ECTS CATALOGUE 2021-2022

The main language of instruction at Coimbra Institute of Engineering is Portuguese. However, some courses from degree and master programs can be offered in English and/or with a tutorial support in English.

The ECTS catalogue includes subject contents in English Language. The Students can choose subjects from this Catalogue to the study plan proposal (Learning Agreement) to be analyzed carefully by the Departmental Coordinators and to be adjusted, after student's arrival, if necessary.

This ECTS catalogue contains information that is valid for this academic year. ISEC reserves the right to adjust the courses offered during the academic year and is not responsible for typing errors or printing mistakes.

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Electromechanical Engineering Bachelor

Old Code	New Code	Title - Portuguese	Title - English	ECTS	Term
1.º ano / 1st Year					
910501	60021519	Análise Matemática I	Mathematical Analysis I	6	Fall
910502	60021525	Física	Physics	5	Fall
910504	61000499	Eletrotecnia I	Electrotechnics I	5	Fall
910505	60021553	Desenho Assistido por Computador	Computer Aided Design	4	Fall
910506	60021564	Introdução à Programação	Introduction to Programming	5	Fall
910507	60021570	Análise Matemática II	Mathematical Analysis II	6	Spring
910508	60021581	Sistemas Digitais	Digital Systems	5	Spring
910509	61000507	Eletrotecnia II	Electrotechnics II	5	Spring
910510	60021609	Mecânica Aplicada	Applied Mechanical	5	Spring
910511	60021615	Termodinâmica	Thermodynamics	6	Spring
910512	60021626	Inglês	Technical English	3	Spring
910503	60021536	Álgebra Linear	Linear Algebra	5	Fall
2.º ano / 2nd Year					
910513	60021637	Teoria dos Sistemas	Systems Theory	5	Fall
910514	61000477	Eletrónica	Electronics	5	Fall
910515	60021652	Medidas e Instrumentação	Measurements and Instrumentation	5	Fall
910516	60021663	Materiais	Materials	5	Fall
910517	60021674	Resistência dos Materiais	Strengths of Materials	5	Fall
910518	60021680	Mecânica dos Fluidos	Fluid Mechanics	5	Fall
910519	60021691	Métodos Estatísticos	Probability and Statistical Methods	4	Spring
910520	61000529	Máquinas Elétricas	Electrical Machines	5	Spring
910521	60021716	Automação Industrial	Industrial Automation	5	Spring
910522	61000554	Sistemas Elétricos e Qualidade de Serviço *	Electrical Power Systems and Power Quality *	5	Spring
910523	60021738	Tecnologia Mecânica	Mechanical Technology	6	Spring
910524	60021749	Máquinas Térmicas e Hidráulicas	Hydraulic and Thermal Machines	5	Spring
3.º ano / 3rd Year					
910525	61000466	Acionamentos Eletromecânicos *	Electromechanical Drives *	5	Fall
910528	60021784	Climatização e Refrigeração	Air Conditioning and Refrigeration	5	Fall
910530	60021806	Fabrico Assistido por Computador	Computer Assisted Manufacturing	5	Fall
910526	61000518	Instalações Elétricas Industriais	Industrial Electrical Installations	5	Fall
910529	60021790	Manutenção e Controlo da Qualidade	Industrial Maintenance and Quality Control	5	Fall
910527	60021773	Órgãos de Máquinas	Machine Elements	5	Fall
910532	61000488	Eletrónica Industrial	Industrial Electronics	5	Spring
910531	60021817	Gestão de Energia	Energy Management	4	Spring
910535	60021850	Motores de Combustão Interna	Internal Combustion Engines	5	Spring
910534	60021845	Organização Industrial e Gestão de Empresas	Industrial Economics and Management	5	Spring
910536	61000535	Projeto	Project	6	Spring
910533	61000546	Projeto de Instalações Eléctricas **	Design of Eletrical Installations **	5	Spring

* This subject is taught just in Portuguese Language

** Related to Portuguese Legislation. Not recommended for all nationality's students (exceptions: Spain, Italy)

Instituto Superior de Engenharia de Coimbra
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Signature of Teacher: _____

Licenciatura – BsC Engenharia Electromecânica

Licenciatura – BsC Electromechanical Engineering

Academic Year: **2018/2019**

Program Contents

Course Unit CALCULUS I

Specialization (s)

Subject type Sciences of speciality **Research Area** Mathematics

Year 1st **Semester** 1st **ECTS** 6

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	2	28
Practical-Laboratory Lectures	1	14
Tutorial Orientation		
Project		
Total of Working Hours		156

Unaccompanied Working Hours

Activity Type	Total Hours
Study	83
Works / Group Works	
Project	
Evaluation	3
Additional	

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Rui Manuel Carreira Rodrigues	PhD	Professor Coordenador
Theoretical-Practical Lectures	Rui Manuel Carreira Rodrigues		
Practical-Laboratory Lectures	Rui Manuel Carreira Rodrigues		
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) Rui Manuel Carreira Rodrigues

Goals

Differential calculus and integral calculus of real functions of a real variable and its applications.
Learning takes place simultaneously in the theoretical classes, in the theoretical-practical classes and in the practical classes, where the topics, included in the syllabus contents of the curricular unit, are presented and discussed, through the resolution of exercises and the use of the following software: GeoGebra, MATLAB / MuPAD and WolframAlpha.
Classes presented in Portuguese language.

Skills

Clear interpretation, use and description of the mathematical concepts studied. Analysis and resolution of problems using software.

Program Contents

1. Real function of a real variable
Properties of real function of a real variable; Limit and continuity, properties and results; Trigonometric functions and inverse trigonometric functions; Exponential function, logarithmic function and hyperbolic functions.
2. Differential calculus
Derivative, properties and results; Derivative of the composition function and the inverse function; Theorems of Rolle, Lagrange and Cauchy; Undetermined forms and Cauchy's rule; Polynomial approximation: differentials and Taylor polynomial.
3. Primitive of real functions of real variable
Techniques for calculating the indefinite integral.
4. Integral calculus
Definite Integral, properties and results; Fundamental theorem of calculus; Integration by parts and by substitution; Applications of the definite integral: area of a plane region, volume of a solid of revolution and length of the arc of a curve; Improper integrals: Integrals at unlimited intervals and integrals of unlimited functions.
5. Introduction to the study of ordinary differential equations
First order ordinary differential equations - Existence and uniqueness of a solution; First order linear equation, Bernoulli equation and equation of separate variables.
6. Component of numerical analysis (laboratory component)
Approximation and error in numerical calculation; Numerical methods for solving non-linear equations: bisection method and Newton-Raphson method; Polynomial interpolation; Numerical integration methods: trapezoid rule and Simpson rule. Numerical methods for differential equations: Euler's method.

Bibliography

Departamento de Física e Matemática, Manual de Matemática, Pré-Cálculo, Introdução ao Cálculo.
Howard Anton, "Cálculo - um novo horizonte", volume 1.
Earl W Swokowski, "Cálculo com Geometria Analítica", volume 1.
Hamilton Luiz Guidorizzi, "Um curso de cálculo", volume 1.
Ron Larson, Robert P. Hostetler e Bruce H. Edwards, "Cálculo", volume 1.
Rui Rodrigues - notas teóricas de análise matemática e exercícios de análise matemática.

Access Conditions and Attendance Excuse

Not applicable.

Conditions for Exam Admission

Access to the exam allowed to all students duly enrolled in the course unit. In particular, access to the appeal period requires enrollment in the academic services.

Evaluation Method

Each student has to choose one of the following assessment methodologies.
• Distributed evaluation - The evaluation consists of the sequential realization: of two tests of the theoretical-practical component, 1st test quoted for 7 values to be held on November 7, 2nd and final test quoted for 7 values (with a minimum rating of 2.5 values) on the date of the first season exam (defined in the exam schedule), and three laboratory tests, 1st and 2nd tests quoted for 1.5 values to be performed in laboratory classes, 3rd test quoted for 3 values to be taken in the last laboratory class. The student approves if the sum of the scores obtained in the tests is greater than or equal to 10 values. The student chooses the distributed evaluation when performing the first test of the theoretical-practical component. From this date on the student will not be able to change from assessment methodology. The second season exam is quoted for 20 values (14 values of the theoretical-practical component and 6 values of the laboratory component) and the student is approved if he or she obtains a classification of 10 values or higher.
• Evaluation by final exam (in the first and the second seasons) - Students have access to two tests: one exam in the first season and one exam in the second season quoted for 20 values (14 values of the theoretical-practical component and 6 values of the laboratory component). The student is approved if he or she obtains a classification of 10 or higher in any of the tests. A supplementary test is mandatory for students with a score of 17 or higher.

Conditions for Results Improvement

Conditions for the improvement of classification defined in the REACTA (regulation of frequency, assessment of knowledge and transition of year).

Date

17.09.2018

Signature from the lecturer responsible for the course

Rui Rodrigues

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher:_____

Licenciatura – BsC Engenharia Eletromecânica (Português)

Licenciatura – BsC Electromechanical Engineering (Inglês)

Academic Year: **2018/2019**

Program Contents

Course Unit PHYSICS

Specialization (s)

Subject type Basic Sciences **Research Area** Physics

Year 1 **Semester** 1 **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	1	14
Practical-Laboratory Lectures	1	14
Tutorial Orientation		
Project		

Unaccompanied Working Hours

Activity Type	Total Hours
Study	57
Works / Group Works	14
Project	
Evaluation	3
Additional	

Total of Working Hours 130

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Susete Teresa Gaspar do Fetal	PhD	Adjunct Professor
Theoretical-Practical Lectures	Susete Teresa Gaspar do Fetal	PhD	Adjunct Professor
Practical-Laboratory Lectures	Susete Teresa Gaspar do Fetal	PhD	Adjunct Professor
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) Susete Teresa Gaspar do Fetal

Goals

Learning the fundamental laws of Nature in the domain of Classical Mechanics, described in the syllabus.
Solve problems and analyse results using the fundamental laws.
Self acquiring knowledge.
Scientific interpretation of physical phenomena.
Acquire and analyse experimental data in group.

Skills

The individual study of the subjects taught, supported by tutorial contacts, constitutes an important part of the work plan, acquiring the students habits of autonomous acquisition of knowledge.
Improve of technical-scientific literacy and apply the processes of ideas communication based on science.
The student will acquire skills in the formulation and interpretation of problems, as well as in their resolution and critical analysis of the results.
The understanding of acquired knowledge is promoted by theoretical-practical exercises and applied in laboratories, which develop a professional attitude towards work.
The student is called to be involved in situations of a practical nature (laboratories) or theoretical-practical (written exercises) in which he must make judgments and make decisions.
The accomplishment of laboratory work in groups allows to exercise the interpersonal exchange of ideas and the discussion of problems and solutions.

Program Contents

1. Systems of units and vector calculus.
International System of Units
Equations of dimensions.
Multiples and submultiples.
Conversion of units.
Scientific notation and significant figures.
Vector representation.
Analytical and graphic sum and subtraction of vectors.
Unit vector.
Projection of a vector.
Scalar product and vectorial product.

2. Rigid body rotation.
Kinematics - Translation and rotation movement. Relationship between linear and angular magnitudes. Uniform circular motion (periodic). Uniformly varied circular motion.
Newton's 2nd Law for Rotation. Moment of a force. Resultant moment. Moment of inertia. Movement of an object that rolls without sliding.
Work and energy: Work; power; kinetic energy of translation and rotation; potential energy; mechanical energy. Conservation of angular momentum.

3. Electromagnetic phenomena and technical applications:
Introduction to electromagnetism. Charges. Currents. Fields.
Electric field created by point charges. Electric force, electric potential and electrostatic energy of point charges.
Capacitor. Relationship between potential difference and electric field. Relationship between electric field and surface charge density. Capacity. Dielectric constant. Association of capacitors in series and in parallel. Stored energy.
Movement of charges within an electric field. Variation of electric potential and variation of kinetic energy. Conservation of mechanical energy.
Electric current. Ohm's Law.
Relation between current and charge. Resistivity. Dependence of resistivity with temperature. Power and energy. Power dissipated in a resistor.
Generation of magnetic field.
Law of Biot-Savart.
Electromagnetic behaviour of materials.
Magnetic force over charges and over currents. Movement of charges within a magnetic induction field.
Lorentz Force.
Magnetic induction. Magnetic flux. Faraday's Law. Law of Lenz.
Self-induction. Mutual induction. Torque on a loop in a magnetic field. DC motor. Induction motor.
Ideal transformer.
Electromagnetic radiation. Poynting´s vector.

4. Geometric optics.
Reflection. Flat mirrors and spherical mirrors: concave and convex.
Refraction. Snell's Law. Depth apparent. Dispersion. Total reflection.
Fine lenses. Lenses manufacturer’s equation. Power of a lens. Association of lenses.
Optical instruments.

Practical works:
• Rotation dynamics.
• Magnetic forces between fields and currents.
• Thomson Tube
• Electrostatic.

Bibliography

Physics for Scientists and Engineers, Volume 2, 6th Edition, Mosca and Tipler, LTC Publisher, ISBN: 9788521617112
Physics, F.J. Bueche and E. Hecht, McGrawHill, Portugal, ISBN: 972-773-089-2.
Fundamentals of Physics, Halliday & Resnick and Jearl Walker, volume 3, 9th edition, ISBN: 9788521619055
Several notes elaborated by ISEC´s teachers from physics section: Power point presentations; Exercises sheets; etc.

Signature of Teacher:_____

Access Conditions and Attendance Excuse

The attendance of the practical classes is required, except for students covered by Laws nº 99/2003 and nº 35/2004.

Conditions for Exam Admission

Approval in practical classes (classification equal or higher than 2 values in 4 values), except for students covered by Laws 99/2003 and 35/2004.

Evaluation Method

Students may choose between a distributed evaluation regime with practical works and tests or practical works and final examination.

Distributed evaluation system
The distributed evaluation consists in 4 laboratorial works and 3 tests distributed along the semester.
The laboratory component, P, regulated by an annexed Regiment, has a weight of 4.0 values, with each laboratory work quoted for 1.0 value.
The first test, T1, covering the program contents of "Unit systems and vector calculus" and "Rigid body dynamics" has the quotation of 5.0 values and will be done on 10/23/2018. The second test, T2, which evaluates the programmatic contents of "Electromagnetic phenomena and technical applications" has the quotation of 8.0 values and will be done on 12/11/2018. The third test, T3, focuses on the programmatic content "Geometric optics", is quoted for 3.0 values and will be realised on the date of the normal exam.
The distributed assessment regime requires an attendance rate of more than 75% of the total number of classes taught during the semester.
The student is approved if, having a attendance rate of more than 75%, P≥2.0 and (P + T1 + T2 + T3) ≥9.5.
A student can abandon the distributed evaluation regime and do final exam for evaluation.

Evaluation by final exam and laboratory work
Students can be evaluated by performing 4 laboratory work during the semester and doing the final exam. The laboratory component, P, regulated by an annexed Regiment, has a weight of 4 values, with each laboratory work quoted for 1 value.
Students who have a classification P≥2.0 will be approved if C = (E + P) ≥9.5, with E being the final exam classification, from 0 to 16 points. Otherwise, the final classification will be C if C <9 or 9 if C> 9.

Students covered by Laws nº 99/2003 and nº 35/2004 may opt for the regime of only final exam, quoted for 20 values.

Note:
During the tests and exams it is not allowed to use any electronic device or any element of consultation except the form provided by the teacher and that will be available in the moodle; it is allowed the use of a non-graphing calculator.

Conditions for Results Improvement

Those foreseen in ISEC´s regulations, with no improvement in the practical component.

Date	**Signature from the lecturer responsible for the course**
09/13/2018	Susete Teresa Gaspar do Fetal

Signature of Teacher:_____

Physics laboratory regulation

1. Four practical works will be carried out by students in groups (between 2 and 4 students).
2. The students' registration in the laboratory and their distribution by groups and shifts is carried out in the first laboratory class.
3. The practical work will be carried out in 3 consecutive hours, every 3 weeks.
4. Each work will be classified between 0 and 1 values, the total classification of the practical work being the sum of the classifications of the 4 works (therefore a maximum of 4 values).
5. The delivery of a pre-report and approval in a short oral test, at the beginning of each class, is a necessary condition for access to the laboratory work. The material necessary for the preparation of the pre-report is in the moodle, in the page of the curricular unit.
6. All doubts that arise in the preparation of the works and in particular on the preparation of the pre-reports must be clarified prior and in time, during the teacher's hours or by email: susete@isec.pt.
7. The report of each work is prepared by all members of the group and is delivered during the practical work class.
8. Unrealized work is quoted with a zero classification. In cases where the work is performed by a group in which one or more elements are missing, these elements will have zero quotation in that work.
9. Any case not covered in this regulation is discussed directly with the responsible professor of the curricular unit.

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Signature of Teacher:

Licenciatura – BsC Engenharia Eletromecânica

Licenciatura – BsC Electromechanical Engineering

Academic Year: **2018/2019**

Program Contents

Course Unit LINEAR ALGEBRA

Specialization (s)

Subject type Basic Sciences **Research Area** Mathematic

Year 1º **Semester** 1º **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	2	28
Practical-Laboratoty Lectures	0	0
Tutorial Orientation	0	0
Project	0	0

Unaccompanied Working Hours

Activity Type	Total Hours
Study	62
Works / Group Works	8.5
Project	0
Evaluation	3.5
Additional	0

Total of Working Hours 130

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Cristina M. Ribeiro Martins Pereira Caridade	PhD	Adjunct Professor
Theoretical-Practical Lectures	Nuno Filipe Jorge Lavado	PhD	Adjunct Professor
Practical-Laboratoty Lectures			
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) Cristina M. Ribeiro Martins Pereira Caridade

Goals

The main aims of this course unit are:

- Perform basic matrix operations.
- Compute matrix determinants, eigenvalues and eigenvectors.
- Understand and apply concepts related to vector spaces and linear transformations.
- Solve and interpret linear systems using matrix theory.
- Understand the importance of linear algebra and analytic geometry in computer science and informatics engineering.
- Recognize the importance of the algorithms in linear algebra.
- Solve real problems which are modelled by matrices and systems.

Skills

At the end of this course unit the learner is expected to be able:

- Develop algorithms using a logical and structured reasoning.
- Solving base problem on mathematics.
- Compare, with criticism, the results obtained by analytical means with the ones obtained by computational means.
- Select appropriately the accessible information (from monographs, textbooks, web …).
- Expose, using documents, the solution problems in a clear and simple way.
- Explain the concepts and solution problems in an appropriated way.
- Solve practical problems with autonomy using, not only the subjects treated in the class, but also other related topics.

Program Contents

1. Complex Numbers (revisions)

2. Systems of linear equations and matrices
- Application of the study of systems of linear equations in solving some problems usually related to Mechanical Engineering.
- Matrix concept.
- Special matrices (row matrix, column matrix, triangular matrix, diagonal matrix, scalar matrix, identity matrix, transposed matrix and conjugate matrix).
- Operations with matrices and some properties: addition of matrices, scalar multiplication and multiplication of matrices.
- Invertible matrices.
- Matrix notation of a system of linear equations.
- Characteristic of a matrix. Calculation of the characteristic by the Gauss elimination method.
- Resolution of linear systems by Gauss elimination method.
- Systems with parameters. Discussion of systems with parameters.
- Inverse matrix. Calculation of the inverse matrix by the Gauss-Jordan method.

3. Vector spaces
- Introduction of the concept of vector space.
- Vector spaces: definition and elementary properties.
- The real vector space.
- Vector subspaces. Classification and characterization of subspaces.
- Subspace construction: linear combination; linear expansion; subspace generated by a set of vectors; space of finite dimension; intersection, sum and subspace meeting.
- Linear dependence and independence.
- Base of a vector space. Dimension of a vector space. Change of base.
- Line spacing; space of columns and null space of an array.

4. Determinants
- Introduction of the notion of determinant.
- Second order determinant: definition and properties.
- Third-order determinant: definition using first line development; one of the lines - "matrix of signals". Rule of Sarrus.
- Determinant of order n; definition.
- Minor, complementary minor and algebraic complement. Laplace's theorem and its generalization. Characteristic of a matrix and order of minors.
- Calculation of the determinant of a matrix through the determinant of a triangular matrix obtained by elimination of Gauss.
- Applications of the determinants: Adjoint matrix and inverse matrix; systems of linear equations. Cramer's Rule.

5. Eigenvalue and Eigenvector
- Introduction of the concept of eigenvalue and eigenvector of a linear application.
- Definition of eigenvalue of a linear application T, eigenvector of T associated with an eigenvalue and space of T associated with an eigenvalue.
- Diagonal matrix representation of a linear application. Concept of diagonalizable matrix and matrix diagonalization.
- Characteristic polynomial and characteristic equation of a matrix. Cayley-Hamilton theorem and some applications.

Bibliography

CRISTINA M.R. CARIDADE, Álgebra Linear, DFM, ISEC, 2018;

e-MAIO (Módulos de Aprendizagem Interativa online) - https://dfmoodle.isec.pt/

MOODLE ISEC – Algebra Linear - http://moodle.isec.pt/

LUÍS T. MAGALHÃES – *Álgebra Linear como introdução à Matemática Aplicada, Texto Editora, lisboa 1990.*

GILBERT STRANG – Linear Algebra and its Applications, Academic Press, New York 1980.

GREGÓRIO LUÍS E SILVA RIBEIRO. – *Álgebra Linear, McGraw Hill, Lisboa 1985.*

C. SILVA RIBEIRO, LUIZETE E SÉRGIO SILVA REIS - Álgebra Linear. Exercícios e Aplicações, MCGraw Hill. Lisboa 1990.

M. RACHIDE ABDULMAGIDE – Lições Teórico-Práticas de Álgebra Linear, Contraponto, porto 1990.

F. R: DIAS AGUDO – Introdução à Álgebra Linear e Geometria Analítica, Escolar Editora, Lisboa 1972.

ANTÓNIO MONTEIRO – Matrizes, Coleção Dashofer, Learning & Higher Education, 2010.

ANTÓNIO MONTEIRO – Álgebra Linear – Espaços vetoriais e transformações lineares,

Coleção Dashofer, Learning & Higher Education, 2010.

Access Conditions and Attendance Excuse

Not Applicable.

Conditions for Exam Admission

All students enrolled in this course have access to the first and second exam call.

Evaluation Method

Students, at the beginning of the year, will opt for a distributed evaluation or a final exam evaluation. The distributed evaluation will be done through two tests and a practical work distributed as follows:

	1st Test	2nd Test	Practical work
Contents	Complex Numbers, Systems of linear equations and matrices, Vector spaces	Determinants, Eigenvalue and Eigenvector.	
Marks	8,0	8,0	4,0
Minimum	No minima	3,0	No minima
Date	November 11 to 17 (during practical classes)	Date of first examination	**Submit:** until 12/31/2018 **Presentation:** exam support week

If the student does not obtain the minimums in the second test, or the sum of the marks obtained in the two tests and in the practical work, is less than 9.5 values, the student will have to make the second examination call. The second exam call will be 20 values and the student will have to obtain a mark of 9.5 or higher.

Students who have chosen a final exam evaluation at the beginning of the year will not have to do the practical work in Matlab. For these students the first and second exam call will be 20 values. The student will have to obtain a grade higher or equal to 9.5 values.

Conditions for Results Improvement

The conditions of results improvement are those that are forecast in the "Regulation of Evaluation of Knowledge and Transition of Year" (REACTA).

