ECTS Information Package: Degree Programme

Bachelor's degree in

ELECTRONICS AND COMPUTER ENGINEERING

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A - General Description

Programme Title - Engenharia Electrotécnica e de Computadores

Qualification awarded - Bachelor's degree in Electronics and Computer Engineering

Level of qualification - First-Cycle degree, ISCED Level 5, EQF Level 6

Specific admission requirements

General

In order to be eligible to this bachelor's degree, students must hold the high-school diploma or legally equivalent qualification. Application can also be made through the following special entry routes:

- Students coming from the Portuguese education system through re-admission, degree change and transfer schemes;
- Holders of a Foundation Course Diploma (CET);
- Adults aged more than 23 who have passed tailor-made examinations intended to assess their ability to pursue higher education studies;
- Holders of Intermediary or Graduate degree diplomas;
- Students coming from foreign higher education.

Specific

Entry Subjects: Mathematics and Physics/Chemistry

The degree in Electronics and Computer Engineering also accepts:

Students who have completed the technological specialisation course (CET) in Electrical Installations and Industrial Automation providing equivalence to 5 modules of the degree.

Students who have completed the technological specialisation course (CET) in Automation, Robotics and Industrial Control providing equivalence to 5 modules of the degree.

Specific arrangements for recognition of prior learning (formal, non-formal and informal)

General
Procedures on the recognition of credits gained in previous learning are established in the regulations for the Recognition and Validation of Qualifications and Skills of ESTT-IPT available at
http://webmanager.ipt.pt/mgallery/default.asp?obj=4536

Specific
Not applicable.

Qualification requirements and regulations:
180 ECTS credits distributed across 6 curricular semesters (3 years), each with 40 weeks of full-time study (20 weeks per semester). Total study hours per year: 1620 (1 ECTS credit = 27 h work load).

The course structure comprises 5 to 6 modules per semester with the second-year students having the chance to choose one of the two available major areas: Energy or Automation. The third-year students must carry out a practical Project or a Professional Internship.

Profile of the program:

The Electrotechnical and Computer Engineering degree (LEEC) was designed so as to provide the students with sound scientific and technological foundations in order to meet the present and future requirements of the labour market. Graduates of this degree are offered a wide range of career opportunities which translates into high employment rates.

Comprising two major areas (Industrial Automation and Energy), the degree aims at delivering first-cycle level professionals prepared to perform duties with scientific accuracy and technological timeliness in the various electricity and electronics related domains. Graduates of this degree acquire varied and versatile skills to conceive, design, plan and implement systems in areas such as control, automation, robotics, energy, machinery, electrical vehicles, electrical installations, domotics, electronics, telecommunications and production and use of electrical power.

Throughout each academic year, extra-class activities are performed, namely seminars, conferences and field trips that greatly contribute to the scientific training of students and their contact with the industrial reality.

The programme guidelines place special emphasis on R&D of applied projects in partnership with companies, business associations (Nersant), business associations (Acitofeba), industrial innovation laboratory (Line.ipt) and research institutions (Telecommunications Institute) as a strategic motor of economical development, innovation and growth of productive capacity.

Key learning outcomes:

- Major in Energy:

Graduates in electronic and computer engineering majoring in energy should be able to design, implement, explore, manage and maintain facilities for the supply, transformation and use of energy complying with safety regulations as well as design, select and maintain energy equipments of industrial units and of electronic, electromechanical and automation systems from extractive, processing and technical installations. They will also have competencies in such areas as renewable energy, energy management and quality and project management.

- Major in Industrial Automation:

Graduates in Electronics and Computer Engineering majoring in automation should be able design, manage, control and maintain industrial systems, namely automated production systems, automated control and supervision processes, robotic control systems and communication systems. They will also be familiar with electronic systems, electromechanical drive systems, electrical and telecommunication systems and project management.

Occupational profiles of graduates with examples:

Graduates from this programme will be prepared to develop their professional activity in a wide range of sectors:

- Telecommunications and power companies;

- Control operators and automated production systems;

- Companies dealing with renewable energy and energy audit;

- Food processing, transport and consumer goods industry;

- Industrial systems maintenance operators;

- Manufacturers and suppliers of electrical and electronic equipment;

- Installation, design and technological development companies;

- Software production and maintenance companies;

- Study, project and consulting units;

- Supervision and standardisation bodies;

- Education, research and training institutions.

Access to further studies:
The bachelor's degree level allows access to postgraduate studies namely Master's and Doctoral programmes.

Course structure diagram with credits

Common Major

Course Title	Year	Semester	Credits
Algebra	1	S1	6
Database Applications	1	S1	3
Digital Systems	1	S1	6
Electronic Engineering Laboratories	1	S1	3
Mathematical Analysis I	1	S1	6
Programming and Algorithmics	1	S1	6
Circuit Analysis	1	S2	5
Computer-Aided Design and Manufacturing	1	S2	3
Mathematical Analysis II	1	S2	6
Physics	1	S2	6
Programming Techniques	1	S2	5
Project Planning and Management	1	S2	5

Major in Energy

Course Title	Year	Semester	Credits
Computer Architecture and Operating Systems	2	S1	6
Electrical Installations	2	S1	6
Electromagnetism	2	S1	6
Electronics I	2	S1	6
Mathematics Applied to Electrotechnics	2	S1	6
Electrical Materials and Power Conversion (Major in Energy)	2	S2	6
Electronics II	2	S2	6
Instrumentation Electronics	2	S2	6
Legislation and Design of Electrical Installations (Major in Energy)	2	S2	6
Systems	2	S2	6
Final Project	3	A	12
Control	3	S1	6
Electrical Machines (Major in Energy)	3	S1	6
Industrial Automation	3	S1	6

Course structure diagram with credits (cont.)

Major in Energy

Course Title	Year	Semester	Credits
Power Electronics (Major in Energy)	3	S1	6
Control of Electromechanical Drives (Major in Energy)	3	S2	6
Energy Quality and Management (Major in Energy)	3	S2	6
Maintenance	3	S2	6
Supply and Microgeneration of Energy (Major in Energy)	3	S2	6

Major in Industrial Automation

Course Title	Year	Semester	Credits
Computer Architecture and Operating Systems	2	S1	6
Electrical Installations	2	S1	6
Electromagnetism	2	S1	6
Electronics I	2	S1	6
Mathematics Applied to Electrotechnics	2	S1	6
Electronics II	2	S2	6
Fundamentals of Power Systems	2	S2	6
Fundamentals of Telecommunications (Major in Industrial Automation)	2	S2	6
Instrumentation Electronics	2	S2	6
Systems	2	S2	6
Final Project	3	A	12
Control	3	S1	6
Data Network (Major in Industrial Automation)	3	S1	6
Electromechanical Drives (Major in Industrial Automation)	3	S1	6
Industrial Automation	3	S1	6
Embedded Systems (Major in Industrial Automation)	3	S2	6
Industrial Networks (Major in Industrial Automation)	3	S2	6
Industrial Robotics (Major in Industrial Automation)	3	S2	6
Maintenance	3	S2	6

Examination regulations, assessment and grading

General
General assessment rules are in line with the Portuguese law and described in the Academic
Regulations of ESTT-IPT available at http://webmanager.ipt.pt/mgallery/default.asp?obj=4539.

The licenciado degree is awarded a final grade between 10 and 20 within a 0/20 scale as well as its
equivalent in the European grading scale.

Specific
In their third year the students must carry out a research project (12 ECTS credits) or a Professional
Inernship (12 ECTS credits) which will be the subject of a final report. In both cases the report will be
evaluated by an examination panel appointed for that purpose.

Graduation requirements:

Mode of study:
Full- or part-time. Day/Evening.

Program director or equivalente

Director: Manuel Fernando Martins de Barros
Erasmus coordinator: Jorge Manuel Correia Guilherme
ECTS coordinator: Jorge Manuel Correia Guilherme

