

## A - General description

**Programme Title** – Mechanical Engineering

**Qualification awarded** – BSc degree (*Licenciatura*)

**Admission requirements** – General Application for Admission to Higher Education and average mark for national examinations.

**Educational and Professional goals** – Part A Educational and Professional goals.

This programme is intended to provide the students with strong practical and experimental foundations in areas such as:

- Computer-aided production, design and manufacturing;
- Structural project, machine parts and devices;
- Analysis, control, organization and production management;
- Automation and maintenance of industrial equipment.

Skills acquired during the programme prepare the students to exercise such functions as intermediate managers and develop into top management positions in industrial, commercial and services companies in related sectors, including:

- Project and industrial development (industrial automation, pneumatic networks, mechanical construction, moulding, product and equipment design, fluid networks, heating/air conditioning systems; electrical machines);
- Energetic and technological audits;
- Metallurgy and metalworking industries;
- Production and industrial organization

**Access to further studies** – Master's Degree

### Course structure diagram with credits (60 per year)

Course Title	Year	Semester	ECTS
Mathematical Analysis I	1	1	6
Mechanics and Waves	1	1	5
Programming	1	1	5
Technical Drawing I	1	1	5
Applied Chemistry	1	1	4
Linear Algebra	1	1	5
Mathematical Analysis II	1	2	6

Electricity and Electronics	1	2	5
Technical Drawing II	1	2	5
Statistical and Numerical Methods	1	2	4
Applied Mechanics I	1	2	5
Science and Engineering of Materials	1	2	5
Technical Drawing Applied to Mechanics	2	1	5
Mechanical Behaviour of Materials	2	1	4.5
Materials Technology	2	1	5
Mathematical Analysis III	2	1	5
Applied Mechanics II	2	1	5
Thermodynamics	2	1	5.5
Mechanics of Materials I	2	2	6
Fluid Mechanics	2	2	5
Hydraulics and Pneumatics	2	2	5
Heat Transfer	2	2	5
Industrial Organisation	2	2	4
Industrial Maintenance	2	2	5
Electrical Machines	3	1	5
Machine Parts I	3	1	5.5
Elective I (Mechanics of Materials II, Climate Control and Refrigeration, Instrumentation and Measurement, Vehicle Mechanics)	3	1	5.5
Elective II (Materials Bonding Technology, Electrical Installations, Vehicle Mechanics, Industrial Computer Systems, Thermal Machines)	3	1	5
Elective III (Casting Technology, Financial Management, Human Resources Management, Quality, Health and Safety, Vehicle Electricity and Electronics, Mechanical Technology I*, Quality Organization and Management*)	3	1	4.5
Elective IV (Casting Technology, Financial Management, Human Resources Management, Quality, Health and Safety, Vehicle Electricity and Electronics Mechanical Technology I*, Quality Organization and Management*)	3	1	4.5

Machine Parts II	3	2	5
Industrial Automation	3	2	4
Elective V (Tool-Machines, Plastic Conformation Processes, Engine Testing, Turbomachines, Industrial Robotics, Data Acquisition Systems, Mechanical Technology II*)	3	2	4
Elective VI (Tool-Machines, Plastic Conformation Processes, Engine Testing, Turbomachines, Industrial Robotics, Data Acquisition Systems, Mechanical Technology II*)	3	2	4
Elective VII (Technical English, French, German, Engineering Ethics, Oral and Written Communication, Introduction to Law, Public Relations, Investment Project Analysis*)	3	2	2
Training (Elective VIII)	3	2	11

(\*)Not available this year (2008/2009)

**Final examination, if any** – Not Applicable

**Final and continuous assessment regulations** – Not Applicable

**ECTS departmental co-ordinator** – Carlos Alexandre Campos Pais Coelho

<b>B - Description of individual course units</b>	
<b>Course title</b>	Mathematical Analysis I
<b>Course code</b>	912302
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	I
<b>Year of study</b>	1 <sup>st</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	6
<b>Name of lecturer</b>	Maria Helena Morgado Monteiro
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The students will learn to interpret data, to formulate and to solve problems connected with differential calculus and integral calculus of functions of one real variable.
<b>Prerequisites</b>	Secondary education-level Mathematics.
<b>Course contents</b>	Real functions. Differential calculus - definition, differentiation formulas, derivatives and its application (related rates, extreme values, extremum problems, graph of a function). Integral calculus - indefinite integral, definite integral (calculation of an area of a region between two graphs, a volume of a solid of revolution and length of a plane curve), improper integral.
<b>Recommended reading</b>	Anton, Howard, " <i>Cálculo, um novo horizonte</i> ", 6 <sup>a</sup> ed., Bookman, Porto Alegre, 2000. Larson, Ron e outros, " <i>Cálculo</i> ", vol. 1, 8 <sup>a</sup> ed., McGraw-Hill, São Paulo, 2006. Monteiro, Helena, " <i>Análise Matemática I, Apontamentos das Aulas Teóricas</i> ", ESTA, 2007.
<b>Teaching methods</b>	Presentation of the theoretical matter followed by exercise resolution under the teacher's guidance.
<b>Assessment methods</b>	Mid-term assessment (two mini-tests and two mid-term tests) and final assessment (examination).
<b>Language of instruction</b>	Portuguese