Date | **Signature from the lecturer responsible for the course**

11th September 2018

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher: _____

Licenciatura – BsC ___ Engenharia Electromecânica ___(Português)

Licenciatura – BsC ___ Electro-Mechanical Engineering ___(Inglês)

Academic Year: **2018/2019**

Program Contents

Course Unit ELECTRICAL CIRCUITS THEORY I

Specialization (s) *NOT APPLICABLE (N/A)*

Subject type Basic Sciences **Research Area** Electrical Engineering

Year 1st **Semester** 1st **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	2	28
Practical-Laboratoty Lectures		
Tutorial Orientation		
Project		
Total of Working Hours		130

Unaccompanied Working Hours

Activity Type	Total Hours
Study	72
Works / Group Works	
Project	
Evaluation	2
Additional	

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Paulo Filipe de Almeida Ferreira Tavares	PhD	Adjunct Professor
Theoretical-Practical Lectures	Paulo Filipe de Almeida Ferreira Tavares	PhD	Adjunct Professor
Practical-Laboratoty Lectures			
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) Paulo Filipe de Almeida Ferreira Tavares

Goals

The objectives of this curricular unit are:
- to impart the principles and basic concepts of Circuit Analysis concepts for DC circuits and single-phase AC circuits.
- to understand/learn the significance of resolution electrical circuits in circuit analysis.
- to understand/learn the theory and functioning DC circuits.
- to understand/learn the theory and functioning of single-phase AC circuits.

Skills

- Understand the meaning of good practices for solving electrical circuits in circuit analysis.
- Understand the theory and operation of DC circuits.
- Understand the theory and operation of single-phase AC circuits.

Signature of Teacher:_____

Program Contents

DC Circuits: Quantities and units of electric charge, current, voltage, power and energy; Ideal Voltage and Current Sources; Electric Power; Resistance and Ohm's Law; Graphs and linear resistive circuits; Circuit topology: node, branch and loop; Kirchhoff's laws; Nodal and loop analysis; Series resistors and voltage division; Parallel resistors and current division; Theorems: Superposition and Source Transformation; Thévenin's/Norton's; Maximum Power Transfer.

AC Circuits: Energy-Storage Elements; Capacitors and inductors; Sinusoidal functions; Phasors and Electric Impedance; AC Circuit Analysis Methods; RL, RC, and RLC circuits; Frequency Response of AC circuits; Power in AC Circuits; Active, Reactive and Apparent Power; Power Factor and Power Factor Compensation.

Bibliography

James W. Nilsson, Susan A. Riedel, "Circuitos Eléctricos", 8ª edição, Pearson (*in Portuguese*).
Edminister, J. A., "Circuitos Eléctricos", Colecção Schaum (*in Portuguese*).
Bessonov, L., "Electricidade Aplicada para Engenheiros", Editora Lopes da Silva (*in Portuguese*).
Support Material Available (*in Portuguese*):
- Copy of the presentations made in theoretical classes;
- Problem Sheets.

A. H. ROBBINS AND W.C. MILLER, "Circuits Analysis: Theory and Practice", 3rd Edition, Thomson Delmar Learning, 2004.
C. K. ALEXANDER, M. SADIKU, "Fundamentals of Electric Circuits", NY, McGraw Hill Science/Engineering/Math, 3rd Edition, 2006.
EDWARD HUGHES, "Electric and Electronic Technology", Prentice Hall, 2002.
THOMAS L. FLOYD, "Principles of Electric Circuits", Prentice Hall, 7th Edition, 2003.

Access Conditions and Attendance Excuse

For students of special schemes, namely those under the Worker-Student Statute (in accordance with current legislation), and for components with compulsory attendance and distributed assessment, it must be agreed between the person responsible for the curricular unit and the student, on the initiative of the student and at the beginning of the academic semester, a form of alternative operation of these components, when the student can not attend them at the scheduled times.
In the case of worker students, the conditions of participation in classes will be combined between the teacher and the students, and in accordance with current legislation.

Conditions for Exam Admission

Students who have obtained the **required minimum attendance** have access to the normal period examination.
The student who has not obtained the minimum attendance, can only have access to the appeal season.
Alternative Assessment for Students - Workers: In the case of students covered by the special schemes provided by law and if they can not meet the attendance conditions, they must complete a final exam (quoted to 20 points).
The student must advise the teacher, **during the first two weeks of classes**, that he / she is unable to attend classes (totally or partially).

Evaluation Method

Realization of two quoted frequencies, each one, for 10 values in the days: November 20, 2018 and December 21, 2018.
In order to have access to the examination of the normal time the student will have to attend 75% of the theoretical-practical classes.
There will be two frequencies, a normal period examination, an examination of appeal and a special examination (which may have conditional access).

Conditions for Results Improvement

At the time of appeal following approval students who have been approved may improve their classification once according to the Frequency, Knowledge Assessment and Year Transition Regulation (REACTA) of the ISEC - Coimbra Institute of Engineering, in particular with regard to deadlines, payments and maintenance of previously obtained note.

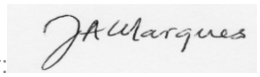
Date

14/09/2018

Signature from the lecturer responsible for the course

Paulo Filipe de Almeida Ferreira Tavares

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher: 

Licenciatura – BsC Engenharia Electromecânica

Licenciatura – BsC Electromechanical Engineering

Academic Year: 2018/2019

Program Contents

Course Unit COMPUTER AIDED DESIGN

Specialization (s)

Subject type Engineering sciences **Research Area** Mechanical Engineering

Year 1st **Semester** 1st **ECTS** 4

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	1	14
Theoretical-Practical Lectures		
Practical-Laboratoty Lectures	3	42
Tutorial Orientation		
Project		

Unaccompanied Working Hours

Activity Type	Total Hours
Study	44
Works / Group Works	
Project	
Evaluation	4
Additional	

Total of Working Hours 104

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	José Armando Cantador Marques	Master's Degree	Adjunct Professor
Theoretical-Practical Lectures			
Practical-Laboratoty Lectures	José Armando Cantador Marques	Master's Degree	Adjunct Professor
	Carlos Miguel de Campos Pinto Borges	Master's Degree	Assistant Prof.
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) José Armando Cantador Marques

Goals

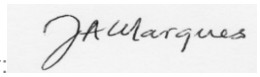
Provide fundamental concepts that allow students to reading, understanding, interpretation and implementation of technical drawings and diagrams, in orthogonal projections and axonometric perspectives. It is also intended that, the students learn the main international standards of tecnical drawing, as well as the latest tools of computer aided design.

Skills

Learn elaborate sketches and technical drawings, either using traditional means or by making use of latest tools of computer aided design.

Program Contents

1. Noções básicas: Normas de desenho técnico; Tipos de linhas; Folhas de desenho; Legendas; esquadrias Listas de peças; Escalas.
2. Projecções ortogonais: Método europeu e americano; Selecção das vistas; Vistas parciais, particulares, loca e auxiliares; Desenho à mão livre.

Signature of Teacher: 

3. Cortes e secções: Interpretação convencional; Planos de corte; Vistas e cortes parciais; Elementos que nã se cortam; Secções.
4. Cotagem: Elementos da cotagem; Inscrição de cotas; Critérios de cotagem.
5. Perspectivas: Tipos; Desenho de perspectivas isométricas; Perspectiva da circunferência.
6. Modelação paramétrica: Esboços; Restrições; Criação de modelos tridimensionais; Conjuntos; Projecções Recursos de Desenho; Cotagem; Desenhos de conjunto; Animação; Apresentações.

Bibliography

- Arlindo Silva, Carlos Ribeiro, João Dias, Luís Sousa, Desenho Técnico Moderno, Editora FCA, 4ª Edição;
- José Simões Morais, Desenho Básico, I Volume, Porto Editora;
- José Simões Morais, Desenho Básico, IIIVolume, Porto Editora, 2007;
- Luís Veiga da Cunha, Desenho Técnico, Fundação Calouste Gulbenkian, 2000;
- Américo Costa, Autodesk Inventor – Curso Completo, Editora FCA, 2013.

Access Conditions and Attendance Excuse

No conditions are laid down

Conditions for Exam Admission

No conditions are laid down

Evaluation Method

Continuous assessment consists of two tests, done during practical classes at the end of each of the two modules: Technical Drawing (50% of classes) and Computer Assisted Drawing (50% of classes). The weighted average of the tests must be equal to or greater than 9.5 / 20 values, and in none of them the grade may be less than 7.5 / 20 values.

If any of these requirements are not met, the student will be evaluated by final exam, where he will have to obtain a weighted grade of 9.5 / 20 points or more, and a mark of more than 7.5 / 20 values in each of the modules. In the final exam, the student will only have to make the module (s) in which he scored lower than 9.5 / 20 values in the continuous assessment tests.

We propose that the tests take place: 1st Test - 29 October at 10:30 H, and the 2nd Test - 17 December at 10:30 H.

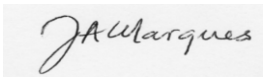
In the tests of the Technical Drawing module, no elements of consultation or use of equipment are allowed; the tests of the Computer Assisted Design module are carried out with the help of a computer, and the consultation elements (books or personal notes) that the student is supposed to take, although not allowed, use of portable information storage devices.

Conditions for Results Improvement

The note improvement (in alternative exam) requires a global exam.

Date	Signature from the lecturer responsible for the course
17/09/2018	

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher: 

Licenciatura – BsC em Engenharia Electromecânica

BsC in Electromechanical Engineering

Academic Year: 2018/2019

Program Contents

Course Unit INTRODUCTION TO PROGRAMMING

Specialization (s)

Subject type Basic sciences **Research Area** Mechanical Engineering

Year 1st **Semester** 1st **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures		
Theoretical-Practical Lectures	1	14
Practical-Laboratory Lectures	3	42
Tutorial Orientation		
Project		

Unaccompanied Working Hours

Activity Type	Total Hours
Study	71
Works / Group Works	
Project	
Evaluation	3
Additional	

Total of Working Hours 130

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	José Armando Cantador Marques	Master´s Degree	Adjunct Professor
Theoretical-Practical Lectures			
Practical-Laboratory Lectures	José Armando Cantador Marques	Master´s Degree	Adjunct Professor
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) José Armando Cantador Marques

Goals

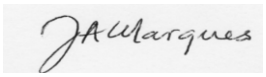
Apprehend the concept of algorithm. Create and to code algorithms in a high level language. Understand and to know how to apply the concepts of modularity and structured programming. Mastering the syntax of the language taught and to know implement, analyze and debug programs in that language.

Skills

Ability to use computer science as an analysis and resolution tool of problems of Mechanical Engineering.

Program Contents

Algorithms
2. The work environment of Matlab; Command Window; Code Editor.
3. M-Files: Scripts and functions.
4. Variables.
5. Numbers.
6. Predefined functions usual.
7. Expressions.
8. Control instructions: Conditional statements – If and Switch Case; Loops – For and While; Arrays: Vectors; Bidimensional arrays; manipulation of arrays; Operations with arrays.

Signature of Teacher: 

9. Functions : Structured programming ; Internal and external functions ; Structure of a function ; Local and global variables.
10. Importing and exporting data.

Bibliography

- Vagner Morais, Cláudio Vieira, Matlab 7 & 6 Curso Completo, Ed. FCA, 2013;
- José Vieira, Matlab num Instante, University of Aveiro, 2004;
- Amos Gilat, Matlab com Aplicações em Engenharia, Ed. Artmed S. A., 2006;
- Jon Chapman, Matlab Programming for Engineers, 4e, Thomson Engineering, 2008;
- José Cantador Marques, Sebenta de Introdução à Programação, ISEC, 2010.

Access Conditions and Attendance Excuse

No conditions are laid down

Conditions for Exam Admission

No conditions are laid down

Evaluation Method

This course has an evaluation process distributed during the academic period, consisting of 2 programming tests. The student's approval in the distributed evaluation exempts the student from the final exam. The arithmetic mean of the tests must be equal to or greater than 9.5 / 20 values and in none of them the grade may be less than 7.5 / 20 values. If any of these requirements are not met, or the student is absent or gives up on one of the tests, he will be evaluated by final exam, at the various times scheduled, where he must obtain a grade of 9.5 / 20 or higher. In the case of passing the distributed assessment, the final grade will be the arithmetic mean of the grades of the two tests.
We propose that the tests take place: 1st Test - November 7 at 5:30 PM, and the 2nd Test - December 19 at 5:30 PM.
In the tests and in the exams tests are not authorized elements of consultation or the use of equipment.

Conditions for Results Improvement

The note improvement (in alternative exam) requires a global exam.

Date	**Signature from the lecturer responsible for the course**
16/09/2018	

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Lecturer's signature: _____

Licenciatura – BSc Engenharia Electromecânica

Bachelor – BSc Electrical Mechanical Engineering

Academic Year: 2018/2019

Program Contents

Course Unit CALCULUS II

Specialization (s) Common Formation

Subject type Basic Science **Research Area** Mathematics

Year 1st **Semester** 2nd **ECTS** 6

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	2	28
Practical-Laboratory Lectures	1	14
Tutorial Orientation	-	-
Project	-	-

Unaccompanied Working Hours

Activity Type	Total Hours
Study	83
Works / Group Works	-
Project	-
Evaluation	3
Additional	-

Total of Working Hours 156

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Patrícia Sofia Simões Santos	PhD	Adjunct Professor
Theoretical-Practical Lectures	Patrícia Sofia Simões Santos		
Practical-Laboratory Lectures	Patrícia Sofia Simões Santos		

Responsible(s) Lecturer (s) Patrícia Sofia Simões Santos

Goals

Interpret and apply essential concepts about Laplace transforms, numerical and power series. Learn the essential tools of differential and integral calculus in IR^n and apply them in engineering problem solving. Understand the importance of the contents lectured and their role of support to a logical and structured reasoning, indispensable in the engineering areas.

Skills

- Be able to use mathematical, analytical and computational techniques in solving problems.
- Competence to understand abstract concepts, interpretation of results and their application in the resolution of engineering problems.
- Self-learning.

Program Contents

1. **Real functions of several variables and their derivatives**

   Conics and quadric surfaces. Topology concepts in IR^n.

   Real functions of several real variables – Domain; Graph; Contours; Limits; Continuity; Partial derivatives; Schwarz theorem; Chain rule; Directional derivative; Gradient vector and its applications; Free and conditional extrema.

2. **Multiple integrals**

Double integrals – Definition and geometric interpretation; Calculus of a double integral in Cartesian and polar coordinates; Applications.

Triple integrals – Definition and geometric interpretation; Calculus of a triple integral in Cartesian, cylindrical and spherical coordinates; Applications.

3. **Laplace transform**

Laplace transform – Definition of Laplace transform; Exponential order (type) function; Existence and properties of the Laplace transform; Laplace transform of derivative of functions; Derivatives of the Laplace transform; Solving Linear Ordinary Differential Equations with the Laplace transform.

4. **Series**

Numerical series – Definition of partial sum; Definition of numerical series; Examples (geometric series, telescopic series, Dirichlet series); Properties; Necessary condition of convergence; Criteria for convergence of series of non-negative terms; Alternating series and Leibniz criterion; Simple and absolute convergence.

Function series – Definition of power series; Convergence; Taylor series.

Bibliography

- José A. Rodrigues, *Curso de Análise Matemática – Cálculo em* IR^n, Princípia, *2008.*
- Ron Larson, Robert Hostetler, Bruce Edwards, *Calculus II*, Houghton Mifflin, 8th Ed. 2005.
- James Stewart, *Calculus: Early Transcendentals,* Cengage, 8th Ed., 2016.
- George Simmons, Steven Krantz, *Differential Eq.: theory, technique and practice*, Chapman & Hall Book, 2nd Ed., 2015.
- George F. Simmons, *Differential equations with applications and historical notes*, Chapman & Hall Book, 3rd Ed., 2017.

Access Conditions and Attendance Excuse

NA

Conditions for Exam Admission

The one predicted in the REACTA, *Diário da República,* 2.ª *série* — N.º 22 — 31/01/2018.

Evaluation Method

Students may choose to take a final written exam for 20 values or choose the following distributed evaluation. Note that the use of calculators is not allowed in the tests and exams of the curricular unit.

Distributed evaluation – Four tests:

- Test 1 on chapter 1, quoted for 8 values, without minimum, in the week of March 18 to 24;
- Test 2 on chapter 2, quoted for 5 values, without minimum, in the week of April 8 to 14;
- Test 3 on chapter 3, quoted for 4 values, with a minimum of 2.0 values, in the week of May 13 to 19;
- Test 4 on chapter 4, quoted for 3 values, with a minimum of 1.5 values, in the last class of the semester of the UC.

If the student achieves the minimums required in the distributed evaluation, the grade will be the sum of the tests results.

If the minimums are not achieve or the grade is less than 9.5 values, the student can choose in the exam to do part of the distributed evaluation (at the most two tests, each test with the minimum defined before). In this case, if the student achieve the minimums then the grade of the distributed evaluation will be the sum of the tests results; otherwise, the grade will be the result of the part done in the exam.

A student is approved when its grade is greater than or equal to 9.5 values.

Conditions for Results Improvement

The classification improvement is done according to the REACTA regulation.

Date
21/01/2019

Signature from the lecturer responsible for the course

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher: 

Licenciatura – BsC Engenharia Electromecânica (Português)

Licenciatura – BsC Electromechanical Engineering (Inglês)

Academic Year: **2018/2019**

Program Contents

Course Unit DIGITAL SYSTEMS

Specialization (s)

Subject type Electrical **Research Area** Electronics and microprocessors

Year 1 **Semester** 2 **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures		
Practical-Laboratoty Lectures	2	28
Tutorial Orientation		
Project		
Total of Working Hours		130

Unaccompanied Working Hours

Activity Type	Total Hours
Study	35
Works / Group Works	35
Project	
Evaluation	4
Additional	

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Fernando Moita	Master	Adjunct Professor
Theoretical-Practical Lectures			
Practical-Laboratoty Lectures	Fernando Moita	Master	Adjunct Professor
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) Fernando Moita

Goals

Approach to the basic operation of digital circuits where content will be addressed such as: logical States, numeration systems, logic families, logic functions, simplifying and manipulation of logical expressions, as well as combinational circuits and sequential.

The knowledge acquired within the framework of this course unit, complemented with the knowledge of others, must allow students to meet, perform and maintain digital circuits and systems.

Skills

At the end of the semester students must understand the meanings of the symbols used in digital electronics and the features and functionality of the various digital circuits.

Select components, materials and digital equipment based on their technological characteristics and in accordance with the existing rules and regulations.

Interpret and correctly use manuals, diagrams and other technical literature provided by the manufacturers of digital electronic equipment.

Develop operational interpretation capabilities of digital circuits and knowledge to enable them to design, implement and test any combinational and sequential circuit.

Signature of Teacher:_____

Program Contents

1. Analog and Digital Systems
2. Digital Numbering systems
3. Boolean algebra and logic gates
4. Simplification and synthesis of Boolean functions
5. Integrated logic families
6. Encoders and Decoders
7. Multiplexer, Demultiplexer, Comparators and other combinational logic circuits
8. Flip Flops
9. Shift Registers
10. Analysis and synthesis of counter circuits
11. Sequential state machines.
12. Discrete Logic vs. Programmable Logic
13. Introduction to FPGAs and Hardware Description Languages (HDL), VHDL
14. Introduction to Microcontrollers

Bibliography

- Teacher support texts
- Sistemas Digitais: Princípios e Aplicações [11 ed.], Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, Pearson, 2011;
- Sistemas Digitais Fundamentos e Aplicações, 9.ª Edição de Thomas Floyd, Bookman, 2007;
- Digital Systems [12th], Moss, Greg; Tocci, Ronald; Widmer, Neal, Pearson, 2017;
- Introduction to Digital Systems Design, Donzellini, Giuliano et al, Springer International Publishing, 2019;
- Introduction to FPGA and HDL Design, Donzellini, Giuliano et al, Springer International Publishing, 2019;
- DIGITAL SYSTEMS : from logic gates to processors, Deschamps, Jean-pierre. Valderrama, Springer International Publishing, 2018;
- Arduino Applied: Comprehensive Projects for Everyday Electronics [1 ed.], Neil Cameron, Apress, 2019;

Access Conditions and Attendance Excuse

Conditions for Exam Admission

Are admitted to the exam all students that are approved in the laboratory component

Evaluation Method

The evaluation consists of three components:

Theoretical component (A)

A final theoretical exam accessible to all students, who have obtained approval in the laboratory component. The exam has a weight of 12 values, with minimum 6.

Continuous component (B)

Will be launched online individual quizzes related to the subjects taught on theoretical and laboratory components. These quizzes will have a final weight of 1 values.

Laboratory Component (C)

Are evaluated the preparation, the implementation and the final reports from several laboratory projects and a final lab test. Total weight of 7 values, with minimum 3.5.

The student must implement at least 2/3 of the works and be present in more than 80% of the lab classes.

Final grade = A*0.6+B*0.05+C*0.35

Conditions for Results Improvement

Any student may propose to the achievement of improved classification only once.
According to the regulations of the Polytechnic Institute of Coimbra (IPC) and of the Coimbra Engineering School (Instituto Superior de Engenharia de Coimbra - ISEC) and other legislation.

Date

20 Fev 2018

Signature from the lecturer responsible for the course

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher:

Licenciatura – BsC em Engenharia Eletromecânica (Português)

Licenciatura – BsC in Electromechanical Engineering (Inglês)

Academic Year: **_2018_/_2019_**

Program Contents

Course Unit ELECTRICAL CIRCUITS THEORY II

Specialization (s)

Subject type Mandatory **Research Area** Electrical Engineering

Year 1st **Semester** 2nd **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	2	28
Practical-Laboratoty Lectures		
Tutorial Orientation		
Project		

Unaccompanied Working Hours

Activity Type	Total Hours
Study	72
Works / Group Works	
Project	
Evaluation	2
Additional	

Total of Working Hours 130

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	António Manuel Ferreira Simões de Almeida	MSc	Adjunct Professor
Theoretical-Practical Lectures	António Manuel Ferreira Simões de Almeida	MSc	Adjunct Professor
Practical-Laboratoty Lectures			
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) António Manuel Ferreira Simões de Almeida

Goals

The main aims of this course unit are:
To familiarize students with the basic concepts of electrical circuit analysis, on single-phase alternating current circuits and three-phase alternating current circuits.

Skills

At the end of this course unit is the learner is expected to be able:
To understand the methods of analysis of electrical circuits.
To understand the theory and operation of single-phase alternating current circuits and three-phase alternating current circuits.
To use the mathematical methods of Fourier and Laplace for signals and electrical systems analysis.

Program Contents

Resonance: Series resonance and parallel resonance; Measuring parameters: bandwidth and quality factor; Parallel resonance: Real circuit.

Three-phase systems: Relationship between phase voltage and line voltage; Balanced circuits; Relationship between line current and phase current; Power in three-phase systems.
Transients in electrical circuits: Transients in RL circuits; Transients in RC circuits; Analysis of RL and RC circuits with sinusoidal type inputs; Using the Laplace transform in circuits; Analysis of RL and RC circuits by Laplace transform; Energy stored in electric field or in magnetic field; Analysis of RL and RC circuits with sinusoidal type inputs by Laplace transform.
Fourier Analysis: Fundamental concept; Fourier series; Exponential Fourier series; Frequency spectrum; Determination of the RMS value of a function from its Fourier series; Examples.