B - Description of individual course units

Course unit title	Algebra
Course unit code	91123
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Pedro Miguel Carrasqueira Carlos Filipe Perquilhas Baptista
Learning outcomes of the course unit	To provide insight on Matrix Algebra, placing special emphasis on the discussion and resolution of systems of linear equations in vector spaces, determinants and eigenvalues and eigenvectors.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1. Complex numbers; 2. Matrices and systems of linear equations; 3. Vector spaces; 4. Determinants; 5. Eigenvalues and eigenvectors of square matrices.
Recommended or required Reading	- Dias Agudo, F.(1978). *Introdução à Álgebra Linear e Geometria Analítica*. Lisboa: Escolar Editora - Giraldes, E. e Smith, P. (1995). *Curso de Álgebra Linear e Geometria Analítica*. Lisboa: McGraw-Hill - T. Magalhães, L.(1989). *Álgebra Linear como Introdução à Matemática Aplicada*. Lisboa: Texto Editora - Nicholson, W.(1995). *Linear Algebra with Applications*. Boston: PWS Publishing Company
Planned learning activities and teaching methods	Lectures and practical classes.
Assessment Methods and criteria	Continuous assessment: 2 written tests. Exam assessment: 1 written test.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Database Applications
Course unit code	911238
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	3
Name of Lecturer(s)	António Casimiro Teixeira Batista Ana Carla Vicente Vieira
Learning outcomes of the course unit	Provide the students with skills to interact with Databases Management Systems (DBMS) using standard tools, to design formally correct databases and to produce complex SQL (Structured Query Language) commands.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1- Relational Model 2 - Relationships. Instances and schemes. Data dictionary . Keys. Primary key, foreign key and indices. Integrity and rules. 3 - Functional dependencies and normalization. First normal form (1FN), second normal form (2FN), third normal form (3FN) and Boyce-Codd normal form. 4 - Entity-relationship method. Extended E-R. 5 - SQL. SQL's DDL commands. SQL's DML commands
Recommended or required Reading	- Pereira, J.(1989). *Tecnologia de Base de Dados*. (Vol. 1). Portugal: FCA - Editora Informática - Date, C.(2003). *An Introduction to Database Systems*. (Vol. 1). US: Addison Wesley
Planned learning activities and teaching methods	Theoretical-practical and laboratory classes including problem solving and experimental work.
Assessment Methods and criteria	Theoretical test. Laboratory works/exercises.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Digital Systems
Course unit code	91122
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Manuel Fernando Martins De Barros
Learning outcomes of the course unit	Analysis of essential concepts of digital logic: numerical coding systems, basic logic gates and Boole's Algebra. Analysis and synthesis of combinatorial and sequential circuits & LSI, MSI and LSI. Introduction and design of programable logic devices.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1) Introduction 2) Boolean logic functions 3) Logic expressions simplifications 4) Digital representation 5) Logic families of integrated circuits 6) Combinatorial logic circuits of medium complexity 7) Basic sequential circuits 8) Synthesis and analysis of sequential circuits 9) Counters, registers and memories. 10) Programmable Logic Devices
Recommended or required Reading	- Dias, M.(2010). *Sistemas Digitais - Princípio e prática*. Portugal: FCA Editora de Informática, Lda - Costa, L. e Padilla, G. (2000). *Electrónica Digital*. Portugal: Mc Graw Hill - Wakerly, J.(2000). *Digital Design Principles and Practices*. USA: Prentice Hall
Planned learning activities and teaching methods	Lectures, Problem solving classes and Laboratory classes;
Assessment Methods and criteria	Written exam (50%), homeworks and final project (50%).
Language of Instruction	Portuguese	**Mentoring in** English
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Electronic Engineering Laboratories
Course unit code	911239
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	3
Name of Lecturer(s)	Francisco José Alexandre Nunes Ana Cristina Barata Pires Lopes Paulo Manuel Machado Coelho Carlos Alberto Farinha Ferreira Jorge Manuel Correia Guilherme José Filipe Correia Fernandes
Learning outcomes of the course unit	To provide the students with basic introductory and motivating knowledge in the main areas of the Electronic and Computer Engineering course.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1-Using the oscilloscope and signal generator; 2-Introduction to electronic technology and applications; 3-Introduction to industrial automation and robotics. 4-Conversion of Energy/Electrical Machines; Simulation of the electrical network; Speed variation; 5-Power generation / renewable energy; Applications of Electrical Engineering; 6 - Introduction to control and intelligent systems.
Recommended or required Reading	- ., ..to be defined on the basis of the students choice of theme. .: .
Planned learning activities and teaching methods	Lectures, practical exercises and lab experiments.
Assessment Methods and criteria	Ongoing assessment including a 20-30 minute test at the end of each lesson. Passing mark is 9.5/20 and exempts students from examination. Two examination seasons for those who failed to achieve a pass in ongoing assessment.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Mathematical Analysis I
Course unit code	91121
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Luís Miguel Merca Fernandes António Miguel Simões Caceiro
Learning outcomes of the course unit	1- To provide the mathematical foundations required in other modules of the programme. 2- To provide the students with skills to work with differential and integral calculus of functions of one real variable.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1- Preliminaries. 2- Real functions of a real variable. 3- Limits and continuity. 4- Differential calculus. 5- Integral calculus.
Recommended or required Reading	- Silva, J.(1999). *Princípios de Análise Matemática Aplicada* . (Vol. 1). (pp. 1-472). Lisboa: McGraw-Hill - Swokowsi, E.(1995). *Cálculo com Geometria Analítica*. (Vol. 1). (pp. 0-744). São Paulo: Makron Books - Howard, A.(2007). *Cálculo um novo horizonte*. (Vol. 1). (pp. 0-581). São Paulo: Bookman - Stewart, J.(2005). *Cálculo*. (Vol. 1). (pp. 0-684). São Paulo: Thomson Pioneira
Planned learning activities and teaching methods	Lectures and practical classes including application exercises.
Assessment Methods and criteria	Continuous assessment: 2 written tests. Exam assessment: 1 written test.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Programming and Algorithmics
Course unit code	91124
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Pedro Miguel Aparício Dias Ana Cristina Barata Pires Lopes Paulo Alexandre Gomes Dos Santos
Learning outcomes of the course unit	Solving problems using algorithms. Using a programming language to express an algorithm. Using 'C' programming language to build a computer program.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	Introduction to Computers and Programming. Algorithms and languages. Data manipulation. Decision-making structures. Repetition structures. Composite data structures (arrays; estruturas; strings). Modularity. Iterative and recursive algorithms.
Recommended or required Reading	- Damas, L.(1999). *Linguagem C*. Portugal: FCA
Planned learning activities and teaching methods	Lectures: course content presentation Practical classes: Laboratorial classes with practical experiments.
Assessment Methods and criteria	Practice (40%): 2 practical tests and final assignment Report and presentation. Theory (60%): Examinations.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Circuit Analysis
Course unit code	91129
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Raul Manuel Domingos Monteiro Francisco José Alexandre Nunes
Learning outcomes of the course unit	Understanding and using techniques and concepts commonly used in electrical circuits analysis, DC and AC. Ability to analyze 1st and 2nd order circuits in time domain. Ability to analyze linear circuits in the frequency domain.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	Quantities and fundamental components of electrical circuits. Kirchhoff's laws. Systematic methods for the analysis of circuits. Capacitors and inductors. 1st and 2nd order circuits analysis. AC circuits analysis. Frequency response.
Recommended or required Reading	- Meireles, V.(2010). *Circuitos Eléctricos*. Lisboa: LIDEL - Medeiros Silva, M.(2001). *Introdução aos circuitos eléctricos e electrónicos*. Lisboa: Fundção Calouste Gulbenkian - Vieira, A.(). *Caderno de exercícios de Análise de Circuitos*.Acedido em3 de junho de 2012 em http://www.e-learning.ipt.pt/ - Nunes, F.(). *Apresentações das aulas teóricas de Análise de Circuitos*.Acedido em3 de junho de 2012 em http://www.e-learning.ipt.pt/
Planned learning activities and teaching methods	Lectures supported bu modern audiovisual resources. Practical classes including problem solving.
Assessment Methods and criteria	Tests carried out throughout the semester or final exam.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Computer-Aided Design and Manufacturing
Course unit code	911241
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	3
Name of Lecturer(s)	Pedro Manuel Granchinho De Matos
Learning outcomes of the course unit	Provide the students with the ability to design and develop new products as well as solving general engineering problems. Design mechanical components using CAD systems and 3-D CAD systems.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1. Standards for technical drawing; 2. Geometric drawing; 3. Orthogonal projections; 4. Cuts and sections; 5. Perspectives; 6. Dimensioning; 7. Computer-aided drawing commands; 7.1 Visualization, modification, edition and coordinate systems; 7.2 Text edition, layers, viewports; 7.3 Three-dimensional modelling - Surface modelling, 3D renders;
Recommended or required Reading	- Silva, A. e Dias, J. e Sousa, L. (2004). *Desenho Técnico Moderno*. Portugal: Lidel - Santos, J.(2009). *Guia de consulta rápida Autocad2010*. (Vol. 1). Portugal: FCA - Santos, J.(2009). *AutoCad 3D 2010*. (Vol. 1). Portugal: FCA - Solidworks.com, S.(). *Tutoriais SolidWorks*.Acedido em1 de maio de 2012 em http://www.solidworks.com/sw/resources/solidworks-tutorials.htm?sw_edu_resources_tutorials
Planned learning activities and teaching methods	Lectures and problem-solving classes.
Assessment Methods and criteria	Project worth 100% of the final mark
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Mathematical Analysis II
Course unit code	91126
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Maria Cristina Oliveira Da Costa
Learning outcomes of the course unit	1- To provide the mathematical foundations required in other modules of the programme. 2- To provide the skills required to work with differential and integral calculus in functions of several real variables.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1- Numerical and Functions Series. 2- Real functions of several real variables. 3- Multiple Integrals.
Recommended or required Reading	- Silva, J.(1999). *Princípios de Análise Matemática Aplicada*. (Vol. 1). (pp. 1-472). Lisboa: McGraw-Hill - Azenha, A. e Jerónimo, M. (1995). *Cálculo Diferencial e Integral em R e Rn*. (Vol. 1). (pp. 1-610). Lisboa: Mac Graw-Hill - Cullen, M. e Zill, D. (2009). *Advanced Engineering Mathematics*. (Vol. 2). (pp. 1-1008). Sudbury: Jones & Bartlett Publishers - Swokowsi, E.(1995). *Cálculo com Geometria Analítica*. (Vol. 1). (pp. 2-744). São Paulo: Makron Books
Planned learning activities and teaching methods	Lectures and tutorials