	<b>B - Description of individual course units</b>
<b>Course title</b>	Mechanics and Waves
<b>Course code</b>	912304
<b>Type of course</b>	One- semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	1st
<b>Semester/trimester</b>	1st
<b>Number of credits</b>	5
<b>Name of lecturer</b>	António Jorge Martins de Araújo Gomes
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The students will familiarise themselves with the course subject matters.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Classical Mechanics. Material-point Kinematics. Newtonian Dynamics. Conservative and Non-Conservative forces. Wave Motion. Electromagnetism.
<b>Recommended reading</b>	<i>Física - um curso Universitário</i> , Alonso & Finn, vol. I e vol II Edgard Blutcher (Ed.), <i>Física</i> , Halliday & Resnick, vols. I e II, Livros Técnicos e Científicos (Ed.); <i>Curso de Física II</i> , Maria Amélia Cutileiro Índias, McGraw-Hill (Ed.), 1994; <i>Vibration Engineering</i> , Andrew D. Dimarogonas, Livraria Escolar Editora (Ed.); <i>Mecânica Vectorial para Engenheiros: Estática</i> , Ferdinand P. Beer; E. Russel Johnston, Jr. McGraw-Hill (Ed.), 1998
<b>Teaching methods</b>	Lectures. Theoretical-practical sessions including case study analysis. Laboratory sessions – lab experiments
<b>Assessment methods</b>	Continuous assessment: Lab coursework Final assessment: Exam.
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Programming
<b>Course code</b>	912305
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	1 <sup>st</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Toni Santos Alves
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The students will be provided with necessary knowledge of algorithmic and programming to be able to use MatLab and LabView software to develop programs and to solve engineering problems in this environment.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Algorithmic, Programming C, Matlab and LabView.
<b>Recommended reading</b>	Handouts prepared by the lecturer. Victorine Viviane Mizrahi, Treinamento em linguagem C, MCGraw Hill
<b>Teaching methods</b>	Lectures and tutorials.
<b>Assessment methods</b>	Exam and works
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Technical Drawing I
<b>Course code</b>	912303
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	1st
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Luis Miguel Marques Ferreira
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Provide the students with solid computer-aided drawing (CAD) foundations so that they can use it as a support tool to other courses.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Standards for technical drawing. Geometric drawing. Orthogonal projections: European and American methods. Axonometric Perspectives. Cuts and sections. Dimensioning. Computer-aided drawing: Drawing commands, visualization, modification and edition. Text edition. Layers. Viewports. Block design. Dimensioning. User's coordinate system. Introduction to three-dimensional modeling.
<b>Recommended reading</b>	Silva, Arlindo; Dias, João; Sousa, Luís – “Desenho Técnico Moderno”, Lidel Cunha, Luís Veiga da – “Desenho Técnico”, Fundação Calouste Gulbenkian Manuais de Autocad 2D
<b>Teaching methods</b>	Lectures presenting the basic concepts using the episcope. Problem resolution resorting to CAD. Use of AUTOCAD as a work tool to apply theoretical concepts.
<b>Assessment methods</b>	Tests and individual assignments using CAD software. Minimum passmark is 7 (out of a 0-20 scale). Final mark is calculated as follows: Tests 60% + assignments 40%.
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Applied Chemistry
<b>Course code</b>	912306
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	1 <sup>st</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	4
<b>Name of lecturer</b>	Valentim Maria Brunheta Nunes
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Learn and develop basic knowledge of chemistry that will serve as a basis to other courses. Stimulate the study of chemistry as a science and show its importance for industry and society, in particular for the activity of the future Mechanical Engineer.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Basic chemistry tools. Atoms, molecules and ions. Chemical reactions and stoichiometry. Chemical bonding and States of Matter. Gases. Intermolecular forces, liquids and solids. Polymers. Chemical equilibrium. Acid – Base equilibrium. Electrochemistry. Introduction to corrosion. Surface treatments by electrochemical methods.
<b>Recommended reading</b>	Chang, R., Química, 8 <sup>a</sup> edição, McGraw-Hill, Lisboa, 2005 Kotz&Treichel, Chemistry and Chemical Reactivity, 5 <sup>th</sup> ed., Thomson Books, 2003 Simões, J.M., Guia do Laboratório de Química e Bioquímica, Lidel, 2000.
<b>Teaching methods</b>	Lectures and tutorials.
<b>Assessment methods</b>	Final written exam and reports of laboratorial activities.
<b>Language of instruction</b>	Portuguese. Possibility of tutorial lectures in English.



<b>B - Description of individual course units</b>	
<b>Course title</b>	Linear Algebra
<b>Course code</b>	912301
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	1 <sup>st</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Maria Isabel Vaz Pitacas
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The students are expected to learn how to use Matrices and Determinants in the resolution of linear equation systems, with particular application to analytical geometry. They must have basic notions of eigenvalues and eigenvectors.
<b>Prerequisites</b>	Secondary education level Mathematics
<b>Course contents</b>	Matrices: matrix algebra, LU decomposition, resolution of linear equation systems. Determinants: calculation, applications. Matrices, determinants, and analytical geometry: internal, external and mixed product; analytical layout of straight and horizontal lines; angles; distances. Eigenvalues and eigenvectors.
<b>Recommended reading</b>	Luís, Gregório e Ribeiro, C. Silva, "Álgebra Linear", McGraw-Hill, Lisboa, 1985 Monteiro, António e Pinto, Gonçalo, "Álgebra Linear e Geometria Analítica, Problemas e Exercícios", McGraw-Hill, Lisboa, 1997. Monteiro, Helena, "Álgebra Linear, Apontamentos das aulas teóricas", ESTA, 2003.
<b>Teaching methods</b>	Presentation of the theoretical matters followed by exercise resolution under the teacher's guidance.
<b>Assessment methods</b>	Mid-term assessment (two mini-tests and two mid-term tests) and final assessment (examination)
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Mathematical Analysis II
<b>Course code</b>	912307
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	II
<b>Year of study</b>	1st
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	6
<b>Name of lecturer</b>	Maria Helena Morgado Monteiro
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The students will learn how to solve problems connected with differential and integral calculation of functions with more than one real variable and to represent some functions by real power series.
<b>Prerequisites</b>	Mathematical Analysis I
<b>Course contents</b>	Differential calculus in $R^n$ - partial derivatives; differentiability; maxima, minima and saddle points, Lagrange's multipliers, tangent plane of a surface. Multiple integrals – definition, properties, evaluation and applications of the double integral and the triple integral (area of a plane region, volume of a solid; moments and center of mass of a thin plate and of a solid). Series: series of numbers and series of functions.
<b>Recommended reading</b>	Breda, A. e Costa, J., “ <i>Cálculo com funções de várias variáveis</i> ”, McGraw-Hill, Lisboa, 1996. Larson, R, “ <i>Cálculo</i> ”, vol 2, 8 <sup>a</sup> ed., São Paulo, McGraw-Hill, 2006. Monteiro, Helena, “ <i>Análise Matemática II, Apontamentos das Aulas Teóricas</i> ”, ESTA, 2007.
<b>Teaching methods</b>	Lectures and tutorials.
<b>Assessment methods</b>	Mid-term assessment (two mini-tests and two mid-term tests) and final assessment (examination)
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Electricity and Electronics
<b>Course code</b>	912325
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	1 <sup>st</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Toni dos Santos Alves
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	An introduction to electronics and electricity.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Basic definitions and conventions. Fundamentals of passive and active circuits. Electromotive force. Circuit analysis: Kirchoff laws, mesh current method. Thévenin and Norton theorems, superposition theorem. Diodes and transistors. Operational amplifiers. Periodic functions and alternate current. Digital instrumentation. Practical works.
<b>Recommended reading</b>	Matias, José – Electricidade, Didáctica Editora (Vol. 1, 2 e 3) Malvino – Princípios de Electrónica – Vol. 1 – McGrawHill. Malvino, Electrónica, Makron Books.
<b>Teaching methods</b>	Lectures and tutorials.
<b>Assessment methods</b>	Exam and practical assignments.
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Technical Drawing II
<b>Course code</b>	912309
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	II
<b>Year of study</b>	1 <sup>st</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Luis Miguel Marques Ferreira
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The students will be provided with notions of 3-D computer-aided tools (CAD). Sizing: dimensional and geometric tolerances, resizing, surface modeling. Drawing of machine parts.
<b>Prerequisites</b>	Projections and perspectives. Crop and sections. Sizing. Concepts of computer-aided drawing.
<b>Course contents</b>	Complements of sizing: tolerances, adjustments, and functional dimensioning. Drawing of attaching parts. Drawing of machine parts. Computer-aided drawing: Three-dimensional modelling. Surface modelling. Render. Two-dimensional drawing from three-dimensional models.
<b>Recommended reading</b>	Silva, Arlindo; Dias, João; Sousa, Luís – “Desenho Técnico Moderno”, Lidel Cunha, Luís Veiga da – “Desenho Técnico”, Fundação Calouste Gulbenkian SolidWorks manuals
<b>Teaching methods</b>	Lectures presenting the basic concepts using the episcopo. Problem resolution resorting to CAD. <b>Note:</b> Use of Solidworks as a worktool for concept application.
<b>Assessment methods</b>	Tests and individual assignments using CAD software. Minimum passmark is 7 (out of a 0-20 scale). Final mark is calculated as follows: Tests 60% + assignments 40%.
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Statistical and Numerical Methods
<b>Course code</b>	912312
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	1 <sup>st</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	4
<b>Name of lecturer</b>	Maria Isabel Vaz Pitacas
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	<p><i>Statistical Methods:</i> The students will learn how to read and communicate information using the tools available in the Descriptive Statistics, as well as build, use and interpret intervals estimation and hypothesis tests.</p> <p><i>Numerical Methods:</i> The students will be provided with basic concepts of Numerical Analysis to solve engineering problems, to know and to apply the appropriate numerical method to each problem.</p>
<b>Prerequisites</b>	Secondary education-level Mathematics and Mathematical Analysis I
<b>Course contents</b>	<p>Descriptive statistics. Introduction to probability theory; random variables; discrete theoretical distributions, continuous theoretical distributions; point and interval estimation, hypothesis tests, linear regression.</p> <p>Error analysis. Non-linear equation roots, polynomial interpolation, numerical integration. Equation systems resolution.</p>
<b>Recommended reading</b>	<p>ROSS, S. M. (1987). <i>Introduction to Probability and Statistics for Engineers and Scientists</i>. New York: John Wiley &amp; Sons.</p> <p>SPIEGEL, M. R. (1993). <i>Estatística</i>. São-Paulo: McGraw-Hill.</p> <p>FAIRES, J. D. &amp; BURDEN, R. (1998). <i>Numerical Methods</i>. Pacific Grove: Brooks/Cole Publishing Company.</p> <p>PINA, H. (1995). <i>Métodos Numéricos</i>. Lisboa: McGraw-Hill.</p>
<b>Teaching methods</b>	Presentation of the theoretical matter followed by exercise solving, under the teacher's guidance.
<b>Assessment methods</b>	Mid-term assessment (two mini-tests and two mid-term tests) and final assessment (examination)
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Applied Mechanics I
<b>Course code</b>	912311
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	I
<b>Year of study</b>	1 <sup>st</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Maria Isabel Martins Simões Ludovino
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	<ul style="list-style-type: none"> <li>- Provide an in-depth introduction of Static equilibrium.</li> <li>- Know how to determine Centroids and Centres of Gravity</li> <li>- Examine structures and machinery.</li> </ul>
<b>Prerequisites</b>	NA
<b>Course contents</b>	Statics of Particles: plane and space forces. Rigid Bodies: Equivalent Force Systems (Two- and three-dimensional Equilibrium of Rigid Bodies). Distributed Forces: Centroids and Centers of Gravity. Analysis of structures and machinery.
<b>Recommended reading</b>	Ferdinand P. Beer , E. Russel Johnston, Jr – “Vector Mechanics for Engineers”, McGraw-Hill.
<b>Teaching methods</b>	Theoretical classes using media resources. Classroom exercises.
<b>Assessment methods</b>	The final mark is calculated as follows: examinations 70% exams and individual works 30%. Final mark=0,7xexams+0,3xworks
<b>Language of instruction</b>	Portuguese