Bibliography

Edminister, J. A., "Circuitos Eléctricos", Colecção Schaum.
Nilsson, J. W., “Circuitos Eléctricos”, LTC Editores S.A.
Bessonov, L., "Electricidade Aplicada para Engenheiros", Editora Lopes da Silva.

Access Conditions and Attendance Excuse

In the case of student-worker students the conditions of participation in the classes will be combined between the teachers and students, in the first week of classes, and according to the current legislation.

Conditions for Exam Admission

Evaluation Method

Final written exam (100%).

Conditions for Results Improvement

The conditions for improvement of classification are those expressed in the law.

Date	Signature from the lecturer responsible for the course
2019-01-18	António Manuel Ferreira Simões de Almeida

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Lecturer's signature: _____

Licenciatura – BsC em Engenharia Eletromecânica (Português)

Licenciatura – BsC in Electromechanical Enginnering (Inglês)

Academic Year: **2018 / 2019**

Program Contents

Course Unit THERMODYNAMICS

Specialization (s)

Subject type Basic Sciences **Research Area** Mechanical Engineering

Year 1º **Semester** 2º **ECTS** 6

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	2	28
Practical-Laboratoty Lectures		
Tutorial Orientation		
Project		

Unaccompanied Working Hours

Activity Type	Total Hours
Study	97
Works / Group Works	
Project	
Evaluation	3
Additional	

Total of Working Hours 156

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Carlos José de Oliveira Pereira e Jorge Alcobia	PhD	Prof. Adjunct
Theoretical-Practical Lectures	Raquel Almeida de Azevedo Faria	PhD	Prof. Adjunct
Theoretical-Practical Lectures	Márcio Duarte Albino dos Santos	Master	Invited Assistant

Responsible(s) Lecturer (s) Carlos José de Oliveira Pereira e Jorge Alcobia

Goals
The main objective of this course is to give students the basic scientific training in the field of Thermal Engineering, preparing them not only to solve some problems related to thermal systems but also to easily integrate into the study of subsequent and related subjects.

Skills
The knowledge acquired in this course should contribute, in a significant way, so that the students acquire the following specific competences:
- Knowing, understanding and applying the laws of thermodynamics, including the ability to make energy balances;
- Understand the operation and be able to install, operate and maintain thermal motor and receiver machines.

Program Contents

1. Introduction
General Concepts. SI - unit system. Temperature and pressure measuring devices (absolute and relative). Thermodynamic

coordinates. Types of systems. Transformations and irreversibility. Representation of transformations.
2. Energy
Forms of energy. Transfer of energy. Work and Heat. The First Law of Thermodynamics.
3. Properties of Pure Substances
Phases of a pure substance. Phase changes. Diagrams p-T, T-h, T-v and p-v. Surface p-v-T. Use of property tables.
Perfect Gases. Equations of perfect gases. Compressibility Factor. Other State Equations.
4. Energetic Analysis of Closed Systems
Balance of energy. Internal Energy, Enthalpy and Specific Heat of gases, liquids and solids.
5. Open Systems Energy Analysis
Energy of a flowing fluid. Energy balance in stationary flow systems, in uniform flow systems and in other types of open systems. Examples of the various types of open systems.
6. The Second Law of Thermodynamics
The Second Law of Thermodynamics. Principle of operation of the Thermal Machines. Yields and efficiencies. The Carnot cycle. The Carnot Principles.

Bibliography

- ÇENGEL, Yunus A.; BOLES, Michael A. – *Thermodynamics, an engineering approach*, McGraw-Hill.
- MORAN, M. J.; SHAPIRO, H. N. - *Fundamentals of Engineering Thermodynamics*, John Wiley & Sons, USA.

Access Conditions and Attendance Excuse

Not applicable.

Conditions for Exam Admission

Those provided for in the legislation and regulations in force.

Evaluation Method
1. Students will be approved in this course unit as long as they take advantage of the final exam.
2. Final examination:
2.1. Students may take the exam at the times authorized by the ISEC Presidency, on the dates determined for this purpose;
2.2. Each exam will consist of a theoretical component and a theoretical-practical component, each of the two components being the quotation of 10 values;
2.3. In the theoretical-practical component only the use of scientific calculating machine is allowed. In this component students will be able to consult the theoretical-practical formulary, as well as the tables of thermodynamic properties.
2.4. To pass the exam it is necessary that:
2.4.1. The final grade is equal to or greater than 9,5 points;
2.4.2. In none of the parts of the exam (theoretical and theoretical-practical) the classification obtained is less than 3,0 values.

Conditions for Results Improvement

Those provided for in the legislation and regulations in force.

Date

15-01-2019

Signature from the lecturer responsible for the course

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher:_____

Licenciatura – BsC Engenharia Electromecânica

Licenciatura – BsC Electromechanical Engineering

Academic Year: **2018/2019**

Program Contents

Course Unit ENGLISH

Specialization (s) - COMMON CORE

Subject type Languages **Research Area** Mechanical Engineering / Humanities

Year 1º **Semester** 2º **ECTS** 3

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures		
Theoretical-Practical Lectures	2	28
Practical-Laboratoty Lectures		
Tutorial Orientation		
Project		

Unaccompanied Working Hours

Activity Type	Total Hours
Study	46
Works / Group Works	1
Project	
Evaluation	3
Additional	

Total of Working Hours 78

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures			
Theoretical-Practical Lectures	Deolinda Simões	PhD	Prof. Adjunto
Practical-Laboratoty Lectures			
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) Deolinda Simões

Goals

The main objective of this subject is to focus on the English language in electromechanical academic engineering contexts and further develop students' communicative language skills through topics related to this engineering field.

Skills

Understand clearly engineering academic language in electromechanical engineering and language patterns in this area;
Be able to present and communicate a topic related to the field of study with at least a high B1 level.

Signature of Teacher:_____ 

Program Contents

1. **Language**

   Grammar revisions such as the tense system, spelling rules, question form, among other language features according to students' needs and difficulties.

2. **Technical Language**

   Sub-technical terms and common non-technical lexis, syntax, linking expressions and words, word formation (suffixes and prefixes), grammar links, phrasal verbs, expressions to describe reason and contrast and verb-noun-adjective changes.

3. **Technical Vocabulary**

   Specific technical lexis related to electromechanical engineering including materials engineering, mechanisms, air-conditioning and refrigeration, forces in engineering, internal combustion engine, electronics, electrical machines, automation and computer science.

4. **Reading Comprehension**

   Scientific literature, graphs and tables and understanding unknown vocabulary.

5. **Listening Comprehension**

   Lectures and Interviews

6. **Writing Skill**

   Genres including formal letter writing such as the letter of application, summarizing, expressing opinions, description and explanation of how an electrical and / or mechanical system works and a CV.

7. **Oral Skill**

   Pronunciation practice through oral drills, introducing and presenting oneself, an oral presentation about a technical topic and general class discussions.

Bibliography

The lecture notes used during lessons can be purchased at the Institute's photocopy centre.
Çengel, Yunus A. and Michael A. Boles Michael. *Thermodynamics - An Engineering Approach*. New York: McGraw-Hill, 2002.
Glendinning, Eric H. and Norman Glendinning. *Oxford English for Electrical and Mechanical Engineering.* Oxford UP, 1997.
Hall, Eugene J. *The Language of Mechanical Engineering in English*, New Jersey: Prentice-Hall, 1977.
Ibbotson, Mark. *Cambridge English for Engineering*. Cambridge UP, 2008.
McGraw-Hill. *Dictionary of Engineering*, USA: McGraw-Hill, 2003.
Myszka, David H. "Introductions to Mechanisms and Kinematics." *Machines and Mechanisms*. India: Prentice Hall, 2005.
Smith, William F. *Foundations of Materials Science and Engineering*. Singapore: McGraw-Hill, 1993.
Smith, William F. *Princípios de Ciência e Engenharia dos Materiais*. Portugal: McGraw-Hill, 1998.
Strasman, Peter G. *Rover 213 & 216 Owners Workshop Manual*. Haynes Publishing Group: Somerset, England, 1988.

Access Conditions and Attendance Excuse

Only students covered by Law in effect can be excused from attending lessons. These include firefighters in Portugal or those with working status, among others defined in the Law.

Conditions for Exam Admission

Those defined in legislation and regulations in effect.

Evaluation Method

Continuous evaluation which includes two tests worth 70%, mandatory attendance and participation worth 15% and an oral presentation worth 15% of the total mark.

There are two exam periods at the end of the semester and these are the normal exam period and the retake exam period. Students who are unable to get a passing mark through continuous evaluation can take a final exam in these periods. This final exam covers all of the material of the subject. It includes a written part worth 80% and an oral part worth 20%. Both parts are mandatory.

Dates of evaluation: The 1st test will be held on the 26th of March, the 2nd test will be on the date of the exam of the normal exam period and oral presentations will be on 21st of May.

Signature of Teacher:_____ 

Conditions for Results Improvement

Those defined in legislation and regulations in effect.

Date	Signature from the lecturer responsible for the course
February 14, 2019	

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher: 

Licenciatura – BsC Engenharia Electromecânica

Licenciatura – BsC Electromechanical Engineering

Academic Year: **2018/2019**

Program Contents

Course Unit MEASUREMENT AND INSTRUMENTATION

Specialization (s)

Subject type Engineering Sciences **Research Area** Electrotechnical

Year 2 **Semester** 1 **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures		28
Practical-Laboratoty Lectures	2	
Tutorial Orientation		
Project		
Total of Working Hours		130

Unaccompanied Working Hours

Activity Type	Total Hours
Study	60
Works / Group Works	14
Project	
Evaluation	
Additional	

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	João Cândido Baptista Santos	Masters Degree	Prof. Adj. Conv.
Theoretical-Practical Lectures			
Practical-Laboratoty Lectures	João Cândido Baptista Santos	Masters Degree	Prof. Adj. Conv.
Tutorial Orientation			
Project			
Responsible(s) Lecturer (s)	João Cândido Baptista Santos		

Goals

The main aims of this course unit are:
To know the working principles of the basic elements of an instrumentation system.
To know the characteristics, applications and limitations of Operational Amplifiers.
To know the basic types of analog-digital and digital-analog converters and their characteristics.
To know the basic principles of signal conversion and storage.
To develop applications in Labview.
To understand the different types of interference, their causes and solutions.

Skills

At the end of this course unit is the learner is expected to be able:
Understand the basic working principles of the various elements in a measurement system.
Understand the basic characteristics, applications and limitations of operational Amplifiers.
Understand the basic principles in signal conversion, conditioning, and storage.
Understand the various transducer working principles.
Understand the basic principles of virtual instrumentation and application development.
Understand interferences, their causes and solutions.

Signature of Teacher: _____

Program Contents

Introduction to Instrumentation.
Operational Amplifier; Instrumentation Amplifier.
Digital-Analog and Analog-Digital Conversion.
Transducers.
Acquisition systems; Labview.
Interference.

Bibliography

Ferreira, J. Instrumentação e Medidas, sebenta de, Secção de textos da F.C.T.U., Coimbra.

Helfrick, Albert D., Cooper, William, D. Instrumentação Electrónica Moderna e Técnicas de Medição, Prentice-Hall do Brasil, 1994 (Biblioteca ISEC, cota: 1-1-204).

Wolf, S., Smith, R. Student Reference Manual for electronic instrumentation laboratories, Perason Prentice-Hall International, USA, 2004.

Access Conditions and Attendance Excuse
Truancy is admissible in the theoretical classes but there is a limit of 2 in the laboratory classes.
Students that are employed, namely those covered by Lei n.º 99/2003 e Lei n.º 35/2004 in the case of the components with obligatory presence, the student must agree with the responsible teacher an alternative method of fulfilling the correspondent obligations in a different schedule.

Conditions for Exam Admission
Only the students approved at the laboratory component have access to the written exam at the final of the semester.

Evaluation Method
Final written exam with 60% weight of the overall grade and minimum of 50% of the grading of the test itself;
Laboratory work with 40% weight in the overall grade and minimum of 50% grading on both components.
. Weekly lab assignments with reports;
and
. Two lab tests (the 50% minimum grading refers to the average on both tests)
The dates of the lab tests will be: 1st test, November 15th and 16th.
2nd test, December 20thand 21th.

The grades obtained are only valid for that same academic year.

Conditions for Results Improvement
In case the student wants to improve his grades, that process will be a holistic one encompassing all the components of the course unit, namely through a global research and application work.

Date

02. Outubro. 2018

Signature from the lecturer responsible for the course

Lecturer's signature:__

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Licenciatura BsC- Engenharia Eletromecânica (Português)

Licenciatura BsC - Electromechanical Engineering (Inglês)

Academic Year: **2018** / **2019**

Program Contents

Course Unit STRENGTH OF MATERIALS

Specialization (s)

Subject type **Research Area** Mechanical Engineering

Year 2 **Semester** 1 **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	1	14
Practical-Laboratoty Lectures	1	14
Tutorial Orientation		
Project		

Unaccompanied Working Hours

Activity Type	Total Hours
Study	40
Works / Group Works	30
Project	
Evaluation	3
Additional	

Total of Working Hours 129

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Urbano Manuel de Oliveira Ramos	PhD.	Professor
Theoretical-Practical Lectures	Pedro Miguel Martins Miguens Amaro	MSc.	Assistant Prof.
Practical-Laboratory Lectures	Pedro Miguel Martins Miguens Amaro	MSc.	Assistant Prof.
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s)

Urbano Manuel de Oliveira Ramos

Goals

This curricular unit aims to develop in the student the abilities to analyze a given problem in a simple way, and to apply fundamental principles of strength of material. This approach makes possible to understand the behavior of numerous mechanical structures used by man in their everyday life, transposing this behavior into simplified models, using analytical methods, taking into account their conditions of use and the requests to which they are subject.

In the laboratory component interconnected with the theoretical and practical-theoretical activities will be developed basic concepts necessary to perform tests on simple mechanical structures. This analysis includes the experimental application of the concepts of resistance electrical extensometry in structures, using control and measuring instruments.

Skills

The student should be able to define the material to be used, evaluate the shape and dimensions more adequate to withstand the different types of external applications applied to isostatic structures, at the lowest possible cost and in maximum safety. The analysis of practical cases in increasing order of difficulty allows to know the dimensioning to the mechanical resistance and the rigidity in structures, as for example, bars, beams, truss and transmission shafts.

Program Contents

1. Introduction

1.1 Mechanical action applied on a mechanical structure: types of loads (concentrated and distributed loads) and moment (moment of a force about a point and moment of a couple). Types of structure support.

1.2 - Degrees of freedom of a body. Study of the equilibrium in the bodies. Free body diagram. Determination of the supports in isostatic structures. Internal actions developed in a mechanical structure: axial loads, shear forces, bending moments and torque moments. Internal actions diagrams.

1.3 – Review of centroids and moments of inertia of plane areas. Steiner's theorem. Polar Moments of Inertia. Properties of structural steel shapes.

2 - Basic Concepts of Strenght of Materials

Normal and Shear Stress. Concept of displacement and strain. Hooke's Law. Stress-strain diagrams for ductile and fragile materials. Concept of elasticity and plasticity. Mechanical properties of materials. Extensometer for electrical resistance. Principle of superposition of the effects of forces. Potential Energy of Deformation. Concept of Resilience and Tenacity of a material. General design process for a mechanical structure. Concept of safety factor.

3 - Structural elements subject to axial loads

Stress and strain state in bars loaded axially. Saint-Venant's principle. Changes in length of axially loaded members. Thermal effects. Statically indeterminate structures. Internal actions determination in reticular systems. Ritter's Method.

4 - Structural Elements Subject to Torsion

Stresses and strains in Pure Shear. Torsion of members with circular and non-circular cross-section. Torsion of closed thin-walled sections of profiles. Torsion of statically indeterminate members. Transmission of Power by circular shafts.

5 - Structural elements subject to bending

Beam of straight geometric straight axle: pure and simple bending. Normal stress – tensile and compressive. Neutral axis. Shear stresses in beams. First moment of the cross section area -circular, rectangular, T-shaped, I-shaped cross section. Beam with axial loads. Beam with torsion. Deflection of beams and shafts using practical tables. Differential equation of the elastic line. Beam deflections and slopes.

6 – Dimensioning structural elements subjected to bending and torsion: for example in a transmission shaft.

Use of resistance criteria for ductile materials and for fragile materials.

Bibliography

- GERE & TIMOSHENKO - *Mechanics of Materials*, ITP - 4ª Edição, 1997
- FARINHA, J.S. BRAZÃO; REIS, A. CORREIA DOS – Tabelas Técnicas, Edição P.O.B., 1992
- HIBBELER,R.C. – Resistência dos Materiais – 5ª edição, Pearson Prentice Hall, 2004,
- BEER, FERDINAND P.; JOHNSTON, E. RUSSELL, Jr; DEWOLF, JONH T.. – Resistência dos Materiais – 4ª edição, McGraw Hill, 2006,

Access Conditions and Attendance Excuse
Nothing to add.

Conditions for Exam Admission
All regularly enrolled students

Evaluation Method

The student decides until the end of the first week of classes if selects the continuous assessment regime. Continuous assessment consists of a set of practical assignments involving research and experimentation to be carried out individually or in a group during the practical / laboratory classes. The reports will be written according to the model available in moodle, which are presented and discussed in the last week of classes, worth 6 values. The enrollment is optional and is done with the teacher, being compulsory attendance in 75% of classes. For students who do not attend practical / laboratory classes the exam is quoted for 20 values. The final exam is written as a written test for all students, structured in a theoretical and a theoretical-practical part (case resolution), and the students enrolled in the continuous assessment must obtain a minimum of 8 points in the exam to obtain approval in the discipline. The work done in the practical classes is only valid for one year.

Conditions for Results Improvement
Not applicable

Date	**Signature from the lecturer responsible for the course**
14.09.2018	

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Lecturer's signature: 

Licenciatura – BsC Engenharia Eletromecânica (Português)

Licenciatura – BsC Electromechanical Engineering (Inglês)

Academic Year: 2018 / 2019

Program Contents

Course Unit FLUID MECHANICS

Specialization (s) Not applicable

Subject type Specialty Sciences **Research Area** MECHANICAL ENGINEERING

Year 2 **Semester** 1 **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	
Theoretical-Practical Lectures	1	
Practical-Laboratoty Lectures	1	
Tutorial Orientation		
Project		

Unaccompanied Working Hours

Activity Type	Total Hours
Study	71
Works / Group Works	
Project	
Evaluation	3
Additional	

Total of Working Hours 130

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	João Carlos Antunes Ferreira Mendes	PhD	Prof. Coordenador
Theoretical-Practical Lectures	João Carlos Antunes Ferreira Mendes	PhD	Prof. Coordenador
Practical-Laboratory Lectures	João Carlos Antunes Ferreira Mendes	PhD	Prof. Coordenador
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) João Carlos Antunes Ferreira Mendes

Goals

Provide the theoretical foundations necessary to study the behavior of resting and moving fluids. As an introductory discipline in the field of Fluid Mechanics will be privileged physical concepts rather than a more fundamental approach.

Skills

It is intended that the specific competence be acquired: to know, to understand and to know how to apply the laws of mechanics to incompressible fluids. The curricular unit also integrates very significant contributions in the acquisition of other competences, namely: knowing and knowing how to use instrumentation of measurement and control; be able to size, install, operate and maintain fluid networks, air conditioning and refrigeration systems; know how to design hydraulic and pneumatic systems; understand the operation and be able to install, operate and maintain thermal machines in general.

Program Contents

Introduction: Fluid characteristics. Molecular structure. Continuous media. Fluid properties: specific mass, relative density, density and specific volume. Pressure. Superficial tension. Steam pressure. Compressibility. Viscosity. Viscosity quantification. Equation of dimensions and units of

viscosity. Kinematic viscosity and its units. Variation of viscosity with pressure and temperature. Fluidity. Non-Newtonian fluids. Ideal fluid.
Fluid Statics: Introduction. Variation of pressure within a fluid. Pressure measurement: barometers; column manometers; metal or Bourdon gauge; Other gauges. Hydrostatic action on submerged surfaces: Resulting from actions on a flat surface; Center of pressures of flat surface. Resultant of actions on curved surfaces; Vertical component of the resultant; Horizontal component of the resultant; Floating force.
Principles of Fluid Movement: Introduction. Variation of the parameters in space and time. One-dimensional, two-dimensional and three-dimensional flow. Acceleration of a particle. Equation of continuity. Bernoulli equation. General equation of permanent flows. Practical form of the energy equation. Transformation of energy into a constant specific mass fluid. Applications of the Bernoulli equation: Flow through bevelled holes, submerged hole, values of hole coefficients.
The Two Types of Flow: Introduction. The demonstration by Reynolds of two types of flow. Flow criteria. Laminar flow and turbulent in tubes. Aspects of turbulence. Boundary layer. Laminar sublayer. Distribution of tangential stresses in a circular tube.
Laminar Flow: Introduction. Laminar flow in circular tubes. Law of Hagen-Poiseuille.
Turbulent Flow in Pipes: Introduction. Loss of charge in a tube. Study of the coefficient of friction. Friction in circular and non-circular ducts. Diagram of Moody. Other load losses in tubes. Loss of load on a sudden increase of section. Loss of load on a pipe outlet. Loss of load in a sudden contraction. Loss of load at the entrance. Diffusers. Losses in curves. Loss on accessories. Piezometric and full height line. Association of tubes in series. Association of tubes in parallel. Flow at the inlet of the tube. Input length.
Measuring Devices: Pitot tube. Determination of velocity of compressible fluids. Venturi. nozzle and orifice meter. Other measuring devices. Transducers. Flow measurement of liquids.

Bibliography

L. A. Oliveira e A. G. Lopes, Mecânica dos Fluidos, Lidel, 2016.
Mendes, João Carlos A. Ferreira, Apontamentos Teóricos de Mecânica dos Fluidos, I.S.E.C., Coimbra, 2005.
Mendes, João Carlos A. Ferreira, Problemas de Mecânica dos Fluidos, I.S.E.C., Coimbra, 2006.
White, F. M., Fluid Mechanics, International Student Edition, McGraw Hill, 2011.
Massey, B. S., Mecânica dos Fluidos, Fundação Calouste Gulbenkian, Lisboa, 2002.
L. A. Oliveira e A. G. Lopes, Mecânica dos Fluidos – Fundamentos de Física e Matemática, Lidel, 2016.

Access Conditions and Attendance Excuse

Final Exam and Resource Exam for all enrolled students.

Conditions for Exam Admission

Not applicable.

Evaluation Method

Each exam exam is divided into three components, theoretical, theoretical-practical and practical, with the quotation of nine, eight and three values, respectively.
Students attending practical classes may be exempted from the practical component of the exam by performing a mini-test.
The minitest P consists of the written answer to a question, focusing on the subject addressed in the practical classes and will be held in the last week of classes. The practical mini-test will have a maximum duration of 30 minutes and the result of this evaluation will have a maximum weight of 3 values, for a total of 20 values.
Examinations outside the assessment periods provided for in the school calendar may take the form of oral tests.

Conditions for Results Improvement

Those provided in the legislation.