Assessment Methods and criteria	Continuous assessment: 2 closed-book written tests. Examination assessment: 1 closed-book written test.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Physics
Course unit code	91125
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Rui Manuel Domingos Gonçalves
Learning outcomes of the course unit	Develop skills for the analysis and resolution of problems related with kinematics, dynamics and electrostatic
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Basics of calculus and trigonometry.
Recommended optional programme componentes	Not applicable.
Course contentes	Measurements and units. International System of Units. Kinematics of material point. Dynamics of material point. Forces. Work and Energy. Rigid Body and statics. Vibration and waves. Electrostatic.
Recommended or required Reading	- Edgard Blutcher, A.(2000). *Física - um curso Universitário (vol. I - Mecânica e vol. II - Campos e Ondas)*. Brasil: Edgard Blutcher - Almeida, G.(2002). *Sistema Internacional de Unidades.*. Lisboa: Platano editora - Resnick,, H.(2000). *Física*. (Vol. I). S. Paulo: Livros Técnicos e Científicos
Planned learning activities and teaching methods	Lectures and practical problem-solving classes. Experimental sessions.
Assessment Methods and criteria	Individual worksheets. Written examination (oral in exceptional cases).
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Programming Techniques
Course unit code	911240
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Paulo Alexandre Gomes Dos Santos
Learning outcomes of the course unit	1 - Describe the most common data structures and algorithms, as well as its advantages, limitations and applications; 2 - Use data structures in the resolution of concrete problems; 3 - Design, develop, and test programs for the resolution of medium- and large-scale problems.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Basics of programming.
Recommended optional programme componentes	Not applicable.
Course contentes	1 - Algorithm development techniques 2 - Sorting algorithms. 3 - Linear data structures 4 - Hierarchical data structures
Recommended or required Reading	- Damas, L.(1999). *Linguagem C*. Portugal: FCA
Planned learning activities and teaching methods	Lectures, tutorials and laboratory sessions.
Assessment Methods and criteria	Practical assignments and a closed -book examination.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Project Planning and Management
Course unit code	911215
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	First Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	5
Name of Lecturer(s)	Pedro Manuel Granchinho De Matos
Learning outcomes of the course unit	- Analyze problems using optimization tools; - Understand the basic methodology for project analysis in conditions of certainty and uncertainty; - Understand the basic methodology for the analysis of economic and financial viability of investment projects.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1. Linear Programming - Formulation of optimization problems; graphical resolution; simplex algorithm; 2. Evaluation of Investment Projects - Basic concepts, business plan estimates; Risk analyses; 3. Project Management - Gantt chart; Critical path method; Probabilistic analysis of the critical path;
Recommended or required Reading	- Winston, W.(1993). *Operations Research* . USA: Duxbury Press - Chase, R. e Aquilano, N. e Jacobs, R. (2001). *Operations Management for Competitive Advantage*. (Vol. 1). USA: McGraw-Hill - Cebola, A.(2005). *Elaboração e análise de projectos de investimento*. (Vol. 1). Portugal: Edições Silabo
Planned learning activities and teaching methods	Lectures and case study analysis.
Assessment Methods and criteria	Written test in any of the assessment seasons and a project. Both worth 50% of the final mark.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Computer Architecture and Operating Systems
Course unit code	911210
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Gabriel Pereira Pires
Learning outcomes of the course unit	On completion of the module, the students should be able to program 8 bit PIC microcontrollers of the 18F family, accomplishing projects that involve reading sensors, signal acquisition, motor actuation, and data communication.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Digital systems
Recommended optional programme componentes	Not applicable.
Course contentes	- Introductory concepts: digital systems, numerical representation and datatypes - Generic computer architecture: main modules and buses - 8 bit PIC microcontrollers: architecture, configuration and programming - digital input/output, internal and external interruptions, timers, counters, PWM and analog inputs - O.S. introduction
Recommended or required Reading	- Peatman, J.(1997). *Design With Pic Microcontrollers* . -: Prentice Hall - Patterson, . e Henessy, , J. (1997). *Computer Organization and Design: The Hardware/Software Interface* . -: Morgan Kaufmann
Planned learning activities and teaching methods	Lectures, practical exercises and lab experiments (projects)
Assessment Methods and criteria	Written exam (60%), Lab work (40%) (compulsory assessment requirements: a minimum of 45% in the written exam and a minimum of 50% in the Labs)
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Electrical Installations
Course unit code	911214
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Mário Helder Rodrigues Gomes
Learning outcomes of the course unit	Skills to be developed: Select electric cutoff and protection equipments; design and dimension electrical pipelines and protections for people and equipments; Design and dimension transformation stations and switchboards; Design interior lighting and security.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	Diagrams and symbols. Electrical pipelines : types, conductors and electric cables, pipelines, conditions of assemblage; sizing. Low voltage electrical apparatus: control, cutoff, maneuver, selection. Overcurrents: overloads and faults, calculation. Transformer stations and power switchboards and control. Interior lighting and safety: project. Basics of ITED Regulations
Recommended or required Reading	- Morais, J.(2006). *Guia Técnico das Instalações Eléctricas*. (Vol. 1). Portugal: Certiel - Regulamento, R.(1997). *Regulamento de Segurança de Subestações, Postos de Transformação e de Seccionamento*. (Vol. 1). Lisboa: DR - Solidal, S.(2005). *Guia Técnico Solidal*. (Vol. 1). L: Solidal Condutores Eléctricos, S.A. - Pinto, V.(1999). *Guia Técnico MG-Calc*. (Vol. 1). Lisboa: Merlin-Gerin
Planned learning activities and teaching methods	Lectures and problem-solving classes
Assessment Methods and criteria	Continuous assessment through practical work to be undertaken during the semester (30%) and written examination to be held in the regular assessment season (70%).
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Electromagnetism
Course unit code	91127
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Rui Manuel Domingos Gonçalves Raul Manuel Domingos Monteiro
Learning outcomes of the course unit	The students should acquire the basic concepts to understand electromagnetic phenomena and be able to apply them in different areas of electrical engineering.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Basics of calculus and trigonometry.
Recommended optional programme componentes	Not applicable.
Course contentes	Structure of matter - atoms and molecules. Electric charge. Coulomb's Law and electric force. Potential. Gauss' law. Dielectric and capacitance. Electric current and electrical resistance. Magnetic Field and its sources. Faraday's Law and Electromagnetic Induction. Maxwell's equations. Propagation of electromagnetic waves. Single-phase sinusoidal AC. Three-phase AC systems.
Recommended or required Reading	- Serway, R.(1996). *Física 3 – Electricidade, Magnetismo e Ótica*. (Vol. 3). S.Paulo: Livros Técnicos e Científicos - Tipler, P.(2000). *Física – Electricidade e Magnetismo*. (Vol. 3). S.Paulo: Livros Técnicos e Científicos - Sadiku, M.(2008). *Fundamentos de Circuitos Elétricos*. Lisboa: McGraw-Hill
Planned learning activities and teaching methods	Lectures, tutorials and lab experimental sessions.
Assessment Methods and criteria	Resolution of individual worksheets. Written(oral in exceptional cases) summative examination
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Electronics I
Course unit code	911213
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Jorge Manuel Correia Guilherme
Learning outcomes of the course unit	Provide knowledge of the main semiconductor devices and circuits. The students will become familiar with matters such as diodes, bipolar and MOS transistors, operational amplifiers, and their main applications.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Circuit Analysis
Recommended optional programme componentes	Not applicable.
Course contentes	Semiconductor properties. Diodes, bipolar, MOS and JFET transistor. LED diodes, Hall effect. Rectifiers, limiters, log amplifiers. Single stage transistor amplifiers. Operational amplifiers. Precision rectifiers. Comparators. Oscillators. Digital electronics. Logic gates, microelectronics technology, digital families. Differential pair. Active loads. Current sources. Precision voltage generators.
Recommended or required Reading	- Silva, M.(1996). *Introdução aos circuitos Eléctricos e Electrónicos*. (Vol. 1). Lisboa: Gulbenkian - Silva, M.(1999). *Circuitos com Transístores Bipolares e MOS*. (Vol. 1). Lisboa: Gulbenkian - Smith, S.(1998). *Microelectronic Circuits*. (Vol. 1). England: Oxford Press, - Gray, P.(2001). *Analysis and Design of Analog Integrated Circuits*. (Vol. 1). US: John Wiley & Sons
Planned learning activities and teaching methods	Lectures, tutorials and laboratory sessions
Assessment Methods and criteria	Written Examination 75%, Practical Works 25%.
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Mathematics Applied to Electrotechnics
Course unit code	911212
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Luis Miguel Lindinho da Cunha Mendes Grilo Carlos Filipe Perquilhas Baptista
Learning outcomes of the course unit	Provide the foundations of the main techniques and methodologies in Statistics, Complex Analysis and Transforms that will deevlop in the students analysis and reasoning skills which will allow them to design and implement solutions to the various problems and facilitate decision-making.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Basics of Calculus and Algebra
Recommended optional programme componentes	Not applicable.
Course contentes	1. Random variables. Some probability distributions; 2. Sample distributions. Parameter estimation; 3. Hypothesis tests. Correlation and simple linear regression; 4. Complex numbers. Analytic functions; 5. Complex integration; 6. Fourier, Laplace and Z Transforms.
Recommended or required Reading	- C. Guimarães, R. e A. Cabral, J. (2007). *Estatística*. : McGraw-Hill - C. Pedrosa, A. e A. Gama, M. (2004). *Introdução Computacional à Probabilidade e Estatística*. : Porto Editora - B. Saff, E. e D. Snider, A. (1993). *Fundamentals of Complex Analysis for Mathematics, Science and Enginnering*. New Jersey: Prentice-Hill - Carreira, M. e Metello de Nápoles, M. (1998). *Variável Complexa*. Lisboa: McGraw-Hill
Planned learning activities and teaching methods	lecturs, tutorials and laboratory sessions
Assessment Methods and criteria	Continuous assessment: 2 written tests Exam assessment: 1 written test
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Electrical Materials and Power Conversion (Major in Energy)
Course unit code	911219
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	José Filipe Correia Fernandes