<b>B – Description of individual course units</b>	
<b>Course title</b>	Science and Engineering of Materials
<b>Course code</b>	912308
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	1 <sup>st</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Carlos Alexandre Campos Pais Coelho
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	<p>Characterise the various types of materials in structural and microstructural terms.</p> <p>Understand the material-processing- microstructure – properties relationship.</p> <p>Be familiar with the life span of the different materials.</p>
<b>Prerequisites</b>	NA
<b>Course contents</b>	An introduction to materials and raw materials; Atomic structure. Crystallographic structure and geometry. Solidification, crystalline imperfections and solid diffusion. Mechanical properties of metals. Electrical and other properties of materials. Phase diagrams. Eco-friendly materials.
<b>Recommended reading</b>	<p>Lecturer's handouts</p> <p>Princípios de Ciência e Engenharia dos Materiais - W.F. Smith ed. McGraw-Hill - Lisboa, 1998</p>
<b>Teaching methods</b>	Lectures and tutorials.
<b>Assessment methods</b>	<p><b>Continuous assessment:</b> grade is the weighted average of two tests and several assignments</p> <p><b>Final assessment:</b> final grade is the weighted average of final exam and final assignment.</p>
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Technical Drawing Applied to Mechanics
<b>Course code</b>	912315
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	2 <sup>nd</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Luis Miguel Marques Ferreira
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Provide the students with skills that enable them to draw mechanical elements using advanced CAD applications.
<b>Prerequisites</b>	Projections and perspectives. Crop and sections. Sizing. Concepts of computer-aided drawing.
<b>Course contents</b>	Drawing of mechanical assemblies: Drawing of structures. Drawing of mechanisms. Advanced computer-aided drawing: advanced three-dimensional modeling. Sheet-metal modeling. Advanced two-dimensional drawing from three-dimensional models.
<b>Recommended reading</b>	Silva, Arlindo; Dias, João; Sousa, Luís – “Desenho Técnico Moderno”, Lidel Cunha, Luís Veiga da – “Desenho Técnico”, Fundação Calouste Gulbenkian Solidworks manuals
<b>Teaching methods</b>	Lectures presenting the basic concepts using the episcope. Problem resolution resorting to CAD. <b>Note:</b> Use of Solidworks as a worktool for concept application.
<b>Assessment methods</b>	Tests and individual assignments using CAD software. Minimum passmark is 7 (out of a 0-20 scale). Final mark is calculated as follows: Tests 60% + assignments 40%.
<b>Language of instruction</b>	Portuguese