Date

12/09/2018

Signature from the lecturer responsible for the course

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher: _____

Licenciatura – BsC *em Engenharia Eletromecânica - 9105*

Licenciatura – BsC in Electromechanical Engineering - 9105

Academic Year: **2018/2019**

Program Contents

Course Unit THEORY OF SYSTEMS

Specialization (s) COMMON TRAINING

Subject type ENGINEERING SCIENCE **Research Area** ELECTRICAL ENGINEERING

Year 2 **Semester** 1 **ECTS** 6.5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	2	28
Practical-Laboratoty Lectures		
Tutorial Orientation		
Project		
Total of Working Hours		130

Unaccompanied Working Hours

Activity Type	Total Hours
Study	70
Works / Group Works	
Project	
Evaluation	4
Additional	

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Nuno Miguel Fonseca Ferreira	PhD	Prof. Adjunto
Theoretical-Practical Lectures	Nuno Miguel Fonseca Ferreira	PhD	Prof. Adjunto
Practical-Laboratoty Lectures			
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) Nuno Miguel Fonseca Ferreira

Goals

Teach systematic methods to the student for performance analysis of linear dynamic systems, as well as methods for designing automatic feedback control algorithms for linear systems.

Skills

Analyze the performance of linear dynamic systems.
Design automatic feedback control algorithms for linear systems.

Program Contents

1. Brief historical description of the evolution of systems theory and control.
2. Algebra of block diagrams, canonical form of a control system, transformation of block diagram, overlap of various input signals, simplification of block diagram, block diagram and mathematical models, rule of mason.
3. Mathematical models, forms of mathematical representation: differential equation, Laplace transform, transfer function. Linearization. Time response from the transfer function: decomposition into partial fractions, transient regime and location of poles of the system. Theorems of initial value and final value.
4. Analysis of open-loop systems in the time domain, study of the behavior of the system described by a differential equation of constant coefficients. Description of a system through its transfer function, analysis of the transient response of first and second order systems and high order, a system of order higher than two can be obtained as a linear combination of the lowest order responses. Routh-Hurwitz stability criterion, zeros effect on step response.
5. Analysis of feedback systems in the time domain. Algebra of block diagrams, permanent regime analysis, root locus method, rules for the construction of the root locus diagram.

Signature of Teacher:

6. Analysis of the systems in the frequency domain, open-loop analysis, frequency response graphical plot, polar diagrams, goat diagram, Nyquist stability criterion. Closed loop analysis, relative stability, delayed feedback systems analysis.
7. Study on controllers, forms of control of feedback systems, ON-OFF controllers and linear controllers. Presentation of the proportional (P), integral (I) and derivative (D) actions, saturation by effect of the integral action presentation of empirical methods for the calibration or tuning of controllers, open loop methods and closed loop methods. Cascade control and feedforward control, compensation for phase advance or delay, and PI action.

Bibliography

[A1] J. L. Martins de Carvalho, "Dynamical Systems and Automatic Control", Prentice Hall International Series in Systems and Control Engineering, 1993, ISBN: 0-13-221755-4

[A2] Katsuhiko OGATA, "Modern Control Engineering", Third Edition, Prentice Hall, Inc.

Access Conditions and Attendance Excuse

For special schemes, namely those under the Worker-Student Statute and for components with compulsory attendance and distributed assessment, it must be agreed between the responsible for the curricular unit and the student, on the initiative of the student and at the beginning of the academic semester, a form of alternative functioning of these components, when the student cannot attend them at the scheduled times

Conditions for Exam Admission

All students enrolled in the course will have access to the exam.

Evaluation Method

The Theoretical classes are complemented with practical examples and the practical classes are applied the knowledge acquired in the theoretical, complemented by solving exercises of real applications. The assessment throughout the semester is made through three tests, the first test is the minimum of 9.5 and the others have the minimum value of 7.5. The final classification is calculated as the arithmetic average of the three grades. The dates of completion are: 30 of October, 27 of November and 11 of December, 2018. Will be two written exams exam (1st call time and resource), within the time fixed by the Pedagogical Council. All written tests include theoretical and practical questions and the students have 2 hours to resolve the test. The final grade will be the grade given to the written test. In any of these assessments it is necessary to obtain a rank equal to or higher than 10.

Conditions for Results Improvement

The improvement of classification will be done through a global evaluation process, in order to allow the improvement of all evaluation components. Through a research work to improve the practical component and final exam in one of the allowed times.

Date	Signature from the lecturer responsible for the course
17/09/2018	

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Lecturer's signature: 

Licenciatura – BsC Engenharia Electromecânica

Licenciatura – BsC Electromechanical Engineering

Academic Year 2018/2019

Program Contents

Course Unit MATERIALS

Specialization (s)

Subject type Engineenring Sciences **Research Area** Mechanical Engineering

Year 2 **Semester** 1 **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	1	14
Practical-Laboratoty Lectures	1	14
Tutorial Orientation		
Project		

Unaccompanied Working Hours

Activity Type	Total Hours
Study	72
Works / Group Works	
Project	
Evaluation	2
Additional	

Total of Working Hours 130

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Fernando António Gaspar Simões	PhD	Coordinator Prof.
Theoretical-Practical Lectures	Fernando António Gaspar Simões	PhD	Coordinator Prof.
Practical-Laboratoty Lectures	Celestino Tavares da Veiga	Master	Assistant Prof.
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) Fernando António Gaspar Simões

Goals

The main objectives of the course unit are: To familiarize students with the different types of materials used in engineering and to enhance knowledge about the composition, structure, properties, applications and processing of different engineering materials; To provide hands-on experience in the use of metallographic techniques and interpretation of microstructures, as well as in the conduction of common heat
treatments.

Skills

The completion of this unit will enable to achieve, or contribute to achieving, the following competences: Capacity to describe and understand the structure, specific properties, potential applications and processing methods of a wide range of engineering materials; Ability to perform different heat treatments and understand their effects;
Ability to perform tests to evaluate mechanical properties of materials, including tensile, hardness and impact, as well as to analyze and interpret the results.

Lecturer's signature: 

Program Contents

Material classes and main features: Metallic; Ceramics; Polymeric Materials, composite materials.
Mechanical Properties of Materials: Stress and strain, elastic and plastic deformation, tensile test, hardness testing, fracture of materials impact tests. Properties of materials: physical and chemical.
Production of iron and steel.
Iron-carbon phase diagram; equilibrium microstructures of iron-carbon alloys.
Classification of steels.
Non-alloy steels: mechanisms of austenite transformation; mechanical properties of steel constituents; relations between steel microstructure and mechanical properties.
Alloy steels: distribution of alloying elements in steels; effects of alloying elements on the iron-carbon phase diagram; influence of alloying elements on steel microstructure.
Heat treatment of steels: austenite transformation diagrams and influence of alloying elements; annealing; normalising; quench hardening; tempering; surface hardening treatments.
Cast irons: white cast irons; grey cast irons; nodular cast irons; malleable cast irons.
Non-ferrous metals and alloys.

Bibliography

• SMITH, William F. - Princípios de Ciência e Engenharia dos Materiais, McGraw-Hill de Portugal, 1998. ISBN: 972-8298-68-4
• POUZADA, A.S. e BERNARDO, C.A. - Introdução à Engenharia de Polímeros, Universidade do Minho, 1983
• SILVA, LUCAS F. – Materiais de Construção, Publindústria, 2013. ISBN: 978-989-723-049-3
• BARRALIS, J.; MAEDER, G. - Prontuário de Metalurgia, Fundação Calouste Gulbenkian, Lisboa, 2005. ISBN: 972-31-1106-3
• SEABRA, Antera Valeriana de - Metalurgia Geral, Vol. II e Vol. III, Laboratório Nacional de Engenharia Civil, Lisboa, 1995
• SOARES, Joaquim Pinto - Aços: Características, Tratamentos, 6.ª Edição, Publindústria, Porto, 2010. ISBN: 978-989-20-1797-6

Access Conditions and Attendance Excuse

Conditions for Exam Admission

Evaluation Method
The evaluation of knowledge can be carried out through two methodologies:
• 1st Methodology - final evaluation: final exam (20 points) covering all program content;
• 2nd Methodology - evaluation distributed throughout the semester: 2 evaluation periods (1st evaluation T1 = 10 values + 2nd evaluation T2 = 10 values). Minimum classification of 35% (3.5 values) in each of the tests (T1, T2) and the final grade (T1 + T2) is higher than 9.5 values; failure to obtain a minimum mark in the 1st evaluation implies failure to take the 2nd evaluation.

Conditions for Results Improvement

Date

14/09/2018

Signature from the lecturer responsible for the course

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher:_____

Licenciatura – Engenharia Electromecânica (Português)

Licenciatura – BsC Electromechanical Engineering (Inglês)

Academic Year: **2018/2019**

Program Contents

Course Unit ELECTRONICS

Specialization (s)

Subject type Electrical **Research Area** Electronics and microprocessors

Year 2 **Semester** 1 **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures		
Practical-Laboratoty Lectures	2	28
Tutorial Orientation		
Project		

Unaccompanied Working Hours

Activity Type	Total Hours
Study	40
Works / Group Works	32
Project	
Evaluation	2
Additional	

Total of Working Hours 130

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Fernando Moita	Master	Adjunct Professor
Theoretical-Practical Lectures			
Practical-Laboratoty Lectures	Fernando Moita	Master	Adjunct Professor
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) Fernando Moita

Goals

- Study the discrete electronic components and basic semiconductors;
- Learn to use more advanced measurement techniques involving the oscilloscope;
- Analyse theoretically and understand the operation of electronic components and circuits;
- Learn to design and implement small complexity electronic circuits;
- Acquire basic concepts of sensors and actuators and implement electronic signal conditioning circuits.

Skills

- • Interpret and draw schematics and technical manuals of components, equipment and electronic systems;
- • Design, implement and maintain circuits and electronic systems;
- • Know how to perform measurement and maintenance tasks with electronic measurement equipment;
- • Be able to choose sensors and actuators suited to a particular application

Signature of Teacher:_____

Program Contents

1) Fundamentals of Electronics
   Basics of electricity; Symbols and Electronic Components;
2) Semiconductor Diodes and Rectification
   Semiconductor physics; The diode;
   Half wave and full wave rectifiers;
   The zener diode; The LED, light emitting diode and photodiode;
   Other circuits with diodes; Circuits and applications;
3) Bipolar Junction Transistor
   Physical structure and mode of operation;
   Typical assemblies - polarization;
   The transistor as amplifier; Graphical analysis of circuits with transistors;
   Power calculation; Circuits and applications;
4) Field Effect Transistor
   Introduction to the theory and operation of field effect transistors;
   Metal oxide field effect transistors;
   The Enhancement-Type MOSFET and Depletion-Type MOSFET;
5) Sensors and Actuators.

Bibliography

- PowerPoint presentations and Teacher notes;
- Microelectronics (Jacob Millman, Arvin Grabel), McGraw-Hill, 1988;
- HAMBLEY, Allan R.- Elecfronics, 2nd Edition, Prentice Hall, 2000;
- SEDRA, Adel; SMITH,Kenneth - Microelectrónica, Volume 1, Makron Books, 1995;
- ROBERTL. BOYLESTAD, LOUIS NASHELSKY, - Dispositivos Eletrónicos e Teoria de circuitos, 6aEdição, LTC,1999;
- BAPTISTA, ANTÓNIO, e outros, Fundamentos de Eletrónica, Lidel 2012;

Access Conditions and Attendance Excuse

The frequency of practical laboratory classes is compulsory.

Conditions for Exam Admission

The final exams are only accessible to students previously approved in the laboratory component.

Evaluation Method

The evaluation is composed of three components:

T-Theoretical component (0-12)

Evaluation by final exam. Accessible to all students, who obtained approval in the laboratory component. The Exam has a weight of 12, with a minimum of 6.

C- Continuous Assessment (0-1)

Small individual and optional tests related to the subjects taught in theory and laboratory classes will be released online regularly. These tests will have a final weight of 1 value.

L- Laboratory Component (0-7)

The laboratory component is set to 7 values with a minimum of 3.5 values. Each student is evaluated individually considering the following parameters:

1. Preparation, execution and quality of final reports for 5 to 6 practical work done in groups; The delivery of the reports must be made until the next class after the work is completed; Completion and delivery of at least 4 reports is mandatory.
2. The number of unexcused absences, being mandatory the presence in at least 80% of the laboratory classes.
3. Ability to work in team and interpersonal relationship.
4. Demonstrated knowledge and skills; Ability to solve problems; Autonomy, initiative and creativity;

Final Classification = T + C + L

Conditions for Results Improvement

Any student may propose to the achievement of improved classification only once. According to the regulations of the Polytechnic Institute of Coimbra (IPC) and of the Coimbra Engineering School (Instituto Superior de Engenharia de Coimbra - ISEC) and other legislation.

Date	**Signature from the lecturer responsible for the course**
17 Set. 2018	Fernando D. Moita

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher:_____

Licenciatura – BsC Engenharia Electromecânica

Licenciatura – BsC Electromechanical Engineering

Academic Year: **2018/2019**

Program Contents

Course Unit STATISTICAL METHODS

Specialization (s)

Subject type **Research Area** Mathematics

Year 2nd **Semester** 2nd **ECTS** 4

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	1	14
Practical-Laboratoty Lectures		
Tutorial Orientation		
Project		

Unaccompanied Working Hours

Activity Type	Total Hours
Study	59
Works / Group Works	
Project	
Evaluation	3
Additional	

Total of Working Hours 104

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Luís Manuel dos Santos de Melo Margalho	PhD	Adjunct Professor
Theoretical-Practical Lectures	Maria Filomena Palmeira Araújo Canova	MSc	Coordinator Professor
Practical-Laboratoty Lectures			
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) Luís Manuel dos Santos de Melo Margalho

Goals

It is intended that students acquire basic concepts of statistics and probability, including the language and rules inherent to these concepts

Skills

It is intended that the student has the skills to identify techniques that allow the statistical analysis of data and perform, if necessary, statistical inference, possibly resorting to statistical software.

Program Contents

1. **Probabilities**. Definitions. Properties. Conditional Probability. Independence. Theorems of total probability and Bayes.
2. **Discrete Random Variables**. Definition. Probability function and distribution function. Expected value, variance and properties. Binomial and Poisson laws. Bidimensional variables. Joint probability and distribution functions, marginal probability, conditional probability. Independence. Covariance and correlation.
3. **Continuous variables**. Definition. Probability density function and distribution function. Expected value, variance and

properties. Uniform, normal and exponential laws. Central Limit Theorem. Applications.

4. **Estimation. Statistical Inference**. Point estimation. Properties. Confidence interval for the mean of a normal population with known/unknown variance, to the variance of a normal population and to parameters of non-normal populations.

5. **Parametric Hypothesis Tests**. Concepts and methodology. Testing the expected value, the proportion and the variance. Comparing expected values, proportions and variances of two populations

In case of time availability, a brief introduction will be made to software for statistical analysis of data, with application to the program contents described above.

Bibliography

- Pedrosa, A.C., Gama, S. M. A. – Introdução Computacional à Probabilidade e Estatística, Porto Editora
- Bowker and Lieberman - Engineering Statistics, Prentice Hall
- Guimarães, Rui C. & Cabral, José A. S. - Estatística, Mc Graw Hill
- Murteira, Bento et all – Introdução à Estatística, Mc Graw-Hill
- Ross, Sheldon – Introduction to Probability and Statistics for Engineers and Scientists, Elsevier
- Notes provided by the teacher

Access Conditions and Attendance Excuse

Conditions for Exam Admission

Access to the exam is allowed to all students duly enrolled in the course unit.

Evaluation Method

Distributed Assessment or Final Exam Evaluation.
The distributed evaluation consists in the accomplishment of two tests, each of them with the duration of 1h15m and quoted to 10 values. The student can obtain approval if the minimum grade in each of the tests is of 4 values and the sum of the two marks is equal or superior to 10 values. The first test will be held in the 9th week of classes and the second test will be carried out simultaneously with the regular season exam.

The final exam evaluation consists of an exam graded for 20 points, in regular season or appeal season, lasting 2h30m. Student will be approved if the grade is, at least, 10 points.

In any form of evaluation, the use of graphic / CAS calculators will not be allowed.

Conditions for Results Improvement

According to the conditions mentioned in REACTA

Date	**Signature from the lecturer responsible for the course**
17/01/2019	

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher: A. Pereira

Licenciatura – BsC Engenharia Electromecânica
Licenciatura – BsC Electromechanical Engineering

Academic Year: 2018/2019

Program Contents

Course Unit ELECTRICAL MACHINES

Specialization (s) -

Subject type Specialty Sciences **Research Area** Electrical Engineering

Year 2º **Semester** 2º **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures		
Practical-Laboratoty Lectures	2	28
Tutorial Orientation		
Project		
Total of Working Hours		130

Unaccompanied Working Hours

Activity Type	Total Hours
Study	51
Works / Group Works	20
Project	
Evaluation	3
Additional	

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Adelino Jorge Coelho Pereira	PhD	Prof. Adjunto
Theoretical-Practical Lectures			
Practical-Laboratoty Lectures	Adelino Jorge Coelho Pereira	PhD	Prof. Adjunto
	Carlos Jorge Coelho Teixeira	Master	Assist. Conv.
Tutorial Orientation			
Project			
Responsible(s) Lecturer (s)	Adelino Jorge Coelho Pereira		

Goals

The main aims of this course unit are:

- To study the major classical electrical machines, including theoretical aspects, problems solving and laboratory practice.

Skills

For the "Classical" Electrical Machines studied, operated and tested (Transformers, Induction Machines, DC Machines and Synchronous Machines), at the end of this course unit, the learner is expected to be able to:
- Describe their constructional features, operation principles and to know their application fields;
- Know their steady-state equivalent circuits, perform experimental determination of the machine parameters and solve voltages, currents, power and efficiency analytical problems using the equivalent circuits and power flow and torque equations.

The learning outcomes, should contribute, along with those acquired in other's Electromechanical Engineering Course Units, to obtain the following competences:
- Design, Execute and Exploit Industrial and Buildings Electrical Installations;
- Know the Operation of Electrical Machines and its Control Equipments;
- Know the principal aspects of the maintenance of electrical installations and industrial electrical equipments;
- Design and execute command and protection systems of industrial equipments;
- Define Electromechanical Equipments Maintenance Plans.

Signature of Teacher: A. Pereira

Program Contents

1- Electrical Machines Principles
Electrical Machinery overview. Importance and applications. Faraday, Lenz, Newton and Laplace laws. Materials.

2- Single-Phase and Three-Phase Transformers
Types and constructive aspects. Working Principle and Equivalent Circuit of a Transformer. Performance Characteristics. Economic Laboratory tests. Transformer's parallel connection. Three-Phase Transformers. Three-Phase Transformers Connections.

3- Induction Machines
Introduction to Polyphase Induction Machines. Constitution, Operation Principle, Equivalent Circuit of an Induction Machine. Power and Torque. Mechanical and Electromechanical Characteristics. Stability. Economic Laboratory Tests. Starting, breaking. Squirrel-Cage Rotors. Induction Generator. Single-Phase Induction Motor.

4- DC Machines
Introduction to DC machines. Operation Principles. EMF generated. Commutation. Power, Torque and Efficiency. Equivalent circuits and Forms of Excitation. DC generators: operation characteristics. DC motors: power flow and losses, operation characteristics. Starting and Control of DC motors.

5- Synchronous Machines
Introduction to Synchronous Machines. Operation Principles. Constructional Features. Cooling and Excitation. Equivalent Circuits. Synchronous Generators: Open Circuit and Steady-State Load Characteristics; Economic Laboratory Tests; Parallel Operation. Synchronous Motors: Load and Field Change Effects; V curves; Starting.

Bibliography

- Electrical Machine Notes

a. Paulo Pereirinha, Máquinas Elétricas – Introdução, ISEC.
b. Joaquim Carvalho, Transformadores, ISEC.
c. Joaquim Carvalho, Máquinas de Indução, ISEC.
d. Joaquim Carvalho, Máquinas Síncronas, ISEC
e. Joaquim Carvalho, Máquinas de Corrente Contínua, ISEC,
f. Guia Laboratorial, ISEC.
g. Folhas de exercícios, ISEC.
h. Adelino Pereira, PowerPoint.

• E. Ras, Transformadores - de Potência, de Medida e de Protecção, Livraria Almedina, Coimbra,1977.
• S. A. Nasar, Máquinas Eléctricas, McGraw-Hill, Brasil, 1984.
• M. P. Kostenko, L. M. Piotrovski, Máquinas Eléctricas I e Máquinas Eléctricas II, Editora Lopes da Silva, Porto, 1979.
• B. S Guru, H. R. Hiziroglu, Electric Machinery and Transformers, Oxford University Press, New York, 3rd. rev edition, 2000.
• P. C. Sen, Principles of Electric Machines and Power Electronics, John Wiley & Sons, Inc., Singapore, 1996.
• S. J. Chapman, Electric Machinery Fundamentals, Mcgraw Hill Higher Education; 5th Revised edition, 2011.
• A. E Fitzgerald, C. Kingsley Jr., A. Kusko, Máquinas Elétricas: com Introdução Eletrônica de Potência, Editora Bookman, Porto Alegre, Brasil, 2006.
• G. R. Slemon, A. Straughen, Electric Machines and Drives, Addison-Wesley Publishing Company, 1992.
• D. P. L. Brandão, Máquinas Eléctricas - Introdução às Máquinas Eléctricas de Corrente Contínua, Fundação Calouste Gulbenkian, Lisboa, 1984.
• Jean Chatelain, Machines électriques - Tome I; Machines électriques - Tome II, Presses polytechniques romandes, 1983.
• John Hindmarsh, Electrical Machines and their Aplications, Butterworth-Heinemann; 4th edition, 1995.
• J. C. P. Palma, Accionamentos electromecânicos de velocidade variável, Fundação Calouste Gulbenkian, Lisboa, 1999.
• Ion Boldea, Syed A. Nasar, Electric drives, Boca Raton, CRC Press, 2nd. Edition, 2006.

- Several digital documents related to the discipline: supplementary notes, catalog of manufacturers, etc ...

Signature of Teacher: A. Pereira

Access Conditions and Attendance Excuse

-

Conditions for Exam Admission

Approval in the Laboratory works assessment and reports components (minimum score: 2.7 points over 6).
The attendance of Laboratory classes are mandatory (minimum 80% attendance; For students of special schemes, namely those under the worker-student), it should be agreed upon between the course unit and the student, on the initiative of the latter and at the beginning of the academic semester, an alternative way of functioning of these components, when the student cannot effectively attend them at the scheduled times.

Evaluation Method

- Laboratory works assessment and reports, 30% of total grade (6 over 20 points: 2.5 for reports, 1 for individual performance and 2.5 for a mini-test to be solved at last laboratory class). Minimum score: 2.7 points over 6.
- Final written exam is worth 70% of total grade (14 over 20 points, of which 7 for theoretical questions and 7 for practical problem solving); minimum score: 6 points (T: 3 points, P: 3 points) over 14.

Conditions for Results Improvement

Improved part of final examination, quoted for 14 points.
Exceptionally, if it is possible from the point of view of the functioning of the laboratory classes, and with the agreement of the teacher in charge, the Practice / Labs section, quoted for 6 values, can also be improved.

Date	Signature from the lecturer responsible for the course
18/01/2019	Adelino Jorge Coelho Pereira

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher: _____

Licenciatura em Eng. Electromecânica

BsC in Electromechanical Eng.

Academic Year: **2018/2019**

Program Contents

Course Unit INDUSTRIAL AUTOMATION

Specialization (s)

Subject type **Research Area**

Year 2nd **Semester** 2nd **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures		
Practical-Laboratoty Lectures	2	28
Tutorial Orientation		
Project		

Unaccompanied Working Hours

Activity Type	Total Hours
Study	32
Works / Group Works	40
Project	
Evaluation	2
Additional	

Total of Working Hours

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Horácio do Carmo Fachada	MSc	Auxiliary Prof.
Theoretical-Practical Lectures			
Practical-Laboratoty Lectures	Horácio do Carmo Fachada	MSc	Auxiliary Prof.
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) Horácio do Carmo Fachada

Goals

Familiarize the students with the knowledge and practices of the areas of pneumatics, automation and robotics.