Learning outcomes of the course unit	Understand the electric and magnetic properties of the main materials applied in electrical engineering; Understand the basics of energy conversion and its application in transducers and in electrical machines. Study the steady state operating mode of DC machines and transformers.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Basics of electromagnetism, electrical circuit analysis and mathematics (partial derivatives and complex numbers)
Recommended optional programme componentes	Not applicable.
Course contentes	The principle of energy conversion to produce force or torque. Fundamentals of DC Machines and windings. Characteristic curves, losses and efficiency of DC motors. Starting and speed control methods of DC motors. Universal motors working in DC and AC. Fundamentals and circuit model of transformers. Internal voltage drop, losses and efficiency in loaded transformers and taps.
Recommended or required Reading	- Fernandes, J.(2007). *Sebenta e acetatos da unidade curricular*. Tomar: Autor - Fitzerald, A. e Kingsley Jr., C. (1994). *Máquinas Eléctricas*. .: McGraw-Hill - Brandão, D.(1982). *Máquinas Eléctricas – Intodução às Máquinas Eléctricas de Corrente Contínua*. Lisboa: Fundação Calouste Gulbenkian - Nasar, S.(1990). *Máquinas Eléctricas*. .: Shaum McGraw-Hill
Planned learning activities and teaching methods	Lectures, tutorials and laboratory classes including problem solving, demonstrations and experiments.
Assessment Methods and criteria	Final mark= 3/4 Mark of a written exam + 1/4 Average mark of laboratory experiments
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Electronics II
Course unit code	911216
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Jorge Manuel Correia Guilherme Carlos Alberto Farinha Ferreira
Learning outcomes of the course unit	Become familiar with the most common circuits used in electronics. Be able to analyse and design electronic circuits.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Circuit analysis, Electronics I
Recommended optional programme componentes	Not applicable.
Course contentes	Analogue multipliers. Output stages in class A, B, C and D. Discrete and integrated amplifiers. Audio power amplifiers. Frequency response of analog circuits. Feedback and stability. Sinusoidal oscillators. Filters. Approximation problem. Continuous and switched capacitor filters. PLL. Signal converters, ADC, DAC and VF. Programmable logic devices. Noise analyses. Transmission lines. Mixers.
Recommended or required Reading	- Silva, M.(1996). *Introdução aos circuitos Eléctricos e Electrónicos*. (Vol. 1). Lisboa: Gulbenkian - Silva, M.(1999). *Circuitos com Transístores Bipolares e MOS*. (Vol. 1). Lisboa: Gulbenkian - Gray, P.(2001). *Analysis and Design of Analog Integrated Circuits*. (Vol. 1). US: John Wiley & Sons - Smith, S.(1998). *Microelectronic Circuits*. (Vol. 1). England: Oxford Press,
Planned learning activities and teaching methods	Lectures, Theoretical-practical classes and Laboratory work.
Assessment Methods and criteria	Written Examination 50%, Practical Project 25%. Lab. works 25%.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Instrumentation Electronics
Course unit code	911218
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Jorge Manuel Correia Guilherme
Learning outcomes of the course unit	Provide knowledge of the main equipments and techniques to measure electric and electronic signals. Become aware of the main limitations when making measurements.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Circuit analysis, Electronics I
Recommended optional programme componentes	Not applicable.
Course contentes	Measurement errors. Electromagnetic instruments. Voltage, current, power and energy measurement. Bridges. Digital instrumentation, voltage meters and frequency meters. Signal generators. Oscilloscopes. Spectrum analyzers. Sensors and signal acquisition. Data converters characteristics. Instrumentation interfaces.
Recommended or required Reading	- Bell, D.(1994). *Electronic Instrumentation and Measurements*. (Vol. 1). US: Prentice Hall - Morris, A.(1993). *Principles of Measurement and Instrumentation*. (Vol. 1). US: Prentice Hall - Fernandes, J.(1998). *Medidas Eléctricas e Instrumentação*. (Vol. 1). Tomar: Escola Superior de Tecnologia de Tomar - Gregory, A.(1973). *An Introduction to Electrical Instrumentation and Measurement Systems*. (Vol. 1). US: The Macmillan Press LTD
Planned learning activities and teaching methods	Lectures, theoretical-practical classes and laboratory work
Assessment Methods and criteria	Written Examination 75%, Laboratory Works 25%.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Legislation and Design of Electrical Installations (Major in Energy)
Course unit code	911220
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Mário Helder Rodrigues Gomes
Learning outcomes of the course unit	The students should be able to understand and apply the applicable legislation on design of electrical and telecommunication installations in buildings. They should be able to design general electrical installations and Class C installations and have a good command of AutoCAD.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1. Developing an implementation and budgeting project 2. Organizing a project with a view to licensing. 3. Regulations, standards and legislation applicable to electrical installations projects. 4. Regulations, standards and legislation applicable to telecommunication projects 5. Designing the electrotechnical infrastructures of a building.
Recommended or required Reading	- Republica, D.(2006). *Portaria n.º 949 – A / 2006 de 11 de Setembro, estabelece as RTIEBT.*. (Vol. 1). Lisboa: Casa da Moeda - Anacom, A.(2009). *Manual ITED, Prescrições e Especificações Técnica*. (Vol. 1). Lisboa: ANACOM - Kurland, K.(2009). *AutoCAD 2D Tutorial, AutoCAD® 2009 2D Training Manual*. (Vol. 1). US: AutoCAD
Planned learning activities and teaching methods	Lectures, tutorials and laboratory classes involving the execution of an electrical infrastructures project with the help of AutoCAD.
Assessment Methods and criteria	Projects Public presentation and discussion of the final assignment (in the examination season)
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Systems
Course unit code	911217
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Paulo Manuel Machado Coelho
Learning outcomes of the course unit	The students will familiarise themselves with the theory of systems and signals with emphasis on continuous linear and time invariant systems They should be able to work with MATLAB - a software for the analysis and simulation of signals systems.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Algebra and Mathematical Analysis and knowledge of electrical concepts (e.g. Circuit Analysis).
Recommended optional programme componentes	Not applicable.
Course contentes	1 – Introduction: classification of signals and systems 2 – Analysis of continuous LIT systems in time domain 3 – Analysis of LIT systems in frequency domain: Laplace transform; transfer function; stability; transient response and steady state response, frequency response of 1st and 2nd order systems 4 – Block diagram representation 5 – Mathematical modelling of systems. Servomechanisms.
Recommended or required Reading	- Lathi, B.(2005). *Linear Systems and Signals* . USA: Oxford University Press - Lourtie, I.(2002). *Sinais e Sistemas*. Portugal: Escolar Editora - Matlab, S.(1995). *The Student Edition of Matlab*. USA: Prentice-Hall
Planned learning activities and teaching methods	Lectures, tutorials and laboratory classes
Assessment Methods and criteria	Written closed-book examination in the regular assessment seasons(75%); and Practical assignments (25%).
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Final Project
Course unit code	911230
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	Anual
Number of ECTS credits allocated	12
Name of Lecturer(s)	Manuel Barros
Learning outcomes of the course unit	Be able to apply knowledge, skills and tools acquired during the degree to develop an applied project.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	Develop a practical project in an area related to the course.
Recommended or required Reading	- ., ..to be defined on the basis of the students choice of theme. .: .
Planned learning activities and teaching methods	Work supervised by a lecturer.
Assessment Methods and criteria	Assessment of project work. The Project assignment is subject to public discussion and consideration. For this purpose the Regulations of ESTT's Licenciatura degree shall apply.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Control
Course unit code	911221
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Paulo Manuel Machado Coelho
Learning outcomes of the course unit	This module aims to provide knowledge of several automatic control systems structures, to develop competences in the design of classical control systems using time invariant linear continuous systems and to analyse stability and performance.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Knowledge of Signals and Systems and of Laplace transform.
Recommended optional programme componentes	Not applicable.
Course contentes	1 – Introduction to control systems 2 – Time domain analysis, in open and closed loop: transient response, steady state error analysis, stability (Routh /Nyquist). 3 – Controller design, analysis and specification of control systems based on root locus, frequency design, Bode Diagram. Stability criterion. 4 – PID control: methods of Ziegler-Nichols, pole-placement, etc.
Recommended or required Reading	- Ogata , K.(2002). *Modern Control Engineering*. USA: Prentice-Hall - Kuo, B. e Golnaraghi, F. (2003). *Automatic Control Systems*. USA: John Wiley & Sons - Emani-Naeini, A. e Powell, D. e Franklin, G. (2006). *Feedback Control of Dynamic Systems* . USA: Pearson Prentice Hall
Planned learning activities and teaching methods	Lectures, tutorials and laboratory sessions
Assessment Methods and criteria	Written open-book examination during regular examination seasons(75%) and Practical assignments (25%).
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Electrical Machines (Major in Energy)
Course unit code	911224
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	José Filipe Correia Fernandes
Learning outcomes of the course unit	The students will familiarise themselves with the safe operation of asynchronous machines (both rotative and linear), asynchronous machines and some special engines under safe conditions for equipment and user.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Basics of energy conversion, electric circuit analysis and mathematics (trigonometry and complex numbers)
Recommended optional programme componentes	Not applicable.
Course contentes	Fundamentals of 3-phase asynchronous machines. The air gap magnetic rotating field. Circuit model, brake and generator of these machines. Starting and speed control methods of these 3-phase machines. 3-phase linear motors. Fundamentals and field systems of synchronous machines. Testing methods, curves and voltage regulation. Alternators and synchronous motors in the grid. Special motors.
Recommended or required Reading	- Fernandes, J.(2007). *Sebenta de Máquinas Eléctricas*. (Vol. 1). Tomar: IPT - Fitzerald, A.(1994). *Máquinas Eléctricas*. (Vol. 1). UK: McGraw-Hill - Chapman, S.(1995). *Electric Machinery Fundamentals*. (Vol. 1). UK: McGraw-Hill - Nasar, S.(1990). *Máquinas Eléctricas*. (Vol. 1). UK: Shaum McGraw-Hill
Planned learning activities and teaching methods	Lectures, tutorials and laboratory classes.
Assessment Methods and criteria	Final mark=3/4 Mark of a written exam + 1/3 Average mark of laboratory assignments
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Industrial Automation
Course unit code	911222
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	António Casimiro Teixeira Batista Ana Cristina Barata Pires Lopes