<b>B – Description of individual course units</b>	
<b>Course title</b>	Mechanical Behaviour of Materials
<b>Course code</b>	912314
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	2 <sup>nd</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	4,5
<b>Name of lecturer</b>	Carlos Alexandre Campos Pais Coelho
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	<p>An introduction to the key mechanisms for material deformation. Identify and explain the various responses of materials to mechanical stress and impact.</p> <p>Be familiar with the various tests for the characterization and evaluation of the mechanical properties of materials.</p>
<b>Prerequisites</b>	NA
<b>Course contents</b>	<p>Introduction: theories and tests on the analysis of the mechanical behaviour of running materials. Project in compliance with the requirements. Dimensioning criteria. Properties of materials. Mechanical behaviour of continuous, homogeneous and isotropic materials. Traction testing: elastic limit, proportionality limit, plastic deformation, ductility limit, breaking tension, resistance to traction and compression. Ductile and fragile behaviour. Materials decay. Safety coefficient. Resilience testing. Deformation energy on traction/compression, pure cutting, torsion, and flexion. Tension concentration and distribution. Stiffness and fatigue testing. Creep testing.</p>
<b>Recommended reading</b>	<p>Course handouts prepared by the lecturer.</p> <p>Sebenta “Tecnologia Mecânica I – Ensaios e Processos” – Eng.<sup>o</sup> João André F. Baptista, I.S.E.C.</p> <p>“Ensaios Mecânicos e Tecnológicos” – J. P. Davim e A. G. Magalhães, Estante Editora, Aveiro, 1992.</p> <p>“Princ. de Ciência e Eng. dos Mat.” – W. F. Smith, ed. Mcgraw-Hill.</p>
<b>Teaching methods</b>	Lectures, Tutorials and laboratory sessions.
<b>Assessment methods</b>	<p><b>Continuous assessment:</b> grade is the weighted average of two tests and several assignments</p> <p><b>Final assessment:</b> final grade is the weighted average of final exam and laboratory coursework.</p>
<b>Language of instruction</b>	Portuguese

<b>B – Description of individual course units</b>	
<b>Course title</b>	Materials Technology
<b>Course code</b>	912317
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	2 <sup>nd</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Carlos Alexandre Campos Pais Coelho
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	<ul style="list-style-type: none"> <li>- Characterise the different types of materials.</li> <li>- Be familiar with the various thermal treatments of metal alloys and its objectives.</li> <li>- Be familiar with the appropriate treatment for every type of material and with metal characterization techniques.</li> </ul>
<b>Prerequisites</b>	NA
<b>Course contents</b>	Ferrous alloys. Steel classification and usage. Thermal treatments. Thermochemical treatments. Electrolytic treatments. Non-ferrous metals. Aluminium alloys. Copper alloys. Composite materials. Ceramic materials. Polymers. Thermoplastics and thermosets. Materials selection introduction.
<b>Recommended reading</b>	<ul style="list-style-type: none"> <li>- Handouts prepared by the lecturer</li> <li>- Aços: Características e Tratamentos, 5<sup>a</sup> ed., Pinto Soares, ed. Livroluz, Porto, 1992 (ESTA 638)</li> <li>- Princípios de Ciência e Engenharia dos Materiais, W. F. Smith, ed. Mcgraw-Hill (ESTA 1268, 62, 608)</li> <li>- Metalurgia Geral – vol. II e III, Antera Valeriana de Seabra</li> </ul>
<b>Teaching methods</b>	Lectures, tutorials and laboratory sessions.
<b>Assessment methods</b>	<p><b>Continuous assessment:</b> grade is the weighted average of two tests and several assignments</p> <p><b>Final assessment:</b> final grade is the weighted average of final exam and laboratory coursework.</p>
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Mathematical Analysis III
<b>Course code</b>	912313
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	III
<b>Year of study</b>	2 <sup>nd</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Maria Helena Morgado Monteiro
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The students should learn how to formulate and solve problems connected with differential equations, line integrals and surface integrals.
<b>Prerequisites</b>	Mathematical Analysis II
<b>Course contents</b>	Differential equations – first-order differential equations and linear differential equations of order n. Laplace's transform. Systems of linear differential equations. Vectorial calculus - vectorial functions, line integrals (the concept of work as a line integral, independence of the path, Green's theorem), surface integrals (fluid flow through a surface, divergence theorem, Stokes' theorem).
<b>Recommended reading</b>	Breda, A. e Costa, J., <i>Cálculo com funções de várias variáveis</i> , McGraw-Hill, Lisboa, 1996. Monteiro, Helena, <i>Apontamentos de Análise Matemática III</i> , ESTA, 2008. Zill, Dennis, <i>Equações Diferenciais</i> , MaKron Books, São Paulo, 2001.
<b>Teaching methods</b>	Presentation of the theoretical matter followed by exercise solving under the teacher's guidance.
<b>Assessment methods</b>	Mid-term assessment (two mini-tests and two mid-term tests) and final assessment (examination)
<b>Language of instruction</b>	Portuguese