Skills

Develop knowledge and understanding in the fields of pneumatics, automation and robotics;
Provide the student with the ability to apply the knowledge acquired in solving specific problems, supported by argument and own actions, seeking to obtain continuous improvement;
Obtain the student's ability to work in groups, developing interpersonal relationships;

Signature of Teacher: Fachada

Program Contents

1. Introduction to automatisms

2. Pneumatics
2.1. Introduction
2.2. Air production and distribution
2.3. Air conditioning unit
2.4. Directional, pressure and flow control valves
2.5. Pneumatic Actuators (linear and rotary)

3. Introduction to Automata and its Programming
3.1. Grafcet level I and II
3.2. Grafcet Ladder Encoding
3.3. Industrial Networks
3.4. Acquisition, control and supervisory systems - Supervisory Control and Data Acquisition (SCADA) and Human Interaction Systems - HMI (Human-Machine Interaction)

4. Industrial Sensors and Actuators
4.1. General characteristics and specifications of industrial sensors and actuators
4.2. Operation of the main measuring transducers
4.3. Industrial actuators (electric, pneumatic and hydraulic)

5. Introduction to Robotics
5.1. Main configurations of industrial robots
5.2. Robot Modeling Basics
5.2.1. Direct kinematics of robots
5.2.2. Reverse kinematics of robots
5.3. Programming of robotic systems (robots and work cells with robots)

Bibliography

[0] H.C. Fachada, Lectures of theoretical and practical classes (2011).
[1] J.P. Ferreira, Lectures of theoretical and practical classes.
[2] Pires, J.N., "Industrial Automation", Lidel, Lisbon, Portugal, 2007
[3] Paulo Oliveira, "Course of Industrial Automation", Etep - Edições Técnicas e Profissionais Lda, Portugal, 2008
[4] CRAIG, John J. - Introduction to robotics: mechanics and control, 2nd ed., Addison-Wesley Publishing Co, Reading, MA, 1989, ISBN: 0-201-09528-9
[5] PROGRAMMING MANUAL - Programmable Controllers - SYSMAC CQM1 / CPM1 / CPM1A / SRM1
[6] Gustavo da Silva, Industrial Instrumentation - 2nd edition
[7] Manuals of OMRON PLC;
[8] FESTO pneumatic equipment manual

Access Conditions and Attendance Excuse

Conditions for Exam Admission

Evaluation Method

The practical classes are classified for 6 values.
The final exam is classified for 14 values.

Conditions for Results Improvement

Date

17 January 2019

Signature from the lecturer responsible for the course

Hélio Fachada

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher: Rita Pereira

Licenciatura – BsC Engenharia Electromecânica (Português)

Licenciatura – BsC Electromechanical Engineering (Inglês)

Academic Year: **2018 / 2019**

Program Contents

Course Unit ELECTRICAL POWER SYSTEMS AND POWER QUALITY

Specialization (s)

Subject type **Research Area**

Year 2 **Semester** 2 **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	2	28
Practical-Laboratoty Lectures		
Tutorial Orientation		
Project		
Total of Working Hours		130

Unaccompanied Working Hours

Activity Type	Total Hours
Study	70
Works / Group Works	
Project	
Evaluation	4
Additional	

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Rita Manuela da Fonseca Monteiro Pereira	PhD	Prof. Adjunto
Theoretical-Practical Lectures	Rita Manuela da Fonseca Monteiro Pereira	PhD	Prof. Adjunto
Practical-Laboratoty Lectures			
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) Rita Manuela da Fonseca Monteiro Pereira

Goals

The main aims of this course unit are:
- introduce the concept of Electric Power System and its structure: generation, transmission, distribution and supply.
- provide the basic concepts underlying both the conventional processes of conversion of the different forms of energy in electrical power and renewable sources.
- present the mathematical concepts, necessary to the modelling of Electric Power Systems, in the steady state.
- introduce the concept of Power Quality in Electric Power Systems: Commercial Quality, Continuity and Quality of the Wave (Sags and swells, Transient overvoltages, Harmonics, Voltage regulation).

Skills

Understand the structure and functioning of the Electric Power System.
Understand the dynamics associated with the functioning of the Electric Power System.
Know some studies to be undertaken to assess the operation, maintenance and expansion in Electric Power System.
Analyze the results of studies and strategies for improving the operation and expansion of Electric Power System.
Design and implement systems for improving quality of service in the Electric Power System.

Signature of Teacher:_____

Program Contents

- Characteristics of the Portuguese electrical energy system.
- Electric energy sources (thermal and hydric power plants, renewable energy)
- Electric Power Demand.
- Power diagram.
- The three-phase system.
- Power Transportation and Distribution.
- Calculate the electric parameters of lines, set the PI model
- Per unit system.
- Power Flow Computations in Electric Power Systems.
- General aspects regarding Quality of Service:
    - Quality of the Wave;
    - Continuity
    - Commercial Quality;
    - Legislation and Recommendations;
    - Analysis of Case Studies.

Bibliography

1. J. P. Sucena Paiva, Redes de Energia Eléctrica, uma Análise Sistémica, IST Press, 2005
2. Manuel Delgado, Sistemas Eléctricos Trifásicos - A Média, Alta e Muito Alta Tensão, Publindústria, 2010
3. R. Castro, "Uma Introdução às Energias Renováveis Eólica, Fotovoltaica e Mini-hídrica", IST Press, 2011
4. Antonio J. Conejo, Luis Baringo, power system operation,Springer, 2018

Available Support Material: lecture notes; notes of practical classes; examples of practical exercises.Access

Conditions and Attendance Excuse

For students of special schemes, namely those under the worker-student statute, it should be agreed upon between the course unit and the student, on the initiative of the latter and at the beginning of the academic semester, an alternative way of functioning of these components, when the student can not effectively attend them at the scheduled times.

Conditions for Exam Admission

Be enrolled in the course unit.

Evaluation Method

The assessment may be done in two ways:
- Frequency 1,(50%);
- Frequency 2,(50%);
- The realization of frequency 1 does not require the student to perform frequency 2;
- The final result is given by the sum of the scores of frequencies 1 and 2.

Dates of partial evaluation tests:
1st Frequency: March 25, 2019
2nd Frequency: May 27, 2019

Or

Final written exam, to take place in regular and / or appeal season (100%).

Conditions for Results Improvement

In accordance with the legislation.

Date	**Signature from the lecturer responsible for the course**
21/01/2019	Rita Maria Meira Peixe

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher:_____

Licenciatura – BsC Engenharia Electromecânica

Licenciatura – BsC Electromechanical Engineering

Academic Year: **2018/2019**

Program Contents

Course Unit MECHANICAL TECHNOLOGY

Specialization (s)

Subject type Eng. Sciences **Research Area** Mechanical Engineering

Year 2st **Semester** 2st **ECTS** 6

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	1	14
Practical-Laboratoty Lectures	2	28
Tutorial Orientation		
Project		

Unaccompanied Working Hours

Activity Type	Total Hours
Study	71
Works / Group Works	10
Project	
Evaluation	3
Additional	

Total of Working Hours 156

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	João Miguel Maia Carrapichano	PhD	Coord. Prof.
Theoretical-Practical Lectures	João Miguel Maia Carrapichano	PhD	Coord. Prof.
Practical-Laboratoty Lectures	José Pedro Pimentel de Almeida	MSc	Assistant
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) João Miguel Maia Carrapichano

Goals

The main aims of this course unit is to provide the students with necessary knowledge about principles of physics, operational features and practical applications for each of the welding and forming processes, as casting and working processes, learnt, and how these processes should be selected, controlled and applied to each concrete case, to manipulate materials, especially to metallic materials conformation of, for the mechanical construction of components, equipment and systems. Another goal is solve theoretical-practical problems in the technological processes presented, resolution to be done mainly in theoretical-practical classes, that may, when necessary, be preceded by corresponding theoretical exposition

Skills

At the end of this course unit the learner is expected to be able:
to know de proprieties and applications ways of engineering materials;
to understand the mechanisms that are part of the forming mechanical technology processes, know how these processes should be selected, controlled and applied in each specific situation;
to understand the mechanisms that are part of the welding processes, thermal cutting and mechanical technology, know how these processes should be selected, controlled and applied in each specific situation in the material joints;
to diagnose defects in welding processes and thermal cutting;
to define all of the procedures to ensure necessary safety conditions and correct welding work methods;
to identify the different welding defects and suggest methods to solve these.

Signature of Teacher:_____

Program Contents

Materials and processing. Classes of materials. Metallic materials: properties and plastic deformation mechanisms.
Technological processes of forming and manufacturing (general designations and characteristics).
Conformation by plastic deformation processes: rolling mill, extrusion, drawing and deep drawing processes, stretching, wire drawing, stamping, forging.
Casting systems.
Generalities, principles and definitions on those forming mechanical technology processes, and respectively classifications.
Calculations and projects on forming mechanical technology processes, and equipments.
Manufacturing and resultant products. Tests (as field and laboratory tests on the processes learnt).
Welding technology - definitions. Welding machines.
Electric arc welding process, MIG/MAG, TIG, submerged arc welding-SAW, SER and special processes, Plasma Welding, Flux core Welding.
Laser welding, Electron beam welding and friction stir welding
Thermal cut process. Welding Metallurgy – discuss and interpretation. Relation between metallurgy and welding processes.

Bibliography

KALPAKJIAN, Serope; SCHMID, Steven – Manufacturing Engineering Technology, 6th Edition
CHIAVERINI, Vicente – Tecnologia Mecânica (Vol II, ISBN: 9780074500903, Makron Books, 1986)
SCHEY, John A. – Introduction to Manufacturing Processes, 3th Edition
LASCOE, O.D. – Handbook of Fabrication Processes, ASM International Metals Park, Ohio
RODRIGUES, Jorge – Tecnologia Mecânica: Tecnologia da Deformação Plástica, Vol. I (Fundamentos Teóricos) e Vol. II (Aplicações Industriais), 2ª Edição, Escolar Editora, 2010
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KOCH, H, Manual de la tecnologia de la soldadura eléctrica por arco, Reverté, Barcelona, 1965
SÉFÉRIAN, D, Las soldaduras, Urmo, Bilbao, 1977, ISBN 84-314-0065-X
RICHARD, KG, Joint preparations for fusion welding of steel, The welding Institute, Cambridge, 1976
SAHLING, L, La técnica de la soldadura en la ingenieria de construcción, 1ª ed., Blume, Madrid, 1970
SANTOS, JFO, Quintino, L, Processos de soldadura, Vol. I e II, Instituto de Soldadura e Qualidade Lisboa, 1993, ISBN 972-9228-17-5 (Vol. I) and ISBN 972-9228-24-8 (Vol. II)
RODRIGUES, AM, Geometria da soldadura no processo MIG robotizado - Factores, FCTUC, Tese de Mestrado, 1998
Supporting texts (by course unit teachers).

Access Conditions and Attendance Excuse

According to general rules used in the school.

Conditions for Exam Admission

According to general rules used in the school.

Evaluation Method

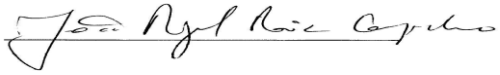
Final written exam grade (0-20) according to official school calendar (50% to forming processes and 50% to welding). *To Erasmus student's progress assessment can be established by lectures as complementary meetings in English language, to develop parallel written project work in a predefined subject, with individual final presentation and discussion, complemented the final written exam*.

Conditions for Results Improvement

Improving grades or retaking exams is allowed, according to general rules of the course and used in the school.

Date **Signature from the lecturer responsible for the course**

11.02.2019



Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher: _____

Licenciatura – BsC Engenharia Electromecânica (Português)

Licenciatura – BsC Electromechanical Engineering (Inglês)

Academic Year: **2018/2019**

Program Contents

Course Unit HYDRAULIC AND THERMAL MACHINES

Specialization (s)

Subject type **Research Area** Electromechanical Engineering

Year 2 **Semester** 2 **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	2	28
Practical-Laboratory Lectures		
Tutorial Orientation		
Project		
Total of Working Hours		130

Unaccompanied Working Hours

Activity Type	Total Hours
Study	68
Works / Group Works	
Project	
Evaluation	6
Additional	

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Avelino Virgílio Fernandes Monteiro de Oliveira	PhD	Adjunct Prof.
Theoretical-Practical Lectures	Avelino Virgílio Fernandes Monteiro de Oliveira Maria Luísa Ingrês Pais Vaz	PhD MSc	Adjunct Prof. Adjunct Prof.
Practical-Laboratory Lectures			
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) Avelino Virgílio Fernandes Monteiro de Oliveira

Signature of Teacher:

Goals

The main aims of this course unit in the Hydraulic Machines Component are:
- Provide a large perspective of the various types of hydraulic machines (pumps, fans and turbines);
- Learn the theoretical fundamentals necessary to characterize the studied machines in order to describe their working principles;
- Provide the knowledge to correctly define the guiding parameters of selection;
- Identify the main fields of application of the different types of pumps, fans and turbines.

The main aims of this course unit in the Thermal Machines Component are:
- Acquire knowledge in the areas of the production, transport and use of thermal energy, particularly in the following subjects:
    - heat exchangers (types, main constitution and accessories, calorific power and efficiency, selection and application of heat exchangers);
    - types and characteristics of fuels (analysis, calculation and combustion graphs);
    - boilers (classification, constitution and manufacturing processes, different types of boilers, equipment and accessories for boilers, thermal balance and efficiency calculations).

Skills

At the end of this course unit in the Hydraulic Machines Component the learner is expected to be able to:
- Identify the various types of hydraulic machines and carry out their global characterization.
- Define the main applications of hydraulic machines, describe the operation principles and accurately perform the selection of pumps, fans and turbines.

At the end of this course unit in the Thermal Machines Component the learner is expected to be able to:
Understand the working principals, have capacity to select, to operate and to define the maintenance mechanisms oh heat exchangers and boilers, as well as perform energy thermal balances and efficiency calculations.

Program Contents

Hydraulic Machines Component
Chapter 1: Definition of Hydraulic Machine. Examples. Classification of the Hydraulic Machines. Fundamental disposal and geometric disposal.

Chapter 2: Dimensional Analysis. Similarity theory. Dynamic, cinematic and geometric similarity. Buckingham Theorem. Non-dimensional coefficients.

Chapter 3: Global efficiency of pumps and turbines. Specific speed. Standard hydraulic machines. Definition of the geometry of the hydraulic machines. Cordier diagram. Characteristic curves (Performance curves). Characteristic curve of the hydraulic machine. Characteristic curve of the installation (System characteristics). Operating point. Parable of the equivalent points. Laws with two parameters.

Chapter 4: Cavitation in pumps and turbines. Net positive suction head (NPSH). Height of the installation. Non-dimensional coefficients in cavitation. Typical values of the specific speed. Cavitation effects: destructive effects and changes in the flow pattern. Ways to avoid cavitation.

Chapter 5: Hydraulic turbines: Pelton, Francis and Kaplan turbines. Centrifugal and axial pumps. Centrifugal and axial fans.

Thermal Machines Component
Chapter 1: Heat Exchangers
Definition. Applications, classification and types. Constitution, design and operational features. Accessories. Calorific power. Efficiency. Selection of heat exchangers.

Chapter 2: Combustion
Definition. Complete and incomplete combustion. Stoichiometric combustion; excess combustion air. Types of fuels and fuels properties. Higher and lower heating values. Ignition temperature. Psychometric diagram. Combustion calculations and combustion analysis. Gaseous emissions. Combustion analysis graphs.

Chapter 3: Boilers
Definition. Main applications, classification and types. Boiler components. Combustion systems. Boiler accessories and fittings. Steam superheaters and reheaters; economizers; combustion air heaters; energy losses and boiler efficiency.

Signature of Teacher:

Chapter 4: Thermal Balance. Energy balances: law of conservation of energy; steady state energy balance on an open system; mass and energy balances of thermal equipment and systems. Fuel flow calculations in boilers. Thermal balance of a water vapour system.

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- Henriques, António Gonçalves - Barragens, Sociedade e Ambiente, Esfera do Caos, ISBN: 978-989-680-172-4
•Faria, Raquel; Oliveira, A. Virgílio M. ; Mendes, João C. A. F. - Máquinas Hidráulicas – Caderno de Problemas, ISEC, Coimbra,2011
Oliveira, A. Virgílio M. – Máquinas Hidráulicas: Análise Dimensional, Teorema de Buckingham, Teoria da Semelhança: Texto de Estudo Complementar, Coimbra, 2017

Access Conditions and Attendance Excuse

Conditions for Exam Admission

All students enrolled have access to the formal exams.

Evaluation Method

The student has to perform a written exam in a formal evaluation period. There is also a possibility to perform an additional test at the end of the lectures of each of the components of the discipline (thermal and hydraulic machines). Each written test has two parts – one for each of the main components of the curricular unit. Each component has a quotation of 10 points. Students who obtain a minimum of 50% of the quotation in any component of the discipline are exempt from repeating that component in subsequent exams. Final approval depends on a positive classification in each of the two components.

Conditions for Results Improvement

Conditions for results improvement are established in the legislation.

Date 16/1/2019

Signature from the lecturer responsible for the course A. Virgílio Monteiro de Oliveira

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher: _____

Licenciatura – Engenharia Eletromecânica - 9105

BSc – Electromechanical Engineering - 9105

Academic Year: 2018/2019

Program Contents

Course Unit ELECTROMECHANICAL DRIVES

Specialization (s) -

Subject type Speciality Sciences **Research Area** Electrical Engineering

Year 3rd **Semester** 1st **ECTS** 6

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures		
Practical-Laboratoty Lectures	2	28
Tutorial Orientation		
Project		
Total of Working Hours		156

Unaccompanied Working Hours

Activity Type	Total Hours
Study	64
Works / Group Works	33
Project	
Evaluation	3
Additional	

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Paulo José Gameiro Pereirinha	PhD	Prof. Coordenador
Theoretical-Practical Lectures			
Practical-Laboratoty Lectures	Paulo José Gameiro Pereirinha José Ladeira Francisco	PhD 5y "Licenciat."	Prof. Coordenador Assistente Convid.
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) Paulo José Gameiro Pereirinha

Goals

To give students theoretical, practical and experimental skills on electromechanical drives and on the respective protection, command and control devices.

Skills

At the end of this course unit, the student is expected to be able to use, design, analyze, optimize, protect and implement electromechanic drives, integrating three-phase induction motors, soft-starters, variable-speed drives, contactors, protection devices and mechanical transmission.
The learning outcomes, associated with those acquired in other course units, contribute for the understanding of the operation of electric motors and of the respective control equipment, the capability of design and implementation of command and protection systems of industrial equipment and the respective electric power networks, the knowledge of relevant aspects of industrial electric power networks and equipment maintenance, and the capability to define maintenance schemes for electromechanical equipment.

Program Contents

1- Sizing and applications of powertrain systems.
Introduction to drives
Energy conversion in electromechanical drives.
Electromechanical drives of constant speed and variable speed. Main industrial applications and power range of

electromechanical drives. Evolution of the distribution of the drives by DC and AC motors.

Standardization of electrical circuits: Symbology for electromechanical drives.

Used but outdated symbology; symbology according to IEC 1082-1. Comparison of the main symbols of International (IEC) and US standards.

Reference to developed electrical circuits.

Rules for implementation of electrical circuits.

Control and power circuits for motor starters.

Currents and binaries during motor starting: direct start, star-triangle. Curves for slip and speed. Typical representations.

Typical control and power circuits.

Other starting:

- Motors with partial winding ("part-winding").
- Stator-Resistor.
- By autotransformer.
- Wound rotor motors.
- Starters-inverters.
- Direct starting of single-phase motors.
- Separate winding 2 speed motors.
- 2-speed motors with pole switching. Dahlander: Binary const. and variable; Constant power.

Drive control equipment

Contactors. Particular aspects of the coil supply in alternating current and direct current (consumption reduction devices).

Forces in alternating current. Function of the shading coil; parallel with the operating principle of shaded pole motors.

Other types of contactors: low consumption contactors. Relays and static contactors.

Examples of choice of contactors depending on the application.

Coordination of contactors with short-circuit protection devices

Electromagnetic and thermal effects of short-circuits.

Notion and types of coordination (nonexistent, type 1, type 2 and total) and their consequences, advantages and disadvantages.

The different motor control and protection solutions. Solutions with 1, 2 or 3 devices to perform the basic functions of a motor output. Advantages and disadvantages.

2- Optimization of electromechanical drives

Introduction

Nature of electromechanical drives. Functional scheme of an electric drive. Steps for design / selection of drives.

Mechanics of Drives: Description and modeling

Fundamental equation of dynamics. Inertia, friction and elastic effects. Friction binaries.

Description and resistant torque of some types of loads.

Organs for transmission and adaptation of movement. Principle of additivity. Mechanical gears. Transmission ratio. Various types of gear units and their gear ratio.

Determination of the mechanical parameters: calculation of the moment of inertia and coefficient of viscous friction; determination of the parameters from the tests.

Service requirements, dynamic regime

Service requirements. Operating quadrants.

Cases study.

Restrictions imposed by the electric machine / converter.

3- Speed variation and position control

Transducers

Analog speed and position transducers: tachymetric dynamos and resolvers.

Digital speed and position transducers: pulse counters with inductive detectors, incremental and absolute encoders (natural binary code and Gray code). Advantages and disadvantages. Current transducers: current transformers and Hall effect sensors.

Electronic starters and variable speed drives

Differences and fields of application of controlled rectifiers, frequency converters and voltage graders.

Constitution: power module and control module. Main functions of electronic starters and variable speed drives.

Variation of voltage with fixed frequency

Soft starters.

Variable Frequency Drives

Simultaneous voltage and frequency variation ("V / f" and "E / f" technique).

Simultaneous variation of current and frequency.

Speed and position control: vector control

Introduction to the Generalized Theory of Electric Machines.

Models of asynchronous three-phase machine in various references.

Equations of the voltages in phase values.

Park transformation applied to a three-phase asynchronous machine.

Principle of Vector Control.

4- Dynamic systems analysis

Reference to the application of Park's Transformation to the three-phase asynchronous machine, for dynamic study and application to vector control.

Signature of Teacher:_____

5- Complementary aspects of electromechanical drives
Potential for energy savings.
Advances and future trends: in electric machines; in drives with induction motors.
Motor mounting positions and insulation classes.

6- Special powertrain systems
Use of Linear Induction Motor and BLDC Motor.
Application of drives in electric traction.

NOTE: In order to ensure the coordination of measures between the theoretical and laboratory practice, the teaching sequence of the materials may not be exactly the shown above.

Bibliography
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Ion Boldea, Syed A. Nasar, Electric drives, CRC Press, Boca Raton, 2nd edition, 2005 (livro e CD).
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Cahier Tech. Schneider Electric n° 208, Démarreurs et variateurs de vitesse électr., Nov. 2003.
Helena Santos, Curso de formação PCP - Protecção e Comando de Potência, e DHM - Diálogo Homem Máquina, Schneider Electric Portugal.
User Guides of SEW and manuals of SEW Drive Engineering.
Catalogs and Manuals of Schneider Electric/Telemecanique, ABB, SEW, WEG ,...
Selected papers.