Learning outcomes of the course unit	On completion of this module the students should be able to: Deal with hardware considerations (different types of actuators and sensors). Specify events and constraints in manufacturing systems. Specify algorithms of local automation using formal methods. Write programs for PLCs
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1 – Introduction to Automation 2 – Sensors and actuators 3 – Wiring logic. 4 – Pneumatics and hydraulics 5 – Programmable Logic Controllers 6 – Industrial Communications.
Recommended or required Reading	- Novais, J.(2008). *Programação de Autómatos, Método GRAFCET*. (Vol. 1). Portugal: Fundação Calouste - Morriss, S.(2000). *Programmable Logic Controllers*. (Vol. 1). US: Prentice-Hall - Siemens, S.(2003). *Simatic, S7-200 Programmable Controller.*. (Vol. 1). Alemanha: Siemens
Planned learning activities and teaching methods	Lectures, tutorials and laboratory classes.
Assessment Methods and criteria	Theoretical test. Laboratory assignments.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Power Electronics (Major in Energy)
Course unit code	911223
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Raul Manuel Domingos Monteiro Francisco José Alexandre Nunes
Learning outcomes of the course unit	Provide knowledge about the components and circuits used in Power Electronics. Study of the most used power converters in Industry and their applications. Introduction to problems that arise in practical situations involving the conception, design and assembly of power converters.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Circuit analysis, Electromagnetism, Electronics I, Electronics II.
Recommended optional programme componentes	Not applicable.
Course contentes	1.Introduction, review of basic concepts 2.Passive and active elements in power converters, characterization; reference to electromagnetic noise and electromagnetic interference (EMI) 3.DC/DC switch-mode power converters 4.DC/DC switch-mode power converters with electrical isolation 5.DC/AC switch-mode power converters 6.AC/DC power converters (rectifiers) 7.Magnetics design and assembly
Recommended or required Reading	- P. Robbins, W. e M. Undeland, T. (2002). *Power Electronics: Converters, Applications, and Design*. Wiley: John Wiley & Sons - F. Schlecht, M. e Kassakian, J. e C. Vergese, G. (1991). *Principles of Power Electronics*. Prentice Hall: Prentice Hall - Monteiro, R.(). *Sebenta de Eletrónica de Potência*.Acedido em20 de setembro de 2011 em http://www.e-learning.ipt.pt/course/category.php?id=78 - Monteiro, R.(). *Caderno de exercícios de Eletrónica de Potência*.Acedido em20 de setembro de 2011 em http://www.e-learning.ipt.pt/course/category.php?id=78
Planned learning activities and teaching methods	Lectures, tutorials and laboratory classes.
Assessment Methods and criteria	Written exam and a project of a power electronic converter, built in PCB; minimum examination mark: 8.5/20; minimum project mark: 9.5/20. The overall mark is the simple arithmetic average of the two components.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Control of Electromechanical Drives (Major in Energy)
Course unit code	911229
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Pedro Manuel Granchinho De Matos
Learning outcomes of the course unit	- Develop dynamic models of mechanical charges, electrical machinery, electronic converter and power supply; - Analyse the performance of industrial drives and electric traction vehicles; - Design control systems for electrical machines.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1. The components of an electromechanical system; 2. Modelling of dynamic and stationary behaviour of mechanical systems; 3. The specific characteristics of electrical vehicles; 4. Applications of control systems in electromechanical drives; 5. Power systems for electrical traction; 6. Power chain in electrical vehicles and hybrid electrical vehicles;
Recommended or required Reading	- Palma, J. e Dente, A. (2008). *Accionamentos Electromecânicos de Velocidade variável*. (Vol. 1). Portugal: Fundação Calouste Gulbenkian - Husain , I.(2003). *Electric and Hybrid Vehicles, Design Fundamentals*. (Vol. 1). USA: CRC Press - Gillespie, T.(1992). *Fundamentals of Vehicle Dynamics, Society of Automotive Engineers*. (Vol. 1). USA: SAE International
Planned learning activities and teaching methods	Lectures and analysis of theoretical-practical case studies
Assessment Methods and criteria	Written test in any of the examination seasons and a project. Both worth 50% of the overall mark.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Energy Quality and Management (Major in Energy)
Course unit code	911227
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Ana Carla Vicente Vieira Francisco José Alexandre Nunes
Learning outcomes of the course unit	The students should understand such issues as power quality, regulations and normalisation, the structure of national electricity sector, commercial relations and regulated fares. They should be able to identify and calculate alternative ways of reducing consumption.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	Electrical Power Quality (PQ): Directives, Standards and Regulations; Terms and definitions related to PQ ; Sources and fundamental principles of protection for PQ problems; Monitoring PQ ; Terms and definitions related to energy management; Energy policies and electricity markets; Electricity rates and bill calculations. Load Management; Energy conservation and rational use; Energy auditing.
Recommended or required Reading	- Dugan, R. e McGranaghan, M. e Beaty, H. (1996). *Electrical Power Systems Quality*. -: McGraw-Hill - Turner, W.(1997). *Energy Management Handbook*. -: Fairmont Press, Inc
Planned learning activities and teaching methods	Lectures (28 hours), problem resolution, practical exercises and lab experiments (42 hours);Practical assignments (incorporated in 87 hours of self-study).
Assessment Methods and criteria	Written Test (mandatory); Team projects, public presentations and discussion (mandatory).
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Maintenance
Course unit code	911226
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Ana Carla Vicente Vieira
Learning outcomes of the course unit	Provide the students with knowledge and skills in the domain of building and industrial maintenance, namely the ability to understand concepts and apply common maintenance management techniques and tools.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	Reliability; Maintenance and diagnosis methods for several Electrical, Mechanical and Electromechanical systems; Industrial Instrumentation Maintenance; Maintenance objectives and strategies; Maintenance information circuits and documents for maintenance; Maintenance service structure and staff organization; Maintenance contracts and Outsourcing; Maintenance management and control.
Recommended or required Reading	- Cardoso, A.(1991). *Diagnóstico de Avarias em Motores de Indução Trifásicos (in Portuguese)*. Portugal: Coimbra Editora - Higgins, L.*Maintenance Engineering Handbook; Edited by Lindley R. Higgins* . -: McGrawHill - CABRAL, J.(2009). *Gestão da Manutenção de Equipamentos, Instalações e Edifícios*. Portugal: LIDEL - STONEHAM, D.(1998). *The Maintenance Management and Technology Handbook*. -: Elsevier Advanced Technology
Planned learning activities and teaching methods	Lectures (28 hours) Case analysis and discussion (42 hours) Practical work proposed by the lecturer (87 hours sel-study)
Assessment Methods and criteria	Written Test (mandatory; Public presentations and discussion of projects(mandatory).
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Supply and Microgeneration of Energy (Major in Energy)
Course unit code	911228
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Mário Helder Rodrigues Gomes
Learning outcomes of the course unit	Understand the constitution and operation of EPS. Be able to design, calculate and deal with high-voltage lines, substations and transformer stations. Become familiar with the different technologies used in supply networks, as well as distributed generation and micro-generation.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1. Electric Power Systems (EPS) - Characterization and operation of an EPS 2. Flow loads - Per unit system method 3. Overhead and underground electrical power transmission 4. Distribution system - Power flow, reactive power and protection in distribution networks 5. Basis of distributed generation, micro-generation and technical conditions for interconnection to the grid
Recommended or required Reading	- Expósito, A.(2002). *Análisis y Operación de Sistemas de Energía Eléctrica*. (Vol. 1). US: McGraw-Hill - Matos, A.(2009). *Apontamentos da disciplina de Sistemas de Energia I*. (Vol. 1). Porto: FEUP, http://paginas.fe.up.pt/~mam/SEE1 - Gouveia, J.(1996). *Fluxo de Cargas*. (Vol. 1). Porto: Sebenta da disciplina de SEE2 (4º ano – 1995/1996), FEUP - Dorf, R.(1997). *The Electrical Engineering Handbook*. (Vol. 1). US: CRC Press, IEEE Press
Planned learning activities and teaching methods	Lectures, tutorials and lab classes including simulation of SEE networks making use of PowerWorld.
Assessment Methods and criteria	Written test (65%) and two assignments (practical/laboratorial)- 35%.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Computer Architecture and Operating Systems
Course unit code	911210
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Gabriel Pereira Pires
Learning outcomes of the course unit	On completion of the module, the students should be able to program 8 bit PIC microcontrollers of the 18F family, accomplishing projects that involve reading sensors, signal acquisition, motor actuation, and data communication.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Digital systems
Recommended optional programme componentes	Not applicable.
Course contentes	- Introductory concepts: digital systems, numerical representation and datatypes - Generic computer architecture: main modules and buses - 8 bit PIC microcontrollers: architecture, configuration and programming - digital input/output, internal and external interruptions, timers, counters, PWM and analog inputs - O.S. introduction
Recommended or required Reading	- Peatman, J.(1997). *Design With Pic Microcontrollers* . -: Prentice Hall - Patterson, . e Henessy, , J. (1997). *Computer Organization and Design: The Hardware/Software Interface* . -: Morgan Kaufmann
Planned learning activities and teaching methods	Lectures, practical exercises and lab experiments (projects)
Assessment Methods and criteria	Written exam (60%), Lab work (40%) (compulsory assessment requirements: a minimum of 45% in the written exam and a minimum of 50% in the Labs)
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Electrical Installations
Course unit code	911214
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Mário Helder Rodrigues Gomes
Learning outcomes of the course unit	Skills to be developed: Select electric cutoff and protection equipments; design and dimension electrical pipelines and protections for people and equipments; Design and dimension transformation stations and switchboards; Design interior lighting and security.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	Diagrams and symbols. Electrical pipelines : types, conductors and electric cables, pipelines, conditions of assemblage; sizing. Low voltage electrical apparatus: control, cutoff, maneuver, selection. Overcurrents: overloads and faults, calculation. Transformer stations and power switchboards and control. Interior lighting and safety: project. Basics of ITED Regulations
Recommended or required Reading	- Morais, J.(2006). *Guia Técnico das Instalações Eléctricas*. (Vol. 1). Portugal: Certiel - Regulamento, R.(1997). *Regulamento de Segurança de Subestações, Postos de Transformação e de Seccionamento*. (Vol. 1). Lisboa: DR - Solidal, S.(2005). *Guia Técnico Solidal*. (Vol. 1). L: Solidal Condutores Eléctricos, S.A. - Pinto, V.(1999). *Guia Técnico MG-Calc*. (Vol. 1). Lisboa: Merlin-Gerin