<b>B – Descrição das unidades curriculares</b>	
<b>Course title</b>	Applied Mechanics II
<b>Course code</b>	912316
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	2 <sup>nd</sup>
<b>Semester/trimester</b>	1st
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Maria Isabel Martins Simões Ludovino
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Analyze structures and machinery and determine the forces applied to various elements. Calculate centres of inertia. Calculate the speed and acceleration of any point of a mechanism.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Friction. Distributed Forces: Moments of Inertia. Kinematics of Rigid Bodies. Plane Motion of Rigid Bodies: Forces and Accelerations
<b>Recommended reading</b>	Ferdinand P. Beer , E. Russel Johnston, Jr – “Vector Mechanics for Engineers”, McGraw-Hill.
<b>Teaching methods</b>	Lectures and tutorials.
<b>Assessment methods</b>	The final mark is calculated as follows: examinations 70% exams and individual works 30%. Final mark=0,7xexams+0,3xworks
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Thermodynamics
<b>Course code</b>	912318
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	2 <sup>nd</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	5.5
<b>Name of lecturer</b>	Flávio Rodrigues Fernandes Chaves
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The main objective of this unit is to remind and consolidate some concepts in this area of knowledge, presenting a comprehensive and rigorous coverage of thermodynamics concepts, thus providing a solid base for subsequent courses in this area.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Basics on thermodynamics: reversibility, energy, thermodynamic coordinates, transforms representation, energy conservation principle and its implications. Thermodynamic principles. Closed systems transformations. Gases: perfect gases equation, internal energy of a gas and Joule's law, entropy variation of a perfect gas. Transformation of gases within closed systems: polytropic, adiabatic, isothermal. Carnot principle. Power cycles: Carnot, Otto, Diesel, Mixed, Stirling, Ericsson and Brayton. Liquids and vapours: phase changes, p-t diagram, t-h diagram and critical point, p-v diagram, p-v-t surface, t-s diagram, throttling effect in a vapour, water vapour changes. Vapour and mixed cycles: Rankine cycle.
<b>Recommended reading</b>	Chaves, F., <b>Sebenta de Termodinâmica – elementos de apoio</b> , Biblioteca da ESTA, 2006/2007. Çengel, Y. A., Boles, Michael A., <b>Termodinâmica</b> , 3rd Ed.; McGraw-Hill, 2000. Çengel, Y. A., <b>Introduction to Thermodynamics and Heat Transfer</b> , McGraw-Hill, 1997.
<b>Teaching methods</b>	Lectures, tutorials and laboratory.
<b>Assessment methods</b>	Assessment is divided into two compulsory complementary parts: Written test and practical assignments.
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Mechanics of Materials I
<b>Course code</b>	912322
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	I
<b>Year of study</b>	2 <sup>nd</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	6
<b>Name of lecturer</b>	Maria Isabel Martins Simões Ludovino
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Calculate simple mechanical elements (bars, shafts and beams) under axial and transverse loads and moments of twisting and bending.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Concept of stress; Stress and strain-axial loading; Torsion; Pure bending; Shearing stresses in beams; Analysis and design of beams for bending; Deflection of beams.
<b>Recommended reading</b>	Beer, Ferdinand P.; Johnston Jr., E. Russel – “Mechanics of Materials
<b>Teaching methods</b>	Theoretical classes using media resources. Classroom exercises.
<b>Assessment methods</b>	Final mark is calculated as follows: examinations 70% exams and individual works 30%. Final mark=0,7xexams+0,3xworks
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Fluid Mechanics
<b>Course code</b>	912321
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	2 <sup>nd</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Flávio Rodrigues Fernandes Chaves
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The students will acquire technical and scientific skills on the hydrostatics and drainage of compressible and incompressible fluids with a special focus on stationary pipe drainage.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Physical properties of fluids. Dimensional analysis. Hydrostatics. Hydrokinematics. Fundamentals of hydrodynamics. Basics of liquid flows. Laminar and turbulent regime. Duct flow under incompressible and compressible conditions.
<b>Recommended reading</b>	Lecturer's handout and worksheets. White, F. M., <b>Mecânica dos Fluidos</b> , McGraw-Hill 4ª edição, 2002. Quintela, A. C., <b>Hidráulica</b> , 1981, ed. Fundação Gulbenkian. Lencastre, A., <b>Hidráulica Geral</b> , 1983, ed. Hidroprojecto. Manzanares, A., <b>Hidráulica Geral</b> , 1980, ed. AEIST, 2 volumes. Novais Barbosa, J., <b>Mecânica dos Fluidos e Hidráulica Geral</b> , 1985, ed. Porto Editora, 2 volumes.
<b>Teaching methods</b>	Lectures and Tutorials.
<b>Assessment methods</b>	Assessment includes two parts: Written test and practical assignments.
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Hydraulics and Pneumatics
<b>Course code</b>	912319
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	2 <sup>nd</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Toni Santos Alves
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Basics of Pneumatics and Hydraulics.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Automation fundamentals. Introduction to digital systems. Numbering systems and codes. Boole algebra and logical circuits. Pneumatics. Sequential method.
<b>Recommended reading</b>	Eng.º Toni Alves, " <b>Sebenta de Hidráulica e Pneumática</b> ", E.S.T. Abrantes , 2007 Eng. Arivelto Fialho, " <b>Automação Pneumática</b> ", Didáctica Érica, 2003 José Novais, " <b>Método Sequencial Para Automatização Electropneumática</b> ", 3.ªEdição, Fundação Calouste Gulbenkian, 1997
<b>Teaching methods</b>	Lectures, tutorials and laboratory sessions.
<b>Assessment methods</b>	Exam and assignments.
<b>Language of instruction</b>	Portuguese



<b>B - Description of individual course units</b>	
<b>Course title</b>	Heat Transfer
<b>Course code</b>	912324
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	2 <sup>nd</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Flávio Rodrigues Fernandes Chaves
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Basic concepts of heat transfer and mechanisms involved such as: conduction, convection and radiation.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Heat transfer mechanisms: conduction, convection, and radiation. Permanent, one-dimensional conduction, with presence and absence of heat generation, through flat walls and cylindrical systems. Thermal insulation: critical radius of insulation. Fins: effectiveness, yield, global heat transfer coefficient. Radiation through a transparent and absorbing medium. Convection fundamentals: forced and natural. Heat exchangers.
<b>Recommended reading</b>	Incropera, F. P.; De Witt, D. P. – Fundamentals of Heat and Mass Transfer, John Wiley & Sons, 2002. Çengel, Y. A., Introduction to Thermodynamics and Heat Transfer; McGraw-Hill.
<b>Teaching methods</b>	Lectures and tutorials.
<b>Assessment methods</b>	Assessment includes two parts: Written test and assignments.
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	<b>Industrial Organization</b>
<b>Course code</b>	912323
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	2 <sup>nd</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	4
<b>Name of lecturer</b>	António Jorge Martins de Araújo Gomes
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	An introduction to the basic concepts of Industrial Organization.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Historical evolution of industrial companies. Concept of company. Company classification. Corporate management. Procurement function. Production function. Commercial function. Personnel function. Financial function.
<b>Recommended reading</b>	Organização e Modernização Industrial. Autor: J. C. Charrier, K. Kemoune. LIDEL – Edições Técnicas Portuguesas 1990; As Novas Regras de Produção. Autor: Pierre Béranger. LIDEL – Edições Técnicas Portuguesas 1989. Gestão da Produção. Autor: A. Courtois, M. Pillet e C. martin. LIDEL – Edições Técnicas Portuguesas 1997. Programa 8S. Autor: José Abrantes. Editora Interciência 2001
<b>Teaching methods</b>	Lectures including case studies.
<b>Assessment methods</b>	An assignment with presentation and discussion.
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Industrial Maintenance
<b>Course code</b>	912320
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	2 <sup>nd</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Maurício Baptista Carlos
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Maintenance planning. Guidelines for an effective maintenance. Tools to organize and/or manage a maintenance department..
<b>Prerequisites</b>	NA
<b>Course contents</b>	Maintenance organization; Maintenance strategies; Maintenance work; Monitoring techniques; Maintenance planning; Maintenance of equipment.
<b>Recommended reading</b>	Cabral, José Saraiva, Organização e Gestão da Manutenção, Lidel, Lisboa, 1998 Ferreira, Luís Andrade, Uma Introdução à Manutenção –, Publindústria, Porto, 1998 Lindley R. Higgins, Maintenance Engineering Handbook, McGraw-Hill, 1995
<b>Teaching methods</b>	Lectures with datashow
<b>Assessment methods</b>	A written test
<b>Language of instruction</b>	Portuguese