Access Conditions and Attendance Excuse
For students of special schemes, namely those under the Worker-Student Statute, and for components with compulsory attendance and distributed assessment, it must be agreed between the responsible for the curricular unit and the student, on the initiative of the student and at the beginning of the academic semester, an alternative way of functioning of these components, when the student cannot effectively attend them at the scheduled times.

Conditions for Exam Admission
Approval in the practical / laboratory component, whose practical classes are of compulsory attendance (at least 80% of classes).
For students under the Worker-Student Statute, regarding the components with compulsory attendance and distributed assessment, it may be agreed between the person in charge of the unit curricular and the student, on his initiative, an alternative form of the functioning of these components.

Evaluation Method
Final exam, marked for 12 points (theoretical: 7 points; theoretical-practical: 5 points) and with a minimum of 5.0 points. With consultation only in the practical part of the catalog (s) indicated in the classes. Calculator machine required for the practical part of the exam.

Practice / Laboratories: marked for 8 points, divided into 3 laboratory works (20 minutes group defense of work 1, in date to be agreed with the students). Minimum mark: 3.0 points.

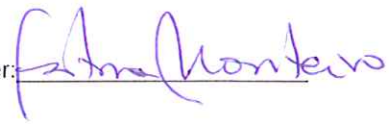
In order to be approved in the Electromechanical Drives subject it is necessary to obtain a final minimum grade of 9.5 points (in 20 points) and a minimum grade in the final exam of 5.0 points (in 12 points).
Note: Students who do not obtain the minimum in the final exam will not be considered the laboratory grade, and the grade of the exam will be marked to 20 points.

Conditions for Results Improvement
Improvement of final exam part, marked for 12 points.
Exceptionally, if it is possible from the point of view of the functioning of the laboratory classes, and with the agreement of the responsible teacher, the Practical / Laboratories part, marked for 8 points, can also be improved.

Date
21/09/2018

Signature from the lecturer responsible for the course

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher: 

Licenciatura – BsC __em Engenharia Eletromecânica_(Português)

Licenciatura – BsC __ in Electromechanical Engineering __(Inglês)

Academic Year: **_2018_/_2019_**

Program Contents

Course Unit INDUSTRIAL ELECTRICAL INSTALLATIONS

Specialization (s)

Subject type Specialty **Research Area** Electrical Engineering

Year 2 **Semester** 4 **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	2	28
Practical-Laboratoty Lectures		
Tutorial Orientation		
Project		
Total of Working Hours		130

Unaccompanied Working Hours

Activity Type	Total Hours
Study	71
Works / Group Works	
Project	
Evaluation	3
Additional	

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Maria de Fátima Coelho Monteiro	PhD	Prof. Adj.
Theoretical-Practical Lectures	Maria de Fátima Coelho Monteiro	PhD	Prof. Adj.
Practical-Laboratoty Lectures			
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) Maria de Fátima Coelho Monteiro

Goals

It is intended that the students who attend this discipline obtain comprehensive knowledge about the constitution, exploration, design and design of industrial and domestic electrical installations
Promote "good practice" and ethical responsibility in this area.
Sensitize students to the importance of protecting people and animals in electrical installations.

Skills

At the end of this UC the student must possess knowledge and know how to apply, on the technical rules regarding the design and protection of electrical installations, protection of people and animals, on transformation posts and on electrical installations in special places.

Program Contents

1. Introduction to electrical installation design
   1.2 The concept of design
   1.3 The ethical dimension of the designer work
   1.4 professional responsibility of the designer

1.5 the professional competence of the designer
1.6 stages and criteria for the elaboration of an electrical installation project
2. Predicting the loads of an electrical installation
2.1. Calculation of power install
2.2 simultaneity, evolution and utilization factors
3. Division of loads and their grouping in electric boards
4. Classification of Electrical Installations
4.1 External influences
4.2 Protection indexes
5. Conductors
5.1 Designation and constitution
5.2. Installation modes
6. Sizing of conductors
6.1 Heating Criteria
6.2. Voltage Drop Criterion
7. Protective equipment against overcurrent
7.1 the fuses
7.2 the circuit breakers
8. Dimensioning of protective equipment against overcurrent
8.1 Protection against overload
8.2 protection against short-circuits
8.3 selectivity and reliability
9. Type of grounds
10. Protection of persons and animals
10.1 The effects of electric current on the human body
10.2 Protection against electric shock.
10.4 Direct and indirect contacts.
10.5 Protection measures against direct and indirect contacts.
10.6 Differential devices. Operation principle.
10.7 Selectivity between differential devices.
11. Electrical boards
12. Rules for electrical installations in special places
13. Collective facilities
14. Protections of surge and lightning of atmospheric origin
15. Power Factor Compensation
16. Transformation Stations

Bibliography

Regras Técnicas das Instalações Eléctricas de Baixa Tensão

Morais, Josué - *Guia Técnico das Instalações de Baixa Tensão*, Certiel

Cotrim, Ademaro A. – *Instalações Eléctricas*, McGraw-Hill, Brasil

Niskier, Júlio; Macintyre, A. – *Instalações Eléctricas*, Guanabara Koogan

Pinto, L. Vilela - *MGCalc*, Edição Merlin Gerin

Access Conditions and Attendance Excuse

Students must attend at least 75% of the classes in order to be able to take the normal period exam (excluding students student workers and legal equivalents).
Exam of the recourse period has no condition.

Conditions for Exam Admission

Students must attend at least 75% of the classes in order to be able to take the normal period exam.
Exam of the recourse period has no condition.

Evaluation Method

The evaluation of the acquired competences will be made by final exam on the totality of the subject taught, with the maximum score of 20 values. The exam will be divided into 2 parts: one focuses mainly on theoretical concepts and the other on theoretical-practical calculations. Each part has the same weight for the final grade (50% = 10 points).
In order to obtain approval the student must have at least 9.5 values in the sum of the two parts, but simultaneously fulfill the minimum of 3.5 values in each of the parts.

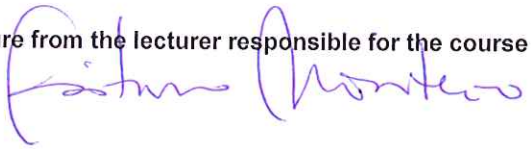
Conditions for Results Improvement

The conditions defined at ISEC

Date

12/09/18

Signature from the lecturer responsible for the course



Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher

Licenciatura – BsC Engenharia Eletromecânica

Licenciatura – BsC Electromechanical Engineering

Academic Year: **2018/2019**

Program Contents

Course Unit **MACHINE ELEMENTS**

Specialization (s) Mechanical Engineering

Subject type Expertise subject **Research Area** Mechanical Engineering

Year 3rd **Semester** 1st **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	2	28
Practical-Laboratoty Lectures		
Tutorial Orientation		
Project		

Unaccompanied Working Hours

Activity Type	Total Hours
Study	71
Works / Group Works	
Project	
Evaluation	3
Additional	

Total of Working Hours 130

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Pedro A. A. Vale Antunes	PhD	Adjunct Prof.
Theoretical-Practical Lectures	Maria de Fátima da Costa Apulino	MsC	Assistant
Practical-Laboratoty Lectures			
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) Pedro A. A. Vale Antunes

Goals

The subjects are intended to give a broad knowledge of the various mechanical components, and an introduction to the calculation / selection of mechanical components of some complexity. The aim is to give an approach of the mechanical design philosophy. To know the methods of static calculation and the fatigue, and the dimensioning of shafts. Mechanical transmissions (flexible and rigid) and bearings will be analyzed.

Skills

Understand the concepts and carry out the dimensioning / selection of machine components with some complexity based on analytical methods and develop a critical sense.

Program Contents

a. Introduction to the design of machine elements.

General characteristics of mechanical transmissions. Types. Comparative analysis of the different types of mechanical transmissions. Transmission selection factors.

b. Flexible mechanical transmissions.

Types. Specific features. Comparative analysis of different types of flexible transmissions. Applications.

c. Belt drives.

Types of belts: flat, trapezoidal and toothed. Specific applications. Comparative analysis of different types of belts. Geometry and nomenclature. Transmission Selection. Construction and assembly details. Types of ruin. Dynamic study. Power and Transmitted Torque. Useful and total forces in the belts branches. Calculation of pre-tensioning force. Induced stresses in the shafts. Tensions along the belt. Toothed Straps. Toothed belts ruin.

d. Chain Transmission

Nomenclature and geometric relations. Kinematic analysis. Transmission selection. Assembly and maintenance. Analysis of requesis. Dynamic study.

e. Fatigue

Fatigue concept; Characterization of the fatigue process; Typical forms of fatigue rupture; Phenomenological laws of fatigue behavior; Finite and infinite lives; Fatigue tests; Fatigue resistance limit; Correction of the fatigue strength limit: determination of the main parameters which affect the components fatigue resistance.

f. Shafts and unions.

Introduction. Dimensioning of shafts for static loads. Alternating bending and static torsion; Sines criterion; Soderberg solution; ASME method. Floating bending and torsion loads; Effect of stress concentration. Dimensioning of shafts to deformation. Materials used on shafts. Shackles. Shaft couplings. Rigid unions. Flexible joints. Universal unions.

g. Bearing bearings.

Concepts and Nomenclature. Bearings features and components. Types of Bearings. Bearing's static and dynamic load capacity. Equivalent bearing load. Life of bearings. Calculation of nominal life. Rotation Limits. Friction. Applications. Lubrication and Assembly. Bearing selection: type and dimensions.

h. Rigid mechanical transmissions: gears.

Generalities. Gears classification. Fundamentals. Cylindrical Spur and Helical Gears: Basics. Basic Law of Engagement. Terminology of sprockets. Classification of gears. Geometric relations. Profile by envelope: analysis and construction. Carve the sprockets. Continuity of gear. Cutting and operating interferences. Kinematics of gears. Efforts on the toothing. Efforts on shafts and supports. Dynamic study. Dimensioning by ISO standards. Dimensioning at break and surface pressure.

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[1] C.M. Branco, M. Ferreira, J. Costa, A. Ribeiro, Projecto de Órgãos de Máquinas, F.C. Gulbenkian, Lisboa, 2005
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[3] R.C. Juvinall and K.M. Marshek, Fundamentals of Machine Component Design, John Wiley & Son, 1991.
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[5] C.M. Branco, Mecânica dos Materiais, F.C. Gulbenkian, 1985.

Access Conditions and Attendance Excuse
Not applicable.

Conditions for Exam Admission
All students are admitted to the final exam.

Evaluation Method

Curricular unit evaluation is carried out through a written test at the end of the semester. This test comprises two components, a theoretical and a theoretical-practical, corresponding to 40% and 60% of the final mark, respectively. It is required to obtain a minimum of 20% on both parts. Examinations outside the assessment periods provided for in the school calendar may take the form of oral tests.

Conditions for Results Improvement
The improvement of classification can only be done through examination.

Date

20/09/2018

Signature from the lecturer responsible for the course

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher:

Licenciatura em Engenharia Eletromecânica (Português)

BSc in Electromechanical Engineering (Inglês)

Academic Year: **2018/2019**

Program Contents

Course Unit AIR CONDITIONING AND REFRIGERATION

Specialization (s)

Subject type Specialty curricular unit **Research Area** Mechanical Engineering

Year 3rd **Semester** 1st **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	1	14
Practical-Laboratory Lectures	1	14
Tutorial Orientation		
Project		

Unaccompanied Working Hours

Activity Type	Total Hours
Study	64
Works / Group Works	7
Project	
Evaluation	3
Additional	

Total of Working Hours 130

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	João Manuel Nogueira Malça de Matos Ferreira	PhD	Adjunct Professor
Theoretical-Practical Lectures	João Manuel Nogueira Malça de Matos Ferreira	PhD	Adjunct Professor
Practical-Laboratory Lectures	João Manuel Nogueira Malça de Matos Ferreira	PhD	Adjunct Professor
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) João Manuel Nogueira Malça de Matos Ferreira

Goals

The main aims of this course unit are: to understand the thermodynamic mechanisms that govern air-water vapor mixtures; to understand the key drivers of thermal comfort and perform heat load calculations; to characterize main air conditioning and refrigeration (AC-R) systems and their field of application; to identify the main components of air conditioning and refrigeration systems and how they interact to heat/refrigerate a space; and to identify and use correctly different tools in HVAC-R maintenance operations.

Skills

At the end of this course unit the student is expected to be able to: understand the importance of the air conditioning and refrigeration field; integrate AC-R fundamentals with day-to-day phenomena; describe the main components of an AC-R system; and use a variety of tools to perform several different tasks in the HVAC-R field.

Program Contents

THEORETICAL LESSONS
1. Introduction. Concepts and definitions used in HVAC-R. Why the need for air-conditioning. Main advantages and difficulties.
2. Environmental comfort conditions. Principles of bioclimatic architecture. Thermal comfort. Relevant parameters. Applicable standards and models. Comfort diagrams.
3. Calculation of thermal loads. Internal and external conditions. Reference data. Latent load and sensible load. Factors involved in the calculation: climatic factors, building characteristics, user profiles. Methodology of calculation.

4. Air filtration. Atmospheric air and health. Principles of filtration. Types of filters: classification, test methods and characteristic curves. Clean rooms. Application examples.
5. Air distribution. Occupied area and challenges in air distribution. Ventilation effectiveness. Terminal units for air supply and air extraction: types, characteristics and selection parameters. Air flow in ducts. Air ducts: types, materials and accessories. Advantages and disadvantages. Sizing of air ducts.
6. HVAC systems. Classification of systems. All air, air-water and refrigerant systems. Main equipment of an air conditioning system. Primary units and terminal units. Air treatment units.
7. Refrigeration cycles. Theoretical vapor compression cycle and real cycle. Irreversibilities. Multi-stage and cascade cycles. Absorption refrigeration cycle.
8. Refrigerants. Types of refrigerants. Main properties and effects on the performance of a refrigeration circuit. Safety and environmental impact.
EXERCISE SOLVING
1. Psychrometrics. The atmospheric air. Theoretical concepts. Psychrometric properties. Psychrometric chart. Exercise solving.
2. Air conditioning processes. Fundamental theoretical concepts. Typical air conditioning operations. Exercise solving.
3. Cooling cycles. Fundamental theoretical concepts. Exercise solving.
LAB ASSIGNMENTS
1. Contact with AVAC-R equipment, tools and accessories in the Air Conditioning Laboratory.
2. Handling of copper tubing: cutting, folding, flaring and bending.
3. Handling of copper tubing: threaded and brazed connections.
4. Maintenance of a split air conditioning unit: detection of faults, recovery of refrigerant, leakage detection, recharging of refrigerant.
5. Refrigeration compressors: types of compressors, breakdowns, troubleshooting.
6. Tests in didactic equipment: refrigeration unit and air conditioning unit.

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• MONTEIRO V – Refrigeração I – Bases e Fundamentos, ETEP, 2015. ISBN: 978-989-8480-12-5
• MONTEIRO V – Refrigeração II – Aplicações e Certificação, ETEP, 2016. ISBN: 978-989-8480-13-2
• RORIZ L – Climatização: Concepção, Instalação e Condução de Sistemas, Ed. Orion, 2006. ISBN: 978-972-8620-09-7
• STOECKER WF – Industrial Refrigeration Handbook, McGraw-Hill, 1998. ISBN: 0-070-61623-X
• CREUS J – Tratado Prático de Refrigeração Automática, Dinalivro, Lisboa, 1978. ISBN: 972-576-129-4
• European directives and regulations and Portuguese legislation.

Access Conditions and Attendance Excuse
N/A

Conditions for Exam Admission
Access to the final exam will not be allowed to students who do not perform the laboratory work.

Evaluation Method
Final written exam (70%); lab assignments (20%); written report of a lecture (10%).
• Only a calculator and the tables and diagrams presented in the classes are allowed in the final exam.
• The document supporting the lab assignments must be delivered to the head of the curricular unit in digital format (in PDF format, email jmalca@isec.pt) up to 2 weeks after the respective lab class.
• The lecture's report must be delivered to the head of the curricular unit in digital format (email jmalca@isec.pt) until the last day of classes according to the available school calendar.
• If there are no lectures, the respective weight in the final grade is transferred to the final written exam.
• Failure to appear in the lecture(s), if duly justified, implies that the respective grade is transferred to the final written exam.
• Examinations outside the assessment periods provided for in the school calendar may take the form of an oral test.

Conditions for Results Improvement
Improvement is only available through the written exam.

Date	**Signature from the lecturer responsible for the course**
12 September 2018	João Malça

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher:

Licenciatura – BsC Engenharia Electromecânica

BSc Electromechanical Engineering

Academic Year: **2018/2019**

Program Contents

Course Unit INDUSTRIAL MAINTENANCE AND QUALITY CONTROL

Specialization (s)

Subject type **Research Area**

Year 3 **Semester** 1 **ECTS** 6

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	2	28
Practical-Laboratory Lectures		
Tutorial Orientation		
Project		
Total of Working Hours		280

Unaccompanied Working Hours

Activity Type	Total Hours
Study	26
Works / Group Works	42
Project	
Evaluation	6
Additional	

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	José Manuel Torres Farinha	PhD	Prof. Coord. Principal.
Theoretical-Practical Lectures	Hugo Nogueira Raposo	PhD	Eq. Prof. Adjunct
Practical-Laboratory Lectures			
Tutorial Orientation			

Responsible(s) Lecturer (s) José Manuel Torres Farinha

Signature of Teacher:

Goals

At the end of the Course Unit, the student must have acquired knowledge on:

- The concept of Maintenance and its evolutions, as well as the concepts associated with it;
- The organization and management of a maintenance department of a company industrial, of services, hospital, hospitality, or another one, where the component of equipment and facilities is relevant;
- The programming, accompaniment and control of the maintenance interventions;
- The use of techniques and methods of maintenance planning;
- The identification and application of some techniques of on-condition maintenance;
- The functioning of the information systems for maintenance management;
- The technical and management indicators and the elaboration of cockpit charts for aid the maintenance;
- The new management methodologies of the maintenance activity;
- The concept of Quality and its evolutions, as well as the concepts associated with it;
- The main Quality Norms to certificate organizations;
- The implementation phases of a normalized quality management system;
- The Quality Control in the manufacturing processes of products and or providing services;
- The techniques and methodologies commons to the maintenance and quality.

Skills

The abilities that the student will have to acquire in this course unit are the following ones:

- To know how to act in a Maintenance department, namely in the preparation and control of the Working Orders, planned and non-planned;
- To know dialoguing with the several departments of the company that interact with the maintenance department;
- To know implementing a cockpit chart to aid the maintenance management and the company;
- To know looking for, by self-initiative, the real solutions for the real problems of the maintenance;
- To know applying the new management techniques to the real problems of the maintenance activity;
- To know acting in a Quality Department, namely in the elaboration of the control maps of products and services of the organizations;
- To know looking for, by self-initiative, the real solutions for the real problems and also implement processes for quality improvement both in products and services of the organizations.

Program Contents

PART I - MAINTENANCE

1. **Framework and Maintenance Organization**
   The Maintenance Concept and associated concepts. The interdisciplinary of the maintenance. The maintenance organization.
2. **Assets Organization**
   Definition of the structure of the Facilities and Equipment. Codification of the Facilities and Equipment.
3. **Types of Maintenance Works**
   Works of Planned Maintenance. Works of Non-Planned Maintenance. Works for maintenance improvement of facilities and equipment. Other types of Works.
4. **Maintenance Planning**
   Types of planned maintenance. Methods Function. The Five Levels of Planning. Algorithms for planning.
5. **Maintenance Resources**
   Human resources. Spare parts. Tools.
6. **Reliability**
   Basic concepts on reliability. Serial and parallel Systems. FMECA analysis.
7. **Information Systems for Maintenance**
   Importance of the information systems in the maintenance. Structure and functioning of an information system.
8. **Maintenance Costs**
   Direct and indirect Costs. Costs Optimization. Cost of Ownership of an Equipment. Cost of the Life Cycle of an Equipment.
9. **Maintenance Indicators**
   Elaboration of indicators. The Portuguese Norms indicators.
10. **New maintenance management methodologies**
    Toyota Production System (TPS); Just In Time; Jidoka (Poka Yoke, Andon). 5S. TPM (Total Productive Maintenance). Lean Maintenance; the seven Mudas. PDCA cycle. 6 Sigma. A3 Method. GUT Matrix. Ishikawa Diagram. Brainstorming. SWOT Analysis.

PART II – QUALITY

1. **Framework**
   Quality concept. Evolution of the Quality concept. The Quality Function in the Organizations. Quality Management *versus* Quality Control.
2. **Normalization of the "Quality Management"**
   The eight principles of Quality management. The Standards for Quality management of the ISO 9000 series. The certification process. Analysis of the requisites of ISO 9001.
3. **Metrology and Control of MMD (Monitoring and Measuring Devices)**
   Standards. Calibration. Test and certification. MMD – Monitoring and Measuring Devices. Quality evaluation and measurement in the services field.
4. **Process Control**
   Introduction to SPC (Statistical Process Control). Flowcharts. Pareto Diagrams. Histograms. Sampling. Scatter Diagram. Control Charts: For discrete variables (pn chart); For continuous variables (average and range charts).

5. **Audits**
   Audits of 1st, 2nd and 3rd parts. Planning. Preparation and implementation of audits. Audits response reports. Improvement plan to adopt. Revision and monitoring of the improvement.
6. **Technical and financial quality ratios**
   Collecting data and accounting the costs and benefits, Non-quality costs. *Tableau de Bord. BSC (Balanced Scorecard). KPI – Key Performance Indicators*. Other technical and financial ratios.
7. **New ways in the quality management**
   Taguchi and Kaizen methodologies. Integration of quality management systems. Safety and environment. New integration of systems. Quality, Energy and maintenance.

Bibliography

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- MITRA, AMITAVA (1998) – *Fundamentals of Quality Control and Improvement*, Prentice Hall, London. ISBN: 0-13-645086-5.
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- TAGUCHI, GENICHI (1990) – *Engenharia da Qualidade em Sistemas de Produção*, McGraw-Hill do Brasil.

Access Conditions and Attendance Excuse

- To access evaluation according to the "Assessment Methodology", the students must attend a minimum of 80% of the lessons taught.
- The students may be excused from lessons according to REACTA.
- If there is an exemption from the class attendance of the Course Unit, the students must do a final assessment exam.

Conditions for Exam Admission

- The students may be excused from lessons according to REACTA.

Evaluation Method

- The evaluation of the course unit will be done by Final exam in the form of written test with a maximum duration of three hours.
- An evaluation component, with a maximum weighting of 25%, resulting from the intervention of the student at the class and or a homework; the evaluation criterions of this component will be defined at the beginning of the Semester.

Conditions for Results Improvement

- According to the evaluation methodology and the general rules of ISEC.

Date

September, 13th 2018

Signature from the lecturer responsible for the course

José Manuel Torres Farinha

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher:_____

Licenciatura – BsC Engenharia Electromecânica

Licenciatura – BsC Electromechanical Engineering

Academic Year: **2018/2019**

Program Contents

Course Unit COMPUTER ASSISTED MANUFACTURING

Specialization (s) ---------

Subject type Specialty Discipline **Research Area** Mechanical Engineering

Year 3º **Semester** 1º **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	1	14
Theoretical-Practical Lectures	-	-
Practical-Laboratoty Lectures	3	42
Tutorial Orientation	-	-
Project	-	-

Unaccompanied Working Hours

Activity Type	Total Hours
Study	68
Works / Group Works	0
Project	-
Evaluation	6
Additional	-

Total of Working Hours

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Pedro Miguel Soares Ferreira	PhD	Adjunct professor
Theoretical-Practical Lectures			
Practical-Laboratoty Lectures	Pedro Miguel Soares Ferreira Celestino Tavares da Veiga	PhD MSc	Adjunct professor Invited Assist.
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) Pedro Miguel Soares Ferreira

Goals

The discipline of Computer Aided Manufacturing intended to transmit the theoretical and practical knowledge of obtaining pieces process gradually from an initial shape, raw or semi-finished until its final shape and dimensions by using cutting operations. This is done by programming numerical codes, computer-controlled machines (CNC) and computer-aided manufacturing (CAD / CAM) software.