Planned learning activities and teaching methods	Lectures and problem-solving classes
Assessment Methods and criteria	Continuous assessment through practical work to be undertaken during the semester (30%) and written examination to be held in the regular assessment season (70%).
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Electromagnetism
Course unit code	91127
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Rui Manuel Domingos Gonçalves Raul Manuel Domingos Monteiro
Learning outcomes of the course unit	The students should acquire the basic concepts to understand electromagnetic phenomena and be able to apply them in different areas of electrical engineering.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Basics of calculus and trigonometry.
Recommended optional programme componentes	Not applicable.
Course contentes	Structure of matter - atoms and molecules. Electric charge. Coulomb's Law and electric force. Potential. Gauss' law. Dielectric and capacitance. Electric current and electrical resistance. Magnetic Field and its sources. Faraday's Law and Electromagnetic Induction. Maxwell's equations. Propagation of electromagnetic waves. Single-phase sinusoidal AC. Three-phase AC systems.
Recommended or required Reading	- Serway, R.(1996). *Física 3 – Electricidade, Magnetismo e Ótica*. (Vol. 3). S.Paulo: Livros Técnicos e Científicos - Tipler, P.(2000). *Física – Electricidade e Magnetismo*. (Vol. 3). S.Paulo: Livros Técnicos e Científicos - Sadiku, M.(2008). *Fundamentos de Circuitos Elétricos*. Lisboa: McGraw-Hill
Planned learning activities and teaching methods	Lectures, tutorials and lab experimental sessions.
Assessment Methods and criteria	Resolution of individual worksheets. Written(oral in exceptional cases) summative examination
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Electronics I
Course unit code	911213
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Jorge Manuel Correia Guilherme
Learning outcomes of the course unit	Provide knowledge of the main semiconductor devices and circuits. The students will become familiar with matters such as diodes, bipolar and MOS transistors, operational amplifiers, and their main applications.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Circuit Analysis
Recommended optional programme componentes	Not applicable.
Course contentes	Semiconductor properties. Diodes, bipolar, MOS and JFET transistor. LED diodes, Hall effect. Rectifiers, limiters, log amplifiers. Single stage transistor amplifiers. Operational amplifiers. Precision rectifiers. Comparators. Oscillators. Digital electronics. Logic gates, microelectronics technology, digital families. Differential pair. Active loads. Current sources. Precision voltage generators.
Recommended or required Reading	- Silva, M.(1996). *Introdução aos circuitos Eléctricos e Electrónicos*. (Vol. 1). Lisboa: Gulbenkian - Silva, M.(1999). *Circuitos com Transístores Bipolares e MOS*. (Vol. 1). Lisboa: Gulbenkian - Smith, S.(1998). *Microelectronic Circuits*. (Vol. 1). England: Oxford Press, - Gray, P.(2001). *Analysis and Design of Analog Integrated Circuits*. (Vol. 1). US: John Wiley & Sons
Planned learning activities and teaching methods	Lectures, tutorials and laboratory sessions
Assessment Methods and criteria	Written Examination 75%, Practical Works 25%.
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Mathematics Applied to Electrotechnics
Course unit code	911212
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Luis Miguel Lindinho da Cunha Mendes Grilo Carlos Filipe Perquilhas Baptista
Learning outcomes of the course unit	Provide the foundations of the main techniques and methodologies in Statistics, Complex Analysis and Transforms that will deevlop in the students analysis and reasoning skills which will allow them to design and implement solutions to the various problems and facilitate decision-making.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Basics of Calculus and Algebra
Recommended optional programme componentes	Not applicable.
Course contentes	1. Random variables. Some probability distributions; 2. Sample distributions. Parameter estimation; 3. Hypothesis tests. Correlation and simple linear regression; 4. Complex numbers. Analytic functions; 5. Complex integration; 6. Fourier, Laplace and Z Transforms.
Recommended or required Reading	- C. Guimarães, R. e A. Cabral, J. (2007). *Estatística*. : McGraw-Hill - C. Pedrosa, A. e A. Gama, M. (2004). *Introdução Computacional à Probabilidade e Estatística*. : Porto Editora - B. Saff, E. e D. Snider, A. (1993). *Fundamentals of Complex Analysis for Mathematics, Science and Enginnering*. New Jersey: Prentice-Hill - Carreira, M. e Metello de Nápoles, M. (1998). *Variável Complexa*. Lisboa: McGraw-Hill
Planned learning activities and teaching methods	lecturs, tutorials and laboratory sessions
Assessment Methods and criteria	Continuous assessment: 2 written tests Exam assessment: 1 written test
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Electronics II
Course unit code	911216
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Jorge Manuel Correia Guilherme Carlos Alberto Farinha Ferreira
Learning outcomes of the course unit	Become familiar with the most common circuits used in electronics. Be able to analyse and design electronic circuits.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Circuit analysis, Electronics I
Recommended optional programme componentes	Not applicable.
Course contentes	Analogue multipliers. Output stages in class A, B, C and D. Discrete and integrated amplifiers. Audio power amplifiers. Frequency response of analog circuits. Feedback and stability. Sinusoidal oscillators. Filters. Approximation problem. Continuous and switched capacitor filters. PLL. Signal converters, ADC, DAC and VF. Programmable logic devices. Noise analyses. Transmission lines. Mixers.
Recommended or required Reading	- Silva, M.(1996). *Introdução aos circuitos Eléctricos e Electrónicos*. (Vol. 1). Lisboa: Gulbenkian - Silva, M.(1999). *Circuitos com Transístores Bipolares e MOS*. (Vol. 1). Lisboa: Gulbenkian - Gray, P.(2001). *Analysis and Design of Analog Integrated Circuits*. (Vol. 1). US: John Wiley & Sons - Smith, S.(1998). *Microelectronic Circuits*. (Vol. 1). England: Oxford Press,
Planned learning activities and teaching methods	Lectures, Theoretical-practical classes and Laboratory work.
Assessment Methods and criteria	Written Examination 50%, Practical Project 25%. Lab. works 25%.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Fundamentals of Power Systems
Course unit code	911232
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Carlos Alberto Farinha Ferreira
Learning outcomes of the course unit	Understand the operating principles and key components of electrical machines and their equivalent circuits. Be able to select and operate electrical machines. Understand the energy production-transportation-supply chain.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Circuit analysis.
Recommended optional programme componentes	Not applicable.
Course contentes	Foundations of electric machines. Operating principles, constitution, equivalent circuit, tests, efficiency, energy and power flux, starting, speed control, rotational inversion of a transformer, a cc machine, a synchronous machine and an asynchronous machine.
Recommended or required Reading	- Fernandes, J. e , . *Sebenta de máquinas eléctricas*. (Vol. -). IPT: - - Fitzgerald, A. e Kingsley Jr, C. e Umans, S. e , . (2003). *Electric Machinery*. -: McGraw-Hill
Planned learning activities and teaching methods	Lectures, problem-solving and laboratory work.
Assessment Methods and criteria	Test: 70%. Practice (laboratorial): 30%.
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Fundamentals of Telecommunications (Major in Industrial Automation)
Course unit code	911231
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Gabriel Pereira Pires
Learning outcomes of the course unit	To understand the frequency analysis of continuous signals using Fourier Transform. To understand the physical impairments of transmission systems. To characterize the different transmission media. To understand modulation systems with continuous carrier applied to analogue and digital transmission.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Mathematical Analysis, Complex Analysis and Basic Electronics.
Recommended optional programme componentes	Not applicable.
Course contentes	1- Introduction to telecommunications; 2- Signals and Systems; 3- Signal theory; 4- Sampling and analog-to-digital conversion: PCM and DPCM modulation; 5- Transmission media; 6- Modulation techniques with continuous carrier; 7- Principles of digital data transmission
Recommended or required Reading	- Forouzan, B.(2006). *Data Communications Networking*. -: McGraw-Hill Science - Lathi, B.(1998). *Modern Digital and Analog Communication Systems* . Oxford University Press: Oxford University Press - Lathi , B.(2000). *Signal Processing and Linear Systems* . USA: Oxford University Press
Planned learning activities and teaching methods	Lectures, Problem solving classes, Laboratory classes;
Assessment Methods and criteria	Exam (70%) (a minimum of 45% is mandatory), Lab (30%) (a minimum of 45% is mandatory). Admission to Exam depends on Lab grade.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Instrumentation Electronics
Course unit code	911218
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Jorge Manuel Correia Guilherme
Learning outcomes of the course unit	Provide knowledge of the main equipments and techniques to measure electric and electronic signals. Become aware of the main limitations when making measurements.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Circuit analysis, Electronics I
Recommended optional programme componentes	Not applicable.
Course contentes	Measurement errors. Electromagnetic instruments. Voltage, current, power and energy measurement. Bridges. Digital instrumentation, voltage meters and frequency meters. Signal generators. Oscilloscopes. Spectrum analyzers. Sensors and signal acquisition. Data converters characteristics. Instrumentation interfaces.
Recommended or required Reading	- Bell, D.(1994). *Electronic Instrumentation and Measurements*. (Vol. 1). US: Prentice Hall - Morris, A.(1993). *Principles of Measurement and Instrumentation*. (Vol. 1). US: Prentice Hall - Fernandes, J.(1998). *Medidas Eléctricas e Instrumentação*. (Vol. 1). Tomar: Escola Superior de Tecnologia de Tomar - Gregory, A.(1973). *An Introduction to Electrical Instrumentation and Measurement Systems*. (Vol. 1). US: The Macmillan Press LTD
Planned learning activities and teaching methods	Lectures, theoretical-practical classes and laboratory work
Assessment Methods and criteria	Written Examination 75%, Laboratory Works 25%.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Systems
Course unit code	911217
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Second Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Paulo Manuel Machado Coelho
Learning outcomes of the course unit	The students will familiarise themselves with the theory of systems and signals with emphasis on continuous linear and time invariant systems They should be able to work with MATLAB - a software for the analysis and simulation of signals systems.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Algebra and Mathematical Analysis and knowledge of electrical concepts (e.g. Circuit Analysis).
Recommended optional programme componentes	Not applicable.
Course contentes	1 – Introduction: classification of signals and systems 2 – Analysis of continuous LIT systems in time domain 3 – Analysis of LIT systems in frequency domain: Laplace transform; transfer function; stability; transient response and steady state response, frequency response of 1st and 2nd order systems 4 – Block diagram representation 5 – Mathematical modelling of systems. Servomechanisms.