	<b>B - Description of individual course units</b>
<b>Course title</b>	Electrical Machines
<b>Course code</b>	912325
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Toni Santos Alves
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The students will learn about the different types of electric machines, its constructive aspects and respective use.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Electric installation. Three-phase and one-phase transformers. Asynchronous machines. Dynamo/Current DC machines.
<b>Recommended reading</b>	Handouts prepared by the teacher. José Matias, Ludgero Leote, Automatismos Industriais, Didáctica Editora, 1993 José Matias, Máquinas Eléctricas Corrente Alternada, Didáctica Editora, 1994 José Matias, Máquinas Eléctricas Corrente Continua, Didáctica Editora, 1990
<b>Teaching methods</b>	Lectures and tutorials.
<b>Assessment methods</b>	Exams and practical works.
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Machine Parts I
<b>Course code</b>	912361
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	I
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	5.5
<b>Name of lecturer</b>	Teresa Leonor Ribeiro C. M. Morgado
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Basics of static and fatigue design, selection and design of mechanic elements, basic concepts of lubrication.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Fatigue dimensioning: characterisation of the process. Fatigue stresses. Oligo-cyclical fatigue. Shafts and respective connections: shaft dimensioning for static loads. Dimensioning of shafts with respect to fatigue. Tension concentration. Dimensioning of shafts with respect to deformation. Materials used for shafts. Shaft connections. Lubrication principles: various types of lubrications and lubricants. Welded connections: joint types. Static calculation of welded joints. Fatigue dimensioning of welded structures. Fastening screws and devices: types of threads. Types of screws. Resistance of screwed connections. Resistance of riveted connections. Keys, pins and collars. Springs: tensions and deformations of helicoidal springs. Dimensioning of helicoidal springs. Torsion bars. Laminated springs.
<b>Recommended reading</b>	J. E. Shigley - <i>“Mechanical engineering Design”</i> , McGraw-Hill C. Moura Branco, J. Martins Ferreira, J. Domingos da Costa, A. Silva Ribeiro – <i>“Projecto de Órgãos de Máquinas”</i> , Fundação Calouste Gulbenkian, 2005
<b>Teaching methods</b>	Theoretical sessions: Presentation of theoretical concepts. Theoretical-practical: application examples, including case studies and practical works.
<b>Assessment methods</b>	Minimum pass mark for written test is 7,5 and for reports and presentation 0,95. Final mark (NF) is calculated as follows: written test 80% (NE) and reports 20%. $NF = 0,80 NE + 0,20 NP$
<b>Language of instruction</b>	Portuguese

<b>B – Description of individual course units</b>	
<b>Course title</b>	Mechanics of Materials II (Option I)
<b>Course code</b>	912329
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	II
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	5.5
<b>Name of lecturer</b>	Teresa Leonor Ribeiro C. M. Morgado
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The students will be provided with knowledge that will enable them to determine beam stresses and deformations, articulated structures and columns using simple, energetic and the finite elements methods.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Energetic methods; curved beams; columns; stress and deformation; combined loads.
<b>Recommended reading</b>	Beer, Johnston e DeWolf, “Resistência dos Materiais”, McGraw Hill Branco, Carlos Moura, “Mecânica dos Materiais”, Fundação Calouste Gulbenkian
<b>Teaching methods</b>	Lectures including practical exercises. Case study analysis resorting to finite elements software.
<b>Assessment methods</b>	Final written test – 75% of final grade Reports and respective presentation – 25% of final grade
<b>Language of instruction</b>	Portuguese

<b>B – Description of individual course units</b>	
<b>Course title</b>	Climate Control and Refrigeration (Option I)
<b>Course code</b>	912326
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3rd
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	5.5
<b>Name of lecturer</b>	Flávio Rodrigues Fernandes Chaves
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The main objective of this unit is to present the Fundamentals of Climatization and Refrigeration, and the general concepts for heating, ventilation and air conditioning.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Classification of climate systems, psychrometrics, indoor air diffusion, ventilation. Air-water vapour mixtures and respective changes, refrigeration cycles. Special emphasis is placed on refrigeration equipments and systems, its operating principles and appropriate usage. Cold applications. Vapour compression system. Refrigeration fluids. Equipments for a vapour compression system - compressors, evaporators, condensers, pumping, valves, reservoir pump. Multiple compression vapour systems. Calculation of thermal charges. Design of a refrigeration system. Regulations for safety and climate control in buildings - RCCTE and RSECE.
<b>Recommended reading</b>	Chaves, F., Sebenta de Climatização e Refrigeração, Escola Superior de Tecnologia de Abrantes, 2003. Pereira, N., Sebenta de Climatização I, Escola Superior de Tecnologia de Setúbal, 1998. Creus, J. Alarcon, Tratado Prático de Refrigeração Automática, Dinalivro, Lisboa. Stocker, W. F., Industrial. Refrigeration Handbook, McGraw-Hill, 1998.
<b>Teaching methods</b>	Lectures and tutorials.
<b>Assessment methods</b>	Assessment includes two parts: written test and assignments.
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Instrumentation and Measurement (Option I)
<b>Course code</b>	912327
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	5.5
<b>Name of lecturer</b>	A lecturer from the Robotics, Instrumentation and Industrial Automation Area (RIAI)
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Study and function analysis of the main equipment used in electrical measures. A special emphasis is placed on metrological functions and characteristics of electronic and digital devices and on the measurement principles for non-electrical measurement units (transducers).
<b>Prerequisites</b>	NA
<b>Course contents</b>	Measurement principles Analogue measurement devices Basics of digital instrumentation Power, energy and impedance measurement units Display and recording devices Functional modules for measuring non-electrical units and its application in instrumentation and measurement.
<b>Recommended reading</b>	Bibliografia suplementar: Larry D.Jones A.Foster Chin, "Electronic Instruments and Measurements", Prentice-Hall. C.S. Rangan, G.R. Sarma, V. Mani, "Instrumentation: Devices and Systems", McGraw-Hill. D.G. Fink, D. Christiansen, "Electronics Engineers' Handbook", McGraw-Hill. J.F. Borges da Silva, "Medidas Eléctricas", AEIST 1972. Direcção Geral da Qualidade, "Vocabulário Internacional de Metrologia", Lisboa 1985. B.M. Oliver, McGraw-Hill, "Electronic Measurement and Instrumentation", 1971.
<b>Teaching methods</b>	Lectures, tutorials and laboratory sessions.
<b>Assessment methods</b>	Written test and laboratory work.
<b>Language of instruction</b>	Portuguese



<b>B - Description of individual course units</b>	
<b>Course title</b>	Vehicle Mechanics (Option I)
<b>Course code</b>	912328
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	5.5
<b>Name of lecturer</b>	A lecturer from the Mechanical Project Area
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Upon completion of course, the students are supposed to interpret and describe: the impact of the different engine/drive configurations of an automobile on the mass geometry and consequently on its dynamic behaviour; the different constructive solutions used in steering and suspension and its relationship with the response to side/transversal movement of vehicle; the different construction solutions used in the braking systems of an automobile; the ABS and ESP systems; the components and functions of a drive system; the different solutions used in the construction of drive systems.
<b>Prerequisites</b>	NA
<b>Course contents</b>	An introduction to vehicle mechanics; steering/suspension systems; braking systems; drive systems.
<b>Recommended reading</b>	Gillespie, Thomas D.; Fundamentals of Vehicle Dynamics, SAE. ISBN: 1-56091-199-9  Milliken, Douglas L.; Race Car Vehicle Dynamics, SAE. ISBN: 1-56091-526-9
<b>Teaching methods</b>	Lectures, tutorials and laboratory sessions.
<b>Assessment methods</b>	Written test and assignments.
<b>Language of instruction</b>	Portuguese

