.- Ability to design, analyze and implement signal of TV (SMATV) distribution

networks.

8.- Ability to design, management and the management of ICT projects.

Bibliography

Distribución de TV. Departamento de Publicaciones de la ETSIS de Telecomunicación

Moodle Web Resources

Year 2015/16

Course Name:	Introduction to Professional and Academic Communication II	Course Code:	595030071
Year:	4	Semester:	7
Credits (ECTS):	3	Credit Hours:	2
Area:	Elective	Type:	Elective / Type C
Term:	Fall / Spring	Language:	English
Prerequisites / Co-requisites:		Introduction To Professional And Academic Communication I	
Coordinator:		Inmaculada Álvarez de Mon	
Bachelor Engineering Program:		Communications Electronics Engineering Telecommunication Systems Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. language and Communication
2. Personal Story and Tradition
3. Technology and Progress
4. Personal Relations and Emotions
5. Procedure and Systems Organization

ABET Student Outcomes

- (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 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.- Organize information from short texts.
- 2.- Expressed in English language with grammatical correctness.
- 3.- Use the bilingual and monolingual dictionary.
- 4.- Recognize and use typical expressions in English in different situations.
- 5.- Take notes of oral as conferences, meetings, discussions and documentaries presentations in English language.
- 6.- Recognize main ideas from texts of intermediate level of complexity.

Bibliography

Global intermediate student's book + e workbook. Lindsay Clanfield , Macmillan Childrens Books, 2010

Year 2015/16

Course Name:	Management of Technological Innovation	Course Code:	595030070
Year:	4	Semester:	8
Credits (ECTS):	3	Credit Hours:	2
Area:	Elective	Type:	Elective / Type C
Term:	Spring	Language:	Spanish
Prerequisites / Co-requisites:		None	
Coordinator:		Juan Manuel Meneses	
Bachelor Engineering Program:		Communications Electronics Engineering Telecommunication Systems Engineering Sound and Image Engineering Telematics Engineering	

Course Contents

1. Course Introduction
2. Technologic Innovation
3. Protection of Results derived from Technologic Innovation
4. Technologic Vigilance and Competitive Intelligence
5. Entrepreneurship

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
- (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 05 Ability for teamwork in multidisciplinary environments.
- CG 06 Ability for adaptability, negotiation, conflict resolution and leadership.
- CG 07 Ability to design, manage, and direct projects.
- CG 08 Ability to organize, plan and make decisions.
- 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.- Awareness of the impact of innovation on: competitiveness, on the volume of business, about the life cycle of the product.
- 2.- Know and apply technological surveillance methodologies and tools.
- 3.- Identify and apply criteria from the application of technological surveillance to decision-making.
- 4.- Learn about the most common financing options to start-up a business idea.
- 5.- Know the types of protection of innovation: patents, industrial design, Software protection.
- 6.- Search for patent information tools, brands...
- 7.- Identify the different types of technological innovation.
- 8.- Learn the most common techniques for the presentation of business ideas.
- 9.- Identify and define entrepreneurial ideas through the study of cases of success.
- 10.- Learn about the structure and contents of a business plan.
- 11.- Manage a tool for analysis and design of business model that sustains a business plan.
- 12.- Meet the assessment criteria commonly used in the evaluation of business ideas.
- 13.- Identify the key aspects of a process of technological innovation.

Bibliography

Innovación Tecnológica. Ideas Básicas. Colección de innovación práctica. Fundación COTEC 2011.ISBN 84-95336-17-0

Manual de Oslo. Edición Comunidad De Madrid. 2007. Disponible en www.madrimasd.org

Criterios e Indicadores de la excelencia en la innovación empresarial. Jaime del Rey, Jaime La Viña. Colección EOI Tecnología e Innovación. 2008. ISBN: 978-84-88723-93-2

Osterwalder, Alexander, Pigneur, Yves. Generación de Modelos de Negocio. DEUSTO SA. Ediciones, 2011

Eric Ries. El método Lean Startup: Cómo crear empresas de éxito utilizando la Innovación continua. Deusto 2012

Year 2015/16

Course Name:	Dynamical Systems	Course Code:	595030173
Year:	4	Semester:	8
Credits (ECTS):	3	Credit Hours:	2
Area:	Elective	Type:	Elective / Type C
Term:	Spring	Language:	Spanish
Prerequisites / Co-requisites:	Linear Algebra Calculus I Calculus II		
Coordinator:	Rafael José Hernández		
Bachelor Engineering Program:	Sound and Image Engineering Communications Electronics Engineering Telecommunication Systems Engineering Telematics Engineering		

Course Contents

1. First Order Ordinary Differential Equations
2. Flat Linear Systems
3. Linear Systems in more dimensions
4. Introduction to non-linear systems
5. Non-linear global techniques
6. Applications in Circuit Theory
7. Lorenz's System: Chaos
8. Homoclinic Phenomena. El Chua circuit.

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

Study Outcomes (according to the Spanish program definition)

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

CG 04	Ability to abstract, analyze, and synthesize, and to solve problems.
CG 05	Ability for teamwork in multidisciplinary environments.
CG 11	Skills for the use of Information and Communication Technologies.
CG 13	Learning skills with a high degree of autonomy.
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 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.

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

- 1.- Learn how to apply dynamical systems theory in Electronics Field: Van der Pol Equation.
- 2.- Describe the phases of flat linear space. Knowing the algebraic and topological classification of such systems.
- 3.- Sorting equilibrium points.
- 4.- Analyze systems modeled by a first order differential equation, determining stationary points and stability. To describe analytical or numerical forks produced in such systems that depend on parameters.
- 5.- Reconocer sistemas no-lineales y encontrar su equilibrio analíticamente o numéricamente.
- 6.- Knowing the typology of the phase of multidimensional linear systems space. Analyze and classify specific systems of that Type:.
- 7.- Use global technical analysis of non-linear systems. Estimating the existence of periodic orbits and apply Poicare-Bendixson theorem.
- 8.- Familiarize yourself with the chaos theory and learn how to predict and to recognize when this phenomenon occurs: The Lorenz system.
- 9.- Recognize the types of bifurcation.
- 10.- Analyze examples of chaotic technology systems: Chua circuit and homoclinics phenomena.
- 11.- Use of numeric and symbolic calculation by computer, such as Maple, Mathematica, Matlab, Python, etc, to analyze systems dynamic of finite dimension.

Bibliography

Moodle Resources