Recommended or required Reading	- Lathi, B.(2005). *Linear Systems and Signals* . USA: Oxford University Press - Lourtie, I.(2002). *Sinais e Sistemas*. Portugal: Escolar Editora - Matlab, S.(1995). *The Student Edition of Matlab*. USA: Prentice-Hall
Planned learning activities and teaching methods	Lectures, tutorials and laboratory classes
Assessment Methods and criteria	Written closed-book examination in the regular assessment seasons(75%); and Practical assignments (25%).
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Final Project
Course unit code	911230
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	Anual
Number of ECTS credits allocated	12
Name of Lecturer(s)	Manuel Barros
Learning outcomes of the course unit	Be able to apply knowledge, skills and tools acquired during the degree to develop an applied project.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	Develop a practical project in an area related to the course.
Recommended or required Reading	- ., ..*to be defined on the basis of the students choice of theme*. .: .
Planned learning activities and teaching methods	Work supervised by a lecturer.
Assessment Methods and criteria	Assessment of project work. The Project assignment is subject to public discussion and consideration. For this purpose the Regulations of ESTT's Licenciatura degree shall apply.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Control
Course unit code	911221
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Paulo Manuel Machado Coelho
Learning outcomes of the course unit	This module aims to provide knowledge of several automatic control systems structures, to develop competences in the design of classical control systems using time invariant linear continuous systems and to analyse stability and performance.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Knowledge of Signals and Systems and of Laplace transform.
Recommended optional programme componentes	Not applicable.
Course contentes	1 – Introduction to control systems 2 – Time domain analysis, in open and closed loop: transient response, steady state error analysis, stability (Routh /Nyquist). 3 – Controller design, analysis and specification of control systems based on root locus, frequency design, Bode Diagram. Stability criterion. 4 – PID control: methods of Ziegler-Nichols, pole-placement, etc.
Recommended or required Reading	- Ogata , K.(2002). *Modern Control Engineering*. USA: Prentice-Hall - Kuo, B. e Golnaraghi, F. (2003). *Automatic Control Systems*. USA: John Wiley & Sons - Emani-Naeini, A. e Powell, D. e Franklin, G. (2006). *Feedback Control of Dynamic Systems* . USA: Pearson Prentice Hall
Planned learning activities and teaching methods	Lectures, tutorials and laboratory sessions
Assessment Methods and criteria	Written open-book examination during regular examination seasons(75%) and Practical assignments (25%).
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Data Network (Major in Industrial Automation)
Course unit code	911233
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Gabriel Pereira Pires
Learning outcomes of the course unit	At the end of this module the students should be able to 1) understand network architectures and data-link and routing protocols 2)Configure switching and routing equipment for Ethernet local networks 3)Design networks based on Etherenet tecnhnology.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Basics of Telecommunications
Recommended optional programme componentes	Not applicable.
Course contentes	1 - Layer architectures 2 - Data transmission 3 - Data-link Layer 4 - Methods for Medium Access Control 5 - Protocols ICMP, ARP, IPv4 addressing 6 - Switching and routing protocols: bridge, VLAN, STP, RIP (802.1d, 802.1p,802.1q) 7 - Network layer: Internet Protocol 8 - Case studies implementation 9 - Introduction to structured cabling: standard 11801
Recommended or required Reading	- Halsall , F.(1996). *Data Communications, Computer Networks and Open Systems*. Addison Wesley: Addison Wesley - Forouzan, B.(2006). *Data Communications and Networking*. McGraw-Hill : McGraw-Hill - Spurgeon, C.(2000). *Ethernet: the definitive guide*. O'Reilly: O'Reilly - Trulove, J.(2005). *Lan Wiring*. McGraw Hill: McGraw Hill
Planned learning activities and teaching methods	Lectures, practical exercises and lab experiments
Assessment Methods and criteria	Written Test (60%), Lab work (20%), Case study implementation (20%) (assessment requirements: a minimum of 45% in the written Test and a minimum of 50% in the Labs and case study)
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Electromechanical Drives (Major in Industrial Automation)
Course unit code	911234
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Carlos Alberto Farinha Ferreira
Learning outcomes of the course unit	The students should understand the circuits and components used in power electronics; the mode of operation of industrial converters and be able to design solutions for open and closed loop electro-mechanical drives.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Knowledge of physics (electromagnetic and mechanics), electric circuits, electronics and control.
Recommended optional programme componentes	Not applicable.
Course contentes	Introduction: Power electronics versus linear electronics. Mechanical systems: transmissions, determination of mechanical parameters. Load demands. Power electronics components and converter typologies, dimensioning and command. Application to asynchronous machines and continuous current machines.
Recommended or required Reading	- Palma, J. e , . *Accionamentos Electromecânicos de Velocidade Variável*. -: Fundação Calouste Gulbenkian - Ion, B. e Nasar, S. e , . (1999). *Electric Drives*. -: - - Mohan, N. e Undeland, T. e Robbins, W. (1989). *"Power Electronics: Converters, Applications and Design*. (Vol. -). -: John Wiley & Sons
Planned learning activities and teaching methods	Lectures, tutorials and laboratory classes
Assessment Methods and criteria	Test: 50%. Practice (laboratorial): 50%.
Language of Instruction	Portuguese | **Mentoring in** English
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Industrial Automation
Course unit code	911222
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	First Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	António Casimiro Teixeira Batista Ana Cristina Barata Pires Lopes
Learning outcomes of the course unit	On completion of this module the students should be able to: Deal with hardware considerations (different types of actuators and sensors). Specify events and constraints in manufacturing systems. Specify algorithms of local automation using formal methods. Write programs for PLCs
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	1 – Introduction to Automation 2 – Sensors and actuators 3 – Wiring logic. 4 – Pneumatics and hydraulics 5 – Programmable Logic Controllers 6 – Industrial Communications.
Recommended or required Reading	- Novais, J.(2008). *Programação de Autómatos, Método GRAFCET*. (Vol. 1). Portugal: Fundação Calouste - Morriss, S.(2000). *Programmable Logic Controllers*. (Vol. 1). US: Prentice-Hall - Siemens, S.(2003). *Simatic, S7-200 Programmable Controller.*. (Vol. 1). Alemanha: Siemens
Planned learning activities and teaching methods	Lectures, tutorials and laboratory classes.
Assessment Methods and criteria	Theoretical test. Laboratory assignments.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Embedded Systems (Major in Industrial Automation)
Course unit code	911236
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Ana Cristina Barata Pires Lopes
Learning outcomes of the course unit	Provide the students with skills related to the project and development of microcontroller based systems.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Algorithms, C programming, digital systems, computer architecture and operating systems.
Recommended optional programme componentes	Not applicable.
Course contentes	1)Introduction to PIC Familly microcontrollers. 2)Interrupts. 3)Timers/counters. 4)Peripheral modules: analog-digital converter, pulse-width modulation, and capture. 5)Serial communication: synchronous and asynchronous universal serial port (USART) and MSSP. 6)Introduction to real-time systems – time constraints, and computational models.
Recommended or required Reading	- Peatman, J.(1998). *Design with PIC Microcontrolers*. (Vol. -). -: Prentice Hall - Peatman, J.(2003). *Embedded Design with PIC 18F452 Microcontrolers*. (Vol. -). -: Prentice Hall - Buttazzo, G.(2004). *Hard Real-Time Computing Systems*. (Vol. -). -: Springer
Planned learning activities and teaching methods	Lectures, practical exercises and lab experiments.
Assessment Methods and criteria	Written test (60%), lab work (40%). A minimum mark of 45% in the written test and a minimum mark of 45% in the labs is mandatory.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Industrial Networks (Major in Industrial Automation)
Course unit code	911235
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	António Casimiro Teixeira Batista
Learning outcomes of the course unit	Upon completion of the course, students should be able to: Specify solutions for remote control of industrial devices. Setup and operate a low level fieldbus solution (Profibus-DP) Write programs for PLC's with high level programming languages (Step7).
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Industrial Automation
Recommended optional programme componentes	Not applicable.
Course contentes	Fieldbuses. OSI model. Fieldbuses architectures. Data link layer. MMS (Manufacturing Message Specification). Protocol solutions commercially available. Master/Slave with token. CSMA/CD(CR, DCR). Producer, distributor and consumer. Industrial networks. Topologies, services and profiles. Examples: Field – Profibus DP; Control – Profibus FMS; Command – ProfiNET.
Recommended or required Reading	- Siemens, S.(2003). *Simatic, S7-200 Programmable Controller..* (Vol. 1). Alemanha: Siemens - Siemens, S.(1979). *SIMATIC S7, Programming with STEP 7.* (Vol. 1). Alemanha: Siemens - Siemens, S.(2001). *SIMATIC NET, NCM S7 for PROFIBUS.* (Vol. 1). Alemanha: Siemens
Planned learning activities and teaching methods	Lectures and laboratory classes
Assessment Methods and criteria	Theoretical test. Laboratory projects.
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Industrial Robotics (Major in Industrial Automation)
Course unit code	911237
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Ana Cristina Barata Pires Lopes
Learning outcomes of the course unit	The students should familiarise themselves with the operation and management of robotic systems: technological components,operation, programming of industrial robots, and industrial applications.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Circuits, programming, electronics, digital systems, computer architecture and operating systems.
Recommended optional programme componentes	Not applicable.
Course contentes	1) Introduction to industrial robotics. 2) Spatial descriptions and transformations. 3) Robot morphology. 4) Robot kinematics. 5) Introduction to trajectory generation. 6) An overview of the industry 7) Brief introduction to mobile robotics.
Recommended or required Reading	- Craig, J.(1989). *Introduction to Robotics*. (Vol. -). -: Addison-Wesley Longman Publishing Co. - Fu, K.(1987). *Robotics : control sensing, visionand inteligence* . (Vol. -). -: McGraw- Hill Book Company
Planned learning activities and teaching methods	Lectures, practical exercises and lab experiments.
Assessment Methods and criteria	Written Test (60%), Lab work (40%) (A minimum mark of 45% in the written Test and a minimum mark of 45% in the Labs is mandatory).
Language of Instruction	Portuguese
Work placement(s)	Not applicable.