<b>B – Description of individual course units</b>	
<b>Course title</b>	Materials Bonding Technology (Option II)
<b>Course code</b>	912330
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	II
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Maria Isabel Martins Simões Ludovino
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	An in-depth introduction to materials bonding technology with emphasis on welding technology. The most important welding processes are studied providing fundamental information about technical, physical, metallurgic and mechanical aspects. Non-destructive tests knowledge is also provided to students.
<b>Prerequisites</b>	NA
<b>Course contents</b>	<p>Welding Fundamentals: Historic development; Joint concept and types; Welding Symbols; Welded joints; Pressure and fusion welding; Health and Safety. Welding machines. Electric arc physics: heat and metal transfer. The effect of heating. Fissuring. Thermal treatment. Non- destructive testing of weld.</p> <p>Classification and analysis of welding processes: Manual metal arc welding; Gas Tungsten Arc Welding; Gas Metal Arc Welding; Cored Wire Welding; Plasma Arc Welding; Submerged Arc Welding; Gas Welding; Resistance; brazing; Ultrasonic Welding; Welding; Electro-Slag Welding; Electron-beam Welding; Laser-beam Welding; Friction Welding. Adhesives.</p>
<b>Recommended reading</b>	J. F. Oliveira Santos e L. Quintino – “Processos de soldadura”, Ed. Técnicas do ISQ; Lisboa, 1998
<b>Teaching methods</b>	Theoretical classes using media resources. Laboratory sessions/workshops on manufacturing processes.
<b>Assessment methods</b>	Final mark is calculated as follows: tests and examinations 70% and practical assignments 30%.
<b>Language of instruction</b>	Portuguese

<b>B – Description of individual course units</b>	
<b>Course title</b>	Electrical Installations (Option III e IV)
<b>Course code</b>	912340
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3rd
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	A lecturer from the Robotics, Instrumentation and Industrial Automation Area (RIAI)
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	A general overview of Electrical Installations including components and technologies and execution of a project in this area.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Design and reading of electrical schemes Energy distribution. Low voltage networks Collective electric installations Energy usage Exploration of electrical installations
<b>Recommended reading</b>	Safety Regulations, catalogues and tables by the manufacturers of cables and fittings. Varied Technical Guides Varied support texts.
<b>Teaching methods</b>	Lectures, tutorials and laboratory sessions.
<b>Assessment methods</b>	Minimum pass mark is 9.5 (out of a 0-20 scale) and minimum grade in each assessment component is 7.5.
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Industrial Computer Systems (Option II)
<b>Course code</b>	912332
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Lecturer from the Robotics, Instrumentation and Industrial Automation Area (RIAI)
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	This course is intended to develop the following skills: be able to analyse, structure, design, implement and document medium-level industrial control systems resorting to modelling tools and programming languages defined by IEC 61131-3 e IEC 61499 standards.
<b>Prerequisites</b>	A lecturer from the Robotics, Instrumentation and Industrial Automation Area (RIAI)
<b>Course contents</b>	UML modelling. Object-oriented programming according to IEC 61131-3 standard. Distributed programming in compliance to IEC 61499 standard. Introduction to OPC technology.
<b>Recommended reading</b>	Lewis, Robert W.;Modelling control systems using IEC 61499. ISBN: 0-85296-796-9 Fowler, Martin;UML distilled. ISBN: 0-201-65783-X Karl-Heinz John, Michael Tiegelkamp;IEC 61131-3: Programming Industrial Automation Systems, Springer; 1 edition (April 27, 2001), 2001. ISBN: ISBN-13: 978-3540677529
<b>Teaching methods</b>	Lectures and tutorials.
<b>Assessment methods</b>	Written test
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Thermal Machines (Option II)
<b>Course code</b>	912331
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Maurício Baptista Carlos
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Provide technical training on the proper operation of piston engines. Design and thermal design engineering: parameters of sizing, construction, performance and its impact on energy production, emission and fuel consumption. Equip students with theoretical knowledge that will enable them to understand the mechanisms involved in the transformation of energy in that, particularly, work is involved ie, external combustion engines and internal combustion engine alternatives and rotating.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Types of alternative engines and their operation; Friction and lubrication; Refrigeration system; Design and operation parameters for piston engines; Thermo chemistry of air-fuel mixture; Properties of working fluids; Ideal motor cycles models; Gas exchanges; Training and monitoring of emissions; Operation features; Systems and thermodynamic cycles.
<b>Recommended reading</b>	Sebenta de Máquinas Térmicas (a fornecer pelo professor) Heywood, John B.; Internal Combustion Engine Fundamentals; McGraw-Hill; Lopes, José Miguel; Motores de Combustão Interna – uma abordagem termodinâmica; Apontamentos teóricos; ASHRAE HANDBOOK; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. Çengel, Yunus A. e Boles, Michael A.; Termodinâmica; McGraw Hill; Moran, M. J., Shapiro, H. N., Fundamentals of Engineering Thermodynamics (SI Version), (Third edition), Wiley (1998) Giacosa, Dante; Motores Endotérmicos; Editorial Científico-Médica.
<b>Teaching methods</b>	Lectures including datashow and exercises
<b>Assessment methods</b>	Written test and theoretical and practical work
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Casting Technology (Option II e IV)
<b>Course code</b>	912338
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3rd
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	4.5
<b>Name of lecturer</b>	Teresa Leonor Ribeiro C. M. Morgado
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Provide the students with theoretical, practical and laboratory skills that allow them to understand the processes involved in casting technology. They should acquire the skills required to design parts for casting.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Casting fundamentals. Classification of different casting types. Selection criteria. Metal melting: solidification of pure metals and alloys. Solidification by casting. Melting defects. Casting alloys. Casting furnace. Moulding, metal die-casting. Moulding sand testing. Filling systems. Feeding systems. Permanent steel moulds injection. Project planning considerations.
<b>Recommended reading</b>	Ferreira, José Carvalho; "Tecnologia da Fundição", Fundação Calouste Gulbenkian. Kalkjian, Serope - "Manufacturing Engineering and Technology", Ed. Addison Wesley. Nebel, Benjamin W.; Draper, Alan B.; Wysk, Richard A. - "Modern Manufacturing Process Engineering", McGraw-Hill International Editions, 1989.
<b>Teaching methods</b>	Lectures. Laboratory work and on-site visits.
<b>Assessment methods</b>	Four on-site visits to four different companies will be carried out. The students must present and defend the respective reports. Assessment will be done through practical assignments. Final mark (NF) is calculated as follows: on-site visits (15%) and practical assignments/projects (85%).
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Financial Management (Option II e IV)
<b>Course code</b>	912335
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	4,5
<b>Name of lecturer</b>	Cláudia Pires da Silva
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	This course is intended to provide the students with the basic principles that will allow them to understand the economic and financial activity and the functioning of an enterprise. They should be able to interpret key financial statements by understanding such concepts as Solvency, Financial Balance, Financial Autonomy, Current Accounts/Management Accounts relationship, Calculus of Operating Fund and Operating Fund Needs. The students will also be provided with project analysis and evaluation tools.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Key financial and economical concepts: Real Flows; Financial Flows (immediate, periodic, multiple and autonomous); Financial cycles (exploration-, investment-, financial operations- related); Cash Flow; Economical Assets; Concepts related with key corporate financial statements: Current Accounts/Management Accounts relationship; Calculus of Operating Fund and Operating Fund Needs. Use of Project analysis and evaluation tools.
<b>Recommended reading</b>	<i>Course Handouts</i> ; A Gestão Financeira das Empresas – Caldeira de Menezes ; Revistas de Gestão nacionais e Executive Digest; Jornais: Semanário Económico; Diário Económico; Suplementos económicos do Expresso, Diário de Notícias, Público, Independente e Semanário; Análise Financeira – Conceitos, Técnicas e Aplicação, de Arlindo F. Santos, INIEF – Economia e Gestão, Lda.
<b>Teaching methods</b>	Powerpoint, Exercises, Case studies.
<b>Assessment methods</b>	Pass requirements: Mini-test – 10% of final grade Class assiduity and participation – 10% of final grade Mid-term test – 80% of final grade (minimum mark:8 grade points out of a 0-20 scale)
<b>Language of instruction</b>	Portuguese