Skills

- Know and know how to use different computerized machining processes involving equipment, tools, cutting parameters and programming.
- Know how to draw drawings and technical drawings, making use of the latest tools of computer aided design.
- Know the properties and fields of use of a wide diversity of engineering materials.
- Know and know how to use technological processes of manufacture, including systems of computer aided manufacture.
- To be able to realize projected solutions.

Program Contents

1. **Chip Cutting Machining**
   Machine tools conventional and computer controlled. Nomenclature of the axle system.
   Main cutting operations by chip trimming: Sawing; Driling; Threading; Rectification; Reaming; Turning; Milling;
   Cutting tools and parameters. Calculation of cutting speed and feed rate;
   Strength and machining power. Torque and power curves of a machine tool;
   Chip formation and heat generated in the cut.

Signature of Teacher:_____

2. **Numerical control of machine tools (CNC)**
   Relative and absolute coordinates. Cartesian and polar coordinates.
   Addresses to define variables and parameters. Codes used in CNC: Preparatory functions (G codes), auxiliary functions (M codes).
   Benchmarks: Concept of zero machine and zero part. Procedure for tool change.
   Concept of tool length and radius compensation.
   Linear interpolation at fast speed and programmed speed. Circular interpolation at programmed speed. Format of the circular interpolation block with the parameter R and with vectors i, j and k.
   Main program and subprograms.
   Drilling and Threading Cycles.
   Mirror function and zero-part change.
   Execution of the main operations in the Machining Center with Fanuc Series O-M Controller and execution of elaborated CNC programs using metallic and polymer materials.
3. **Measuring tools**
   Principle of operation and use of measuring tools (caliper and micrometer).
   Roughness meter
4. **CAD / CAM technologies**
   CAD / CAM systems and methodology to create a machining program.
   Post-processing.
   Trajectory of the tool and allowable tolerance.
5. **Computer Assisted Manufacturing Software (CAM)**
   Mastercam program architecture.
   Create and modify features.
   Conversion of files generated in CAD programs to the Mastercam program.
   Create 2D machining operations: Contours, facings, pockets drilling and threading cycles.
   Simulation of programmed and post-processing machining paths.
   Transmission of CNC programs to the machining center and execution of the CNC code.

Bibliography

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- Álisson Rocha Machado e outros - Teoria da Usinagem dos Materiais, Editora Blucher, 2009. ISBN: 9788521204527
- Completo e outros - Tecnologias de Fabrico, Publindústria, 2009. ISBN: 9789728953317
- John R. Walker - Machining Fundamentals, The Goodheart – Willcox Company, Illiinois, USA, 1998. ISBN: 1566374030
- Mikell P. Groover, Emory W. Zimmers Jr - CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall 1984
- Paulo Amaro e Fernando Simões - Controlador Fanuc Series O-M, Manual do utilizador, ISEC 2009.
- Joaquim Rocha – Programação CAD/CAM em MASTERCAM, FAC – Editora de informática, Lda, 2016. ISBN:9789727228423
- Joaquim Rocha – Programação de CNC para torno e fresadora, FAC – Editora de informática, Lda, 2016. ISBN:9789727228430
- Mastercam software manuals and tutorials.

Access Conditions and Attendance Excuse
There are no special conditions for dispensing

Conditions for Exam Admission
They are not provided any special conditions of access to examination.

Evaluation Method

1. For evaluation purposes, the course unit comprises the following components:
   Component I: Chapters 1 and 4 (theoretical contents)
   Component II: Chapter 2 and 3 (CNC laboratory component)
   Component III: Chapter 5 (CAM laboratory component)
2. The curricular unit comprises a part evaluated by written test (component I and II) and one part evaluated by individual laboratory work (component III).
3. The evaluation mentioned in the previous point may be carried out in stages during the semester, in which two tests are held, one in the middle of the semester and the remainder in the period of normal or appeal examinations (case I). Alternatively, a single final exam at the time of examination (case II).

Case I

a) Approximately in the middle of the semester, there is 1 test related to the contents teach in the laboratory classes and discussed up to that time. This test covers the program content mentioned in point's 2 and 3 (Component II). The date for that test is 14 of November of 2018 at 14h30m.
b) At the time of normal or recourse examination, the test consists of the component and that relates to the contents taught in the theoretical classes mentioned in points 1 and 4 (component I) and the program mentioned in point 5 (Component III)
c) In each of the 3 tests, the student will have to obtain a minimum mark of 7.5 values. The final mark is the arithmetic mean of the 3 tests. To obtain approval in the course unit, it is necessary that the final mark is equal to or greater than 10 values.

Signature of Teacher:_____

d) In case of not being reached the minimum mark of 7.5 values in the component realized during the semester, it is necessary to respond in addition to this component in the test realized at the time of examinations. Students who have obtained in this test a mark of 7.5 or higher, it is at their discretion to repeat this component under examination, but only the last note obtained is considered, whether higher or lower than the one obtained previously.
e) In order to opt for this method of evaluation, a maximum of 2 absences are allowed to the laboratory classes effectively taught (1 lack in the CNC component and 1 lack in the CAM component).

Case II

a) The test is composed of a part evaluated by written test at the examination date (component I and component II) and by a component evaluated by individual laboratory work (component III), to be carried out after the examination, on a date to be combined with the teacher.
b) There is no minimum number of laboratory classes attended.
c) The final grade is the arithmetic mean of the 3 components performed, being necessary to obtain a minimum grade of 7.5 values each component.

In special periods of exams it is mandatory to carry out all the components, whether students choose the evaluation method defined in case I or II

Conditions for Results Improvement

The improvement of classification may take place through the performance of a new examination exam, under the conditions defined for case II.

Date	**Signature from the lecturer responsible for the course**
17/09/2018	

Signature of Teacher: M.T. Outeiro

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Licenciatura – BsC Engenharia Electromecânica

Licenciatura – BsC Electromechanical Engineering

Academic Year: **2018 / 2019**

Program Contents

Course Unit INDUSTRIAL ELECTRONICS

Specialization (s) ELECTRICAL ENGINEERING

Subject type Speciality **Research Area** Mechanical Engineering
Electrical Engineering

Year 3rd **Semester** 2nd **ECTS** 6

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures		
Practical-Laboratoty Lectures	2	28
Tutorial Orientation		
Project	4	56
Total of Working Hours		156

Unaccompanied Working Hours

Activity Type	Total Hours
Study	42
Works / Group Works	55
Project	
Evaluation	3
Additional	

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Maria Teresa Outeiro	PhD	Adjunct Professor
Theoretical-Practical Lectures			
Practical-Laboratory Lectures	Maria Teresa Outeiro	PhD	Adjunct Professor
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) Maria Teresa Outeiro, PhD

Goals

Power electronics systems deal with the process of converting electrical power from one form to another. The syllabus reflects the learning objectives of curricular unit.
This curricular unit will start by remembering the basics of power semiconductor devices.
The first presented converter will be the rectifier (ac-dc converter). The discussion of line-current harmonic distortion and input power factor in nonlinear loads will be an important topic for the students' curriculum. Then dc-dc converters and inverters (dc-ac converters) will be introduced. Throughout the course there will be some classes related to power converter modelling, simulation and control, providing to the students basic technical knowledge on the design and implementation of power electronic converters. With the knowledge provided in this curricular unit, the students will be able to have an integrated view of power generation and conversion systems, particularly from the electronic control point of view.

Skills

The balance between the presentation of theoretical aspects in classroom lectures and the development of knowledge by students through practical problem solving as well as the execution of simulation and laboratory works, allows a solid learning of the fundamental aspects of the power electronic converters operation, design and control.
It is expected that, with the acquired knowledge and the possibility of analyzing the operation of real converters, the students will be able to understand, design and evaluate the performance of power electronic converters.

Signature of Teacher: MT. Barroca

Program Contents

1. Overview of Power Electronics Devices : Seminconductor Devices and Passive Components
2. AC-DC Converters
2.1. Non-controlled rectifiers (diodes).
2.2. Semi-controlled and full-controlled rectifiers (diodes and thyristors).
2.3. Line-current harmonic distortion and input power factor in nonlinear loads.
3. DC-DC Converters
3.1. Introduction, technologies, power topologies and power levels
3.2 Non-isolated topologies
3.3 Isolated topologies
4. DC-AC Converters
4.1. Half-bridge and Full-bridge single-phase Inverter
4.2. Modulation strategies
4.3. Full-bridge three-phase, two and multi-level Inverters
5. Other Converter Topologies
6. Applications
7. Power converter modelling, simulation and control basics

Bibliography

- Electrónica Industrial - Ciryl Lander
- Elements of Power Electronics -Joseph Vithayathil
- Power Electronics: Converters, Applications, and Design, Ned Mohan
- Power Electronics: Circuits, Devices and Applications, Muhammad Rashid
- Ahmed, Ashfaq; Eletrônica de Potência.

Access Conditions and Attendance Excuse

For students in special conditions (working students, fireman or others) exceptional actions/evaluation procedures are available and defined in the regulation imposed by ISEC-IPC

Conditions for Exam Admission

50% average in the Laboratory component

Evaluation Method

Final written exam (70%); Laboratory reports and individual assignments (30%)

Conditions for Results Improvement

Students can only improve the final written exam

Signature from the lecturer responsible for the course

Date 21.01.2019

Maria Teresa Duarte Barroca Delgado

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher:

Licenciatura – BsC em Engenharia Eletromecânica (Português)

Licenciatura – BsC in Electromechanical Engineering (Inglês)

Academic Year: **_2018_/_2019_**

Program Contents

Course Unit ENERGY MANAGEMENT

Specialization (s)

Subject type Mandatory **Research Area** Electrical Engineering

Year 3st **Semester** 2nd **ECTS** 4

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures		
Practical-Laboratoty Lectures	2	28
Tutorial Orientation		
Project		

Unaccompanied Working Hours

Activity Type	Total Hours
Study	26
Works / Group Works	20
Project	
Evaluation	2
Additional	

Total of Working Hours 130

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	António Manuel Ferreira Simões de Almeida	MSc	Adjunct Professor
Theoretical-Practical Lectures			
Practical-Laboratoty Lectures	António Manuel Ferreira Simões de Almeida	MSc	Adjunct Professor
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) António Manuel Ferreira Simões de Almeida

Goals

The main aims of this course unit are:
To familiarize students with the basic concepts of energy management.
To help students to develop the knowledge and analytical skills needed for a successful career in the energy sector, in terms of energy policy analysis and energy management.

Skills

At the end of this course unit is the learner is expected to be able:
To become familiar with the concepts related to energy use and efficient use of energy; To analyze electricity bills ; To know how to prepare and perform energy audits.
To know how to apply energy consumption rationalization plans.
To investigate and choose efficient technological solutions and be able to argue with the employer or client.

Program Contents

Introduction to Energy Management.
Importance of Various Sectors of the Economy in the Global Energy Consumption.

Energy Rate Structures. The Portuguese Fees. Electric Bill Analysis
Energy Audits: Methodology and Equipment. Methods for Estimating Energy Savings. Economic Analysis.
Energy Consumption Rationalization Plan.
Efficient Use of Electricity: Lighting; Driving Force; Other equipment; Solutions for Energy Recovery. Portuguese legislation about Energy Efficiency.
Demand-Side Management (DSM): Concepts; DSM Planning and Implementation.

Bibliography
Teaching support material provided during classes.
Energy Management Guide, ISEC 1-9-148– 14870.
Manual of Practice for Energy Efficiency (in Portuguese), BCSD Portugal/ ISR Coimbra, 2005.
Updated regulations and legislation.
Dulce Coelho. Energy Audits (in Portuguese), 2000, ISEC 1-9-20.
Dulce Coelho, Demand-Side Management – Impacts on Production Planning, 1998. ISEC 1-9-21
Dulce Coelho. Energy Efficiency in Motor drive Systems (in Portuguese), ISEC 2005.

Access Conditions and Attendance Excuse
In the case of student-worker students the conditions of participation in the classes will be combined between the teachers and students, in the first week of classes, and according to the current legislation.

Conditions for Exam Admission
Obtaining the minimums in the laboratory component. Participation in at least 75% of practical classes.

Evaluation Method
Written exam (without consultation) - normal final exam, recourse or special - 50% - 10 points, with a minimum of 40%.
Continuous evaluation of the laboratory component - 50% - 10 values, with a minimum of 40%.

Conditions for Results Improvement
The conditions for improvement of classification are those expressed in the law.

Date	**Signature from the lecturer responsible for the course**
2019-01-18	António Manuel Ferreira Simões de Almeida

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher:

Licenciatura – BsC Engenharia Eletromecânica (Português)

Licenciatura – BsC Electromechanical Engineering (Inglês)

Academic Year: **2018/2019**

Program Contents

Course Unit DESIGN OF ELETRICAL INSTALLATIONS

Specialization (s) ELETRICAL ENGINEERING

Subject type **Research Area**

Year 3rd **Semester** 2st **ECTS** 6

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	1	14
Theoretical-Practical Lectures		
Practical-Laboratoty Lectures	2	28
Tutorial Orientation		
Project		

Unaccompanied Working Hours

Activity Type	Total Hours
Study	14
Works / Group Works	
Project	72
Evaluation	2
Additional	

Total of Working Hours 130

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Cristina Isabel Ferreira Figueiras Faustino Agreira	PhD	Adjunct Professor
Theoretical-Practical Lectures			
Practical-Laboratoty Lectures	Cristina Isabel Ferreira Figueiras Faustino Agreira	PhD	Adjunct Professor
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) Cristina Isabel Ferreira Figueiras Faustino Agreira

Goals

Design Low Voltage electrical installations in residential, commercial and industrial buildings. Concepts and Design the Distributions in Low Voltage
Design and dimensions of the Transformers Stations.
Design telecommunication facilities in buildings (ITED).
Use and apply the Technical Rules on the charging of electric vehicles.

Skills

Be able to design Low Voltage electrical installations in residential, commercial and industrial buildings.
Distributions in low voltge
Be able on concepts and Design the Distributions in Low Voltage
Be able to design and dimensions of the Transformers Stations.
Being able to design telecommunication facilities in buildings (ITED)
Understand and apply the Technical Rules on charging of electric vehicles correctly.

Signature of Teacher:

Program Contents

1 - Technical Rules for Low Voltage Electrical Installations
Design of electric conductors
Design of electrical installations
Protective equipment
Overcurrent and overload protection in electrical circuits
Design of protection of electrical installations
Charging of electric vehicles
Grounding system
Protections sensitive to fault currents
2 – Security Regulation of the LV distribution networks
Dimensioning of Electrical Conductors
Protection Equipment
Overcurrent and overload protection in electrical circuits
Design of protection of electrical installation
3-Telecommunications Installations in Buildings
General information on telecommunications facilities in buildings
ITED Basics
ITED Manual

Bibliography

Technical Rules for Low Voltage Electrical Installations
Regulation on the Safety of Electric Power Distribution Networks in Low Voltage.
Technical specifications
ITED Manual
Notes provided by the Teacher.

Access Conditions and Attendance Excuse

Available conditions at REATA

Conditions for Exam Admission

Available conditions at REATA

Evaluation Method

Theoretical Part: Exame for 5 Values: Minimum required: 2.5 Values
Practical Part: Project of Electrical Installations of a Residential Building and of Commercial Establishment, and LV Project -7.5 Values,
Project of Electrical Installations of an Industrial Complex - 7.5 Values
The two projects will be presented and discussed in the last, practical semester class.
The final classification obtained will be as follows:

CF = CT + CP

Where: CF - Final Classification
CT - Theoretical Classification
..... CP - Practical Classification

Conditions for Results Improvement

Improving the theoretical part of the Classification can be obtain with the student enrollment in the theoretical examination of the appeal period. The improvement of the Classification of the practical part requires the presentation and discussion of one (or more) new project (s).

Date	Signature from the lecturer responsible for the course
11/01/2019	

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher:_____

Licenciatura – BsC Engenharia Eletromecânica (Português)

Licenciatura – BsC Electromechanical Engineering (Inglês)

Academic Year: **2018/2019**

Program Contents

Course Unit INDUSTRIAL ECONOMICS AND MANAGEMENT

Specialization (s)

Subject type Complementary Sciences **Research Area** Electrical Engineering

Year 3.º **Semester** 2.º **ECTS** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	2	28
Practical-Laboratoty Lectures		
Tutorial Orientation		
Project		

Unaccompanied Working Hours

Activity Type	Total Hours
Study	64
Works / Group Works	7
Project	
Evaluation	3
Additional	

Total of Working Hours 130

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	Elsa do Carmo Santos Pedroso	PhD	Invited Assistant Professor
Theoretical-Practical Lectures	Carlos Alberto da Rocha Lebres	MSc	Guest Assistant
Practical-Laboratoty Lectures			
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s)

Elsa do Carmo Santos Pedroso

Goals

- Providing an overview of the organizations and the management in the context of contemporary societies.
- Understand and analyze the main concepts and theories within the framework of the functions of the management process: planning, organization, direction and control.
- Understand the main features of Operations Management to integrate them into a product, process and asset flow perspective.
- Promote the acquisition of basic and specific knowledge in the functional area of the operations in organizations, particularly the business ones.
- Understand the concepts and techniques used in the management of this function, especially in an information flow perspective and information systems.
- Understand the problems associated with the various functions of Operations Management, namely aspects related to the organization and planning of production.
- Understand the concepts, methods and criteria for the preparation and disclosure of standardized accounting information.
- Understand the relevance of Management Accounting to support managers' decision-making in today's business environment.
- Understand how the cost of products and services is determined and how this information can be used by managers to make decisions.

Signature of Teacher:_____

- Understand, analyze and use methodologies, techniques and evaluation models for corporate financial management.
- Develop analytical capacity, both in the internal aspects of business finance (financial diagnosis) and external (business analysis).
- Use the concepts of updating, capitalization and cost of capital to evaluate investment and financing decisions.

Skills

- Plan and coordinate projects.
- Define project performance metrics and evaluate results.
- Budgeting, supervision and management of works.
- Design, execute and maintain production organization and team management solutions.
- Launch new products.
- Design and implement annual budget and variance calculation
- Design, execute and maintain measures to critically analyze the company's performance and operational practices.
- Prepare the financial documents related to strategic financial decisions and cash budgets.
- Know and understand the functioning of the different economic mechanisms, the behavior of companies and consumers.
- Apply methods of management and economic and financial analysis in companies and organizations.

Program Contents

Accounting and Analysis of Investments

1. Commercial Companies

Scope of application. Personality and ability. Partnership agreement. Companies by quotas. Anonymous society. Individual entrepreneurs.

2. Financial and Management Accounting

Financial flows in business activity. Functions, divisions and general principles of accounting. Accounting Normalization. Notion. Advantages and disadvantages. The Normalization of Accounting in Portugal. The Accounting Standardization System (SNC). Study of the accounts of the CNS. Elements of the Financial Statements within the scope of the SNC. Swing. Demonstration of Results by Natures. Income Statement by Functions. Statement of Changes in Equity. Statement of Cash Flows. Attachment. Principles of Financial Management. The main concepts of profitability of the company. Cost-volume-results. Critical point. Ratios.

3. Economic investment decision

Essential economic parameters. Free means of investments. Maps of the financial flows of investments. Methods of economic decision evaluation - Net Current Value (NPV), Internal Rate of Return (IRR), Payback Period.

Operations Management

4. Principles of Operations Management

Strategy. Design of Products and Services. Location and implementation of the means of production. Implantation: Importance of the study; Several aspects of the problem; Circulation of materials; Circulation of people; Savings of personnel; Quality of work; Work conditions; Management and control facilities; Construction and installation costs; Ease of conservation; Possible magnification. Implementation of workshops: Different types of implementation; Deployment depending on the type of industry; Implantation according to the production organization; Functional implantation; Deployment in chain. Online production; Products at a fixed post; Assembly line at fixed stations; Method of work in the study of the implantation of workshops; Analyze; Looking for a solution; Calculation of implantation surfaces; Chain method; Method of fictitious ranges; Use of models; Study of a chain implantation; Calculation of saturation and balance of the stations; Calculation of the chain rhythm; Calculation of intermediate stocks; Study of material resources. Deployment of warehouses: Method of work for the study of the implantation of warehouses; Methods of ordering in warehouses; Examples of ordering plans; Storage materials; Warehouses outside. Aggregate planning.

5. Planning and Project Management

Project management. Creation, evaluation and selection of projects. Phases of a project. Project organization: management structure; documents and information flows; progress reports and monitoring reports. Project networks. Planning and control: times, resources and costs. The PERT method. Gantt and load diagrams. The CPM method.

6. Materials Management

Stock classification models. Components of stock management models. Deterministic models (instantaneous / non-instantaneous replacement, with / without breakage allowed). Stochastic models (order-level and cyclic revision policies). Global and partial optimization models. Demand forecasting methods. Time series. Forecasting techniques for constant level, linear trend, constant level models with seasonal effects. Linear regression. Nonlinear regression. Management of dependent demand stocks (MRP).

Signature of Teacher:_____

Bibliography

- Roldão, Victor Sequeira - Planeamento e Programação da Produção, Edição Monitor.
- Chase, R. e Aquilano, N. (1997) - Gestão da Produção e das Operações - Ed. Monitor.
- CAMPOS, Torres de - *PERT e CPM*, LNEC.
- Schroeder, Roger - *Operations Management*, McGraw-Hill.
- MICHELLE, Pierre - *Estudo de Implantações de Empresas.*
- Menezes, Caldeira - *PRINCÍPIOS DE GESTÃO FINANCEIRA*, Editorial Presença.
- Barros, Hélio – Análise de Projectos de Investimento, Edições Silabo, 4.ª Edição, 2008
- Rocha, D.; Azevedo, G.; Rodrigues, A. M. - Contabilidade para Todos, Almedina, 2.ª edição, 2016.
- Borges, António e outros - Elementos de Contabilidade Geral (26.ª edição), Áreas Editora, 2014.
- Lisboa, J. e outros - Introdução à Gestão de Organizações, Vida Económica, 2016.
- Rodrigues, João - Sistema de Normalização Contabilística – SNC Explicado (6.ª edição), Porto Editora, 2016.
- The slides used in the class will be available for downloading at the course website.

Access Conditions and Attendance Excuse

Not available.

Conditions for Exam Admission

Not available.

Evaluation Method

Individual work (IW) for bibliographic review on a topic related to the Operations Management programmatic content, individual written test (IWT) related to the programmatic contents of Accounting and Analysis of Investments and individual written examination (EX).

The final classification (CF) results from the weighted sum of the previous elements:

$$CF = 0{,}1 \times IW + 0{,}1 \times IWT + 0{,}8 \times EX$$

The passing of the course implies a minimum grade of 9.5 points.

Individual work:

Papers should be between 10 and 15 pages (Times, 11 points and 1.5 spacing). Any annexes or figures that occupy a considerable part of the space are not considered here, and should be presented in a technical report format, with an adequate structure.