B - Description of individual course units

Course unit title	Maintenance
Course unit code	911226
Type of course unit	Compulsory
Level of Course unit	First Cycle
Year of Study	Third Year
Semester/Trimester when the course unit is delivered	Second Semester
Number of ECTS credits allocated	6
Name of Lecturer(s)	Ana Carla Vicente Vieira
Learning outcomes of the course unit	Provide the students with knowledge and skills in the domain of building and industrial maintenance, namely the ability to understand concepts and apply common maintenance management techniques and tools.
Mode of delivery	Face-to-face
Prerequisites and co-requisites	Not applicable.
Recommended optional programme componentes	Not applicable.
Course contentes	Reliability; Maintenance and diagnosis methods for several Electrical, Mechanical and Electromechanical systems; Industrial Instrumentation Maintenance; Maintenance objectives and strategies; Maintenance information circuits and documents for maintenance; Maintenance service structure and staff organization; Maintenance contracts and Outsourcing; Maintenance management and control.
Recommended or required Reading	- Cardoso, A.(1991). *Diagnóstico de Avarias em Motores de Indução Trifásicos (in Portuguese)*. Portugal: Coimbra Editora - Higgins, L.*Maintenance Engineering Handbook; Edited by Lindley R. Higgins* . -: McGrawHill - CABRAL, J.(2009). *Gestão da Manutenção de Equipamentos, Instalações e Edifícios*. Portugal: LIDEL - STONEHAM, D.(1998). *The Maintenance Management and Technology Handbook*. -: Elsevier Advanced Technology
Planned learning activities and teaching methods	Lectures (28 hours) Case analysis and discussion (42 hours) Practical work proposed by the lecturer (87 hours sel-study)
Assessment Methods and criteria	Written Test (mandatory; Public presentations and discussion of projects(mandatory).
Language of Instruction	Portuguese
Work placement(s)	Not applicable.