Individual work must be delivered electronically and in paper format by May 13, 2019.

Individual written test:

The individual written test will focus on the programmatic contents of Accounting and Analysis of Investments and will be on April 11, 2019.

Conditions for Results Improvement

The improvement of classification implies the repetition of the individual work of bibliographical revision, of the individual written test and of final examination in one of the times predicted.

Date **Signature from the lecturer responsible for the course**

21-01-2019

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Signature of Teacher: 

Licenciatura – BsC Engenharia Eletromecânica (Português)

Licenciatura – BsC Electromechanical Engineering (Inglês)

Academic Year: **2018 / 2019**

Program Contents

Course Unit: Internal Combustion Engines

Specialization (s): Internal Combustion Engines

Subject type: Specialty Unit **Research Area:** Internal Combustion Engines

Year: 3rd **Semester:** 2nd **ECTS:** 5

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures	2	28
Theoretical-Practical Lectures	2	28
Practical-Laboratoty Lectures	1	14
Tutorial Orientation		
Project		

Unaccompanied Working Hours

Activity Type	Total Hours
Study	28
Works / Group Works	28
Project	
Evaluation	4
Additional	

Total of Working Hours 130

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures	António Santos Simões	PhD	Adjunct Professor
Theoretical-Practical Lectures	António Santos Simões	PhD	Adjunct Professor
Practical-Laboratoty Lectures	António Santos Simões	PhD	Adjunct Professor
Tutorial Orientation			
Project			

Responsible(s) Lecturer (s) António Santos Simões

Goals

General goals:
1-To discuss working principles of internal combustion engines found in many practical applications; 2- To evaluate the functioning states of an engine, assuring desired standards of quality; 3- To facilitate an easy integration in the labor market in the segment of the automobile maintenance and repair companies, road transports enterprises and automobile components / systems manufacturers; 4- Capacity to pick up, to select and to interpret important information to justify the recommend solutions and the emitted diagnoses; 5- To facilitate the formation along the life, supported in new technologies in the ambit of the internet, new informatics programs and audiovisual means.

Specific goals:
1-To provide fundamental information dealing with recent concepts of combustion engines and tools for their optimization, especially considering mixture formation, combustion and gas exchange principles; 2-To understand the constructive details and working principles; to evaluate the operation states, in view to assure the quality patterns; capacity to install and to operate reciprocating engines; to know to intervene, through simple projects, in the power management and to mitigate consumptions and environmental impacts; to know to answer to the maintenance needs and repair; to know to select the different engine components and systems; to know to accompany the technological evolutions; 3-To know to analyze the engine performance and to study its characteristics; 4-To estimate, in an experimental part, the performance of both spark ignition and compression ignition engines and to understand the effect of some parameters on engine performance like ignition timing, air/fuel ratio, compression ratio and perform an energy balance of the engine.

Skills

A) Generics skills:

The development of competences is gotten through theoretical lessons with discussion of themes and theoretical-practical lessons with a component of physical engines description and another of resolution of theoretical-practical exercises. The practical works performed in laboratory classes will be initially presented by the teacher and later on repeated by the students' groups.

B) Specific skills.

The student should be able to:

1- To know to understand and to apply the laws of thermodynamics, mechanics of fluids and heat transmission, in internal combustion engines

2- To know the various parameters used for identifying engine performance and their measurements.

3- To identify the major factors that help improving engine performance.

4- To have fundamental knowledge about the combustion process in SI and CI engines.

5- To understand a mathematical model for the ideal and fuel-air cycle and study the effect of certain parameters on engine performance.

6- To know identify, to understand the operation and to know to select different engine types.

7- To have capacity to install, to operate and to make internal combustion engines maintenance and repair.

8- To know to accomplish mensuration, to instrument and to control the operation of internal combustion engines.

9- To understand the existent relationships between car engine parts functions and the properties of the materials used in its production.

10- To understand the necessities of maintenance and repair of internal combustion engines

11- To know to apply techniques of fault detection in internal combustion engines.

12-The developed aptitudes, integrated with others course units, promote capacities in the sense to assure good patterns of efficiency in car repair shop management activity, as well as in the fleet technical services of road transports. The students will be enabled to accomplish the following laboratory works:

a) Compression and tight tests. b) Rehearsals and diagnosis of mishaps in motors. c) Engine testing on dynamometer bench.

Program Contents

PART I – ENGINES THEORY

1. Function, operation and design of internal combustion engines. Evolution, classification and nomenclature of actual engines. Intake and exhaust processes. External and internal heat supply. Heat transfer.
2. Ideal analysis of thermodynamic cycles.

   Fundamental operating principles of closed and open thermodynamic system. Energy equation for open system. Principles of positive displacement engines. Engine simulation. Ideal and real cycles. Thermal efficiency. Mean pressure. Generalized cycle. Ideal Otto cycle. Ideal Diesel cycle. Ideal Dual cycle or Sabatté cycle. Analysis and comparison of the ideal cycles. Air cycle.
3. Fuels, combustion, working fluid and emissions.
4. Fuel and additive characteristics. Heat and energy flow in the internal combustion engine process. Various fuel types as energy source. Different combustion systems with its particular heat release. Mixture formation of spark ignition and diesel engines. Fuel chemistry. Combustion chemistry and stoichiometry. Air excess. Dissociation - CO formation.
5. Characteristic numbers of internal combustion engines: Octane number and cetane number. Specific mass and calorific power. Other characteristics.

   Working fluid. Composition. Atmospheric air. Stequiometric and real combustion air / fuel relation. Air-fuel mixture formation in the SI e SI engines. Elementary combustion reaction and respective combustion products.
6. Engine friction, lubrication and cooling.

   Principal mechanisms of heat flux. Calculation methods of heat transfer, heat conduction and thermal stresses. Components under friction. Boundary and hydrodynamic lubrication. Lubricating oils. Properties and classifications. Viscosity and viscosity index. Oil additives Lubricants choice and use. Layout of lubricating systems and their components

   Cooling. Layout of cooling systems and their components.
7. Real cycles. Pressure diagrams.

   Characterization of the processes that integrate the real cycle. Indicated cycle and indicated mean pressure. Fault diagnosis based on indicated diagram exam. Pressure diagram inside the cylinder in function of the angular displacement of the crankshaft for 2-stroke and 4-stroke engines. Indicated cycle prediction.
8. Geometric and performance characteristics. Engine energy balance.

   Engine designs: four-stroke and two-stroke reciprocating engines; Wankel engine. Kinematics of internal combustion engines. Crankdrive mechanism. Reciprocating inertia forces and its influence in the engine torque. Resulting forces diagram.

Indicated parameters, mechanical losses, absorbed power and effective parameters. Characteristic curves. Brake thermal efficiency. Consumptions in SI and CI engines. Friction losses and piston rings sealing principle Decomposition of engine work and resulting engine efficiency into thermodynamic and mechanical factors. Analysis of losses. Influence of charge exchange, volumetric efficiency, supercharging, Maps of engines Volumetric efficiency. Exhaust Gas Recirculation (EGR). Valve train diagram. Gas exchange, ports and valves, valve gear timing. Valve train types. Stability in the engine operation. Phase variators. Engine energy balance.

Similarity rules and indices in order to layout engines and to estimate mechanical power limits.

Four stroke engines: Spark-ignition (SI) engines and compression ignition (CI) engines.

Function, classification and operation. Combustion chambers. Mixture preparation for SI and CI engines - principles and control. Fuel feeding systems. Carburadores. Sistemas de injecção. Direct injection stratified charge engines. HCCI Engine ignition systems at SI engines Combined electronic injection ignition systems. Engines with hybrid combustion processes. CI engine injection systems. Direct injection (DI) systems. Indirect injection (IDI) systems. Fuel injection equipment (injectors, injection pumps, common rail systems).

Two stroke engines.

Geometries and components. Types of scavenging. Crankcase compression.

9. Supercharging and turbocharging systems.
   Justification. Types of compressors. The turbocharger. Feeding pressure control.
10. Ecological parameters and anti-pollution systems.

    Combustion in ICE. Air pollutants formation and their treatment and control. Pollutant emissions. NOx formation. Unburned hydrocarbon sources. Soot formation. Characteristics of petrol. In-vehicle performance of fuels. Characteristics of diesel fuel. Diesel fuel additives. Alternative diesel fuels.

    Exhaust gas after treatment for different types of engines. Pollution reduction methods and technologies. Engine noise.

    Fuel cells.
11. Engine performance testing and characteristics.

    Experimental means used in the characteristic curves determination. Dynamometric bench. Brake horsepower and its mensuration: Friction dynamometer (Prony), hidraulic chassis dynamometer (Froude), electric chassis dynamometer and e aerodynamic chassis dynamometer.

PART II – ENGINES DESCRIPTION / THEORETICAL- PRACTICAL EXERCISES

12. Engines description. Engines structure and construction. Engine components. Knuckle-crankshaft system.
    Cylinder block. Cylinder head; Cylinders, Pistons and its dimensions. Number and disposition of the cylinders. Crankshaft - Connecting Rod system and its more common defects.
13. Distribution system of working fluid.

    Different mechanisms of distribution of the working fluid. Kinematics of valve train and crank train. Valve train systems (valve types, valve-operating systems, dynamic behaviour of valve train). Flow characteristics of poppet valves. Valve timing (effects of valve timing, variable valve timing). Manifold design. Two stroke engines. Scavenging systems. Port flow characteristics. EGR. Main faults associated to the valvtrain system.
14. SI fuel feeding and ignition systems.

    Gasoline engines fuel feeding systems. Port and direct injection. Spark ignition systems. Conventional ignition. Electronic and transistorized Ignition. Automatic ignition timing advance. Spark plugs.
15. CI fuel feeding systems.

    Diesel engines fuel feeding systems. Theories and principles of the diesel fuel injection pump, fuel injection nozzle, fuel injection components and controls. Incandescent plugs. Diagnosis and adjustment of fuel systems utilizing available tools and computer technology. Identification and function of components involved in fuel systems.
16. Engine Auxiliary Systems: Engines cooling systems; Engine lubrication systems; Engine starting and charge systems.
    Engines cooling systems description; lubrication systems description; Engines starting methods. Starting motor. Starting systems failure and its resolution.
17. Theoretical-practical exercises:
    - Firing order for the different cylinders.
    - Calculation of the main points of the cycles. Calculation of the ideal thermal efficiency. Calculation of mean cycle pressure.
    - Calculation of displacement, combustion chamber, total volume and compression ratio.
    - • Calculation of fluid force, inertia force and resulting force in the piston / connecting rod / crank system. Calculation of normal force, tangential force and motor torque.
    - • Calculation of the distance traveled by the piston, cylinder lateral surface, connecting rod obliqueness, instantaneous piston speed, average piston speed, piston acceleration and alternating inertia force as a function of the crankshaft angular displacement.
    - • Selection of motors.
    - • Calculation of effective power and engine torque as a function of effective mean pressure.
    - • Repair of an engine. Selection of new pistons and head gasket. Influence on effective mean pressure and effective power.
    - • Calculations of yields (including volumetric), air mass flow rate, mass flow rate of fuel (consumption) and air / fuel ratio.
    - • Thermal balance.

PARTE III – ENGINES LABORATORIES

18. Practical works in laboratory.
19. Methods of analysis of engine performance.

Practical experience with engines in diagnosing, disassembling, assembling, tuning and repairing equipment assembly and tuning of engines.

- Use of manufacturer's specifications and repair manuals as well as methods of equipment overhaul. Involves performance testing, diagnostic testing before and performance testing after repair.
- Methods of engine testing.

Test hardware. Compression and tight tests. Electrical / electronic injection and ignition control. Motor starting analysis. Oscillograms analysis, Power balance between cylinders. Escape gases analyses. Engine curves characteristics determination

Bibliography

- MARTINS, Jorge – Motores de Combustão Interna, Publindústria, 2ª. Edição, 2006, ISBN 972-98726-8-6.
- HEYWOOD, John B. - *Internal Combustion Engine Fundamentals*, McGraw Hill, 1988, ISBN: 0-07-100499-8.
- LUCCHESI, Domenico - *O Automóvel - Curso Técnico,* vol. 1 e 2, Editorial Presença, 1989.ISBN: 972-23-1022-4 e 972-23-1045-3.
- BOCCHI, Giuseppe - *Motori a Quattro Tempi*, Hoepli Editore, ISBN: 88-203-1533-5.
- GIACOSA, Dante - *Motores Endotérmicos*, Editorial Dossat, S.A., 3ª. Edição, 1986, ISBN: 84-237-0382-7.
- ÇENGEL, Yunus A.; BOLES, Michael A. - *Thermodynamics, an Engineering Aproach*, McGraw Hill, 1994, ISBN: 0-07-113249-X.
- ARIAS-PAZ - *Manual da Técnica Automóvel*, Editora Mestre Jou, ISBN: 84-89656-09-6.
- STONE, Richard – *Introduction to Internal Combustion Engine*, Macmillan Press, Ltd., Second Edition, 1992, ISBN 0-333-55084-6.
- ROGOWSKI, A.R. – *Elements of Internal combustion Engine,* ISBN 07-053575-2.
- BERNARD, Adam – *Motores Diesel*, ISBN 84-7214-047-4.
- LICHETY, Lester C. – *Combustion Engine Processes,* McGraw Hill, ISBN 07-037720-0.
- Power Point slides.

Access Conditions and Attendance Excuse

In order to obtain attendance, students must reach a minimum of 75% attendance in the theoretical, theoretical-practical and laboratory classes. The following students are exempted from attendance: student workers, associative leaders, firefighters, students classified in other situations provided for by law or in cases of justified absence due to illness or family support, if duly substantiated.

Conditions for Exam Admission

Unrestricted for student students, associative leaders, firefighters, students classified in other situations provided for by law or in a situation of justified absence due to illness or support to the family, provided duly proven.
With a minimum attendance of 75% of attendance in the total hours of classes of the curricular unit, in all other cases. However, repeating students who, in the previous school year, obtained a minimum attendance of 75% of attendance in the total hours of classes of the course unit, are exempt from fulfilling this requirement.

Evaluation Method

In addition to the final exams provided for in the ISAC REACTA, there is a continuous written assessment system consisting of 2 tests, which require a minimum of 75% attendance in all theoretical, theoretical-practical and laboratory classes. have elapsed. These tests may exempt the student from the final written exam.
The test schedule is as follows: the first test will be held in the theoretical-practical class in the week beginning March 25, 2019 and the second test in the theoretical-practical class in the week beginning May 20, 2019.
The competencies inherent to the laboratory component are assessed through the execution of a work / report with 3 parts. The document will be written in Word format, for each of the groups of 2 to 4 students and complemented with a synthesis / presentation, in Power-Point file. The quality shown in the preparation of the report and in its oral presentation, together with the group's performance in its oral argument / defense, will dictate the classification given in this component.
The practical works are specified in the Program Contents, Part III - Engine Laboratories, refer to those mentioned in sub-points 18.2.1 and 18.2.2 and point 18.3, and will be delivered to the teacher in digital format and on paper until 9:00 pm on June 11, 2018. The presentations and defenses / discussions of the reports of the practical works, in reverse order of delivery, will take place on June 3 to 7, 2019.
In the final exams, each written exam will have a maximum duration of 3 hours and will consist of a theoretical component and a theoretical-practical component. Each of the two components will have the quotation of 10 values.

The student's approval, by continuous evaluation and / or the final exam, is subject to the following requirements:
a) To obtain frequency, when it does not enjoy a dispensation by law;
b) To obtain a minimum of 30% of the quotation in each of the components: theoretical and theoretical-practical.
c) To have reached a minimum of 8.5 values in the average of the classifications of the 2 tests or in the final exam. (A);
d) A minimum of 7.5 values in the classifications of each of the 2 tests;
e) Average rating of not less than 10 values, on a scale of 0-20 values, in the practical-laboratory component (B).
f) A minimum of 9,5 values in the "Final Classification of UC", calculated by the following equation:

Final classification of UC = 0.75 * A + 0.25 * B

A-Classification in written test (s); B - Classification in the laboratory part. The latter includes 2 components: B.1) Classification by performance in laboratory classes (20%); B.2) Preparation, presentation and oral discussion, by working groups, of a written report referring to laboratory classes (80%).

NOTES:
1) In the practical component students can only use scientific calculators.
2) In the continuous evaluation, each student can only make and defend reports of experimental works, in which he has participated.
3) When the student has not reached a minimum of 7.5 values in the classifications of each of the 2 tests, he / she will have to do final examination on all the Programmatic Content.

Conditions for Results Improvement

In accordance with REACTA, all students can propose to obtain an improvement in classification.

Signature from the lecturer responsible for the course,

Date: 2019-01-16

António Santos Simões
(Professor Adjunto)

Signature of Teacher: 

Instituto Superior de Engenharia de Coimbra
www.isec.pt

Licenciatura – BsC Engenharia Electromecânica

Licenciatura – BsC Electromechanical Engineering

Academic Year: **2018 / 2019**

Program Contents

Course Unit PROJECT

Specialization (s)

Subject type Speciality **Research Area** Mechanical Engineering
Electrical Engineering

Year 3rd **Semester** 2nd **ECTS** 6

Working Hours

Activity Type	Working Hours Per Week	Total Hours
Theoretical Lectures		
Theoretical-Practical Lectures		
Practical-Laboratoty Lectures		
Tutorial Orientation		
Project	4	56
Total of Working Hours		152

Unaccompanied Working Hours

Activity Type	Total Hours
Study	18
Works / Group Works	
Project	80
Evaluation	2
Additional	

Lecturer

Activity Type	Name	Qualifications	Category
Theoretical Lectures			
Theoretical-Practical Lectures			
Practical-Laboratory Lectures			
Tutorial Orientation			
Project	Luis Manuel Ferreira Roseiro	PhD	Coordinator Professor
	Maria Teresa Duarte Barroca Delgado do Outeiro	PhD	Adjunct Professor
	Cristina Isabel Ferreira Figueiras Faustino Agreira	PhD	Adjunct Professor
	Vítor Manuel Maranha Lopes	MsC	Assistent

Responsible(s) Lecturer (s) Luis Manuel Ferreira Roseiro
Maria Teresa Duarte Barroca Delgado do Outeiro

Goals

This curricular unit aims to develop students' ability to apply the knowledge acquired throughout the course. The curricular unit also stimulates the capacity for analysis and critical thinking of students as well as their skills in organization, communication and teamwork. Wherever possible, the project work is carried out in collaboration with companies or other entities outside the school, looking for its implementation in a real context.

Skills

It is intended that students acquire a set of skills, which can be enumerated as follows:

- Apply the knowledge and comprehension skills acquired in the various courses of the BsC;
- Identify, analyze and solve problems, as well as build and substantiate the argumentation of the proposed solution;
- Search in a clear and objective way the available information, both at the level of publications of a technical-scientific nature, patents and utility models that involve the theme, as well as existing solutions in the market;
- Collect, select and interpret the relevant information to justify the recommended solutions and the judgments issued;

- Plan activities in space and time, identifying and managing their implementation;
- Get ability to integrate recent technological innovations in the professional intervention domain;
- Get ability to transmit information, ideas, problems and solutions, in a clear and objective way;
- Get ability to develop teamwork;
- Get ability to write clearly and succinctly a report describing the work developed.

Program Contents

Elaboration of a project work, concentrating on topics that include several areas of Mechanical Engineering and Electrical Engineering and correspond to concrete cases, involving the study, calculation and dimensioning of devices, mechanisms, equipment or installations. Students are acquainted with the design, development and implementation phases of a project, also taking into account their economic cost.

Methodology:
The students are divided into groups of two elements, and there may be, in justifiable situations, works individually elaborated or in groups of three students. To each group will be given a work with a topic previously defined by the advisory teacher in conjunction with the entities associated with the project, if this is the case. Each group will be accompanied and guided by a teacher of the curricular unit. Given the comprehensive nature of the curricular unit, in terms of engineering areas, the students will be guided by one or more teachers, being one of them responsible for the group's monitoring. The groups should preferably use the classes to carry out their projects and to analyze and discuss specific problems with the teachers. Teachers will be able to use some classes for the presentation of topics common to the various groups, such as the methodology of elaboration of the project, the structure of the report, norms and regulations, manipulation of calculation tools, among others. Students are encouraged to carry out bibliographic research, of a technical-scientific nature, as well as patents and existing utility models and existing solutions in the market. If relevant to the work in development, the experimentation and the construction of functional prototypes are valued.

Methodology:

The students are divided preferably into groups of two elements. In justifiable situations, works can be individually elaborated or in groups of three students;

Teachers will propose different work themes to carry out the project work, whose summary description will be made available on the Moodle platform. These subjects will also be exposed by the teachers in the first class of the curricular unit;

The groups of students choose, in order of preference, three themes to carry out the work. In case of a tie in the choice, the professors of the curricular unit proceed to the selection of the themes to be assigned to each group;

Considering the comprehensive nature of the UC, in terms of engineering areas, students may be guided by one or more teachers, and there is always a teacher who is responsible for the follow-up of the group;

Class attendance is mandatory and groups should preferably use the classes to carry out their projects and to analyze and discuss specific problems with the teachers;

Teachers will be able to use some classes for the presentation of topics common to the various groups, such as the methodology of elaboration of the project, the structure of the report, norms and regulations, manipulation of calculation tools, among others;

Students are encouraged to carry out bibliographic research, technical and scientific, as well as existing patents and utility models and existing solutions in the market;

Students are advised to participate in workshops and / or special lectures that take place at ISEC, and which are linked to the skills acquired in the context of the project curricular unit;

If it is relevant to the work in development, the experimentation and the construction of functional prototypes will be valued.

Bibliography

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Access Conditions and Attendance Excuse

N.A.

Conditions for Exam Admission

N.A.

Evaluation Method

The assessment of knowledge is based on a set of factors considered important in the context of the skills to be acquired during the course unit, namely:

• The student's motivation and participation in the development of the work;
• The quality and evolution of the project reports and presentation poster;
• The presentation and intermediate and final discussion of the work.

Intermediate evaluation of work

Each group will have to submit an intermediate progress report on the Moodle platform during the 7th week of classes, based on a template to be made available. At the time and date to be defined, during the 8th week, students should make a presentation of the evolution of the work, with a limit duration of 3 minutes. The presentation and the report will be discussed in front of the teachers. This evaluation will have a valuation of 10% of the CU.

Final evaluation of the work

Each group will have to submit in the Moodle platform a final report, in word and pdf format, until the following deadlines: 1st Phase: July 17, 2019; 2nd Phase: September 13, 2019.

The report should be written according to the template provided in the Moodle platform, with a limit of 30 pages of writing, from introduction to completion. The submission of the report will have to be made by 23:59 of the established deadlines.
From the work done, students should prepare a poster according to the template made available on the Moodle platform. The presentation of the work will be done by all groups that submitted the reports by the deadline established, at a date and time to be defined during the semester. The presentation will have as visual support one poster elaborated and printed, and the discussion will be done in front of the teachers of the curricular unit. The presentation cannot exceed 5 minutes and the discussion of each work 20 minutes. Although all elements of the group have to know the whole project, each of the students can be responsible for different parts of the project, presenting and defending its component in the final discussion. The final classification is therefore individual.

The project should be carried out, mainly, during the period of classes, so the groups should use the classes for this purpose.

Conditions for Results Improvement

The existing Regulations

Signature from the lecturer responsible for the course

Date 21.01.2019