<b>B – Description of individual course units</b>	
<b>Course title</b>	Human Resources Management (Option II e IV)
<b>Course code</b>	912334
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	4.5
<b>Name of lecturer</b>	Sílvia Manuel da Rocha Brito
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	An introduction to human resources management and some tools that facilitate business management particularly in terms of staff management.
<b>Prerequisites</b>	NA
<b>Course contents</b>	1- Administrative Management of Human Resources 2- Analysis and description of job duties 3- Staff recruitment and selection 4- Motivation management and team development 5- Career organization and planning 6- Health, prevention and safety at work
<b>Recommended reading</b>	Câmara, P. Guerra, P. Rodrigues, J. (2000). <i>Humanator – Recursos Humanos e Sucesso Empresarial</i> . Publicações. D. Quixote. Ceitil, Mário (2006) <i>Gestão dos Recursos Humanos para o séc. XXI</i> , Edições Sílabo. Chiavenato, I. (2000). <i>Recursos Humanos</i> . Coleção Atlas. Chiavenato, I. (2006). <i>Recursos Humanos</i> . Edição Compacta, Coleção Atlas
<b>Teaching methods</b>	Lectures and tutorials
<b>Assessment methods</b>	Continuous assessment. Final exam for the students with an average mark below 10 grade points (out of a 0-20 scale). Practical assignments.
<b>Language of instruction</b>	Portuguese



	<b>B – Description of individual course units</b>
<b>Course title</b>	Quality (Option IIe IV)
<b>Course code</b>	912337
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	4,5
<b>Name of lecturer</b>	Amândio Gonçalves
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Provide the students with management, control and quality improvement techniques so that they can establish, implement and develop quality management systems in the organizations. Acquire the necessary competences that enable them to control quality processes in the organizations.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Introduction to quality management: concepts and historical context – From inspection to TQM (Total Quality Management). Approaches to quality improvement ( Juran, Deming ). Quality management models and systems. ISO 9000. ISO 9001 requirements. Portuguese Quality System and certification. Quality audits. Management systems development: quality, environment ( ISO 14001 ) and safety integration ( OHSAS 18001 ). Product and services certification. Quality control. Statistical process control. Sampling procedures for inspection. Quality improvement and total quality management: concepts and ISO 9000. Quality improvement and problem solving projects.
<b>Recommended reading</b>	Pires, A. Ramos – “Sistemas de gestão da qualidade” , Ed. Sílabo. Straker, David– “A Toolbook for quality improvement and problem solving”, Prentice Hall. Juran, J. M. ; Godfrey. A. B. – “Juran´s Quality Handbook” ( fifth edition ), McGraw-Hill. Juran, J.M.– “Juran na liderança pela qualidade”, Pioneira Editora.
<b>Teaching methods</b>	Lectures and tutorials.
<b>Assessment methods</b>	Continuous assessment (two tests and three practical works), final assessment (a final examination and a practical work).
<b>Language of instruction</b>	Portuguese

<b>B – Description of individual course units</b>	
<b>Course title</b>	Health and Safety (Option III e IV)
<b>Course code</b>	912336
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	4.5
<b>Name of lecturer</b>	Manuel Soeiro Alves
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	<p>Upon completion of course the students should:</p> <ul style="list-style-type: none"> <li>- Be aware of the importance and role of health and safety at work.</li> <li>- Be familiar with national and international laws and HSE legislation.</li> <li>- Be able to evaluate and anticipate eventual professional risks and promote health and safety of employees.</li> <li>- Be aware of the importance of safety plans and their implementation.</li> <li>- Be able to perform ergonomic analyses and development studies.</li> </ul>
<b>Prerequisites</b>	NA
<b>Course contents</b>	Health and Safety concepts, risk analyses, administrative and organizational aspects, provisions concerning individual protection, protective and preventive actions against fire and electric risks, maintenance, chemical contamination, noise, vibrations, environmental climate, radiation, illumination and ergonomics.
<b>Recommended reading</b>	Manual de Higiene e Segurança no Trabalho – Alberto Sérgio, Porto Editora; Manual de higiene e segurança na indústria – Ricardo Macedo; Ergonomia prática – J. Dul e B. Weerdemeester Higiene e segurança nos locais de trabalho – Dir. Geral da Indústria; Colectânea de legislação sobre segurança, higiene e saúde no trabalho; Concepção dos locais de trabalho - IDICT
<b>Teaching methods</b>	Lectures and tutorials.
<b>Assessment methods</b>	<p>Mid-term test that exempts the students final exam. Final mark will be the average of mid-term test (NE) + assignments (NT) + individual participation (NA) according to the following formula:  <math>NF = NE (70\%) + NT (20\%) + NA (10\%)</math></p> <p>Using this formula, a minimum mark of 7 (seven) in the mid-term test is required to pass.</p> <p>As for examination, a grade higher than ten is required to pass.</p>
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Vehicle Electricity and Electronics (Option III e IV)
<b>Course code</b>	912333
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	1 <sup>st</sup>
<b>Number of credits</b>	4.5
<b>Name of lecturer</b>	Lecturer from the Robotics, Instrumentation and Industrial Automation Area (RIAI)
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Identify the standards for the sector; Describe the operation requirements of the various automobile systems; Project and integrate the various automobile subsystems.
<b>Prerequisites</b>	NA
<b>Course contents</b>	The automobile electronics panorama; Electrical and electronic circuits; Introduction to control theory; Engine control; Safety; Comfort.
<b>Recommended reading</b>	H. Shiga and S. Mizitani, Car Electronics, ALCA Inc, Japan, 1988. (BPG-SDUM 90491) W. B. Ribbens, Understanding Automotive Electronics, SAMS, 1988. (BPG-SDUM 90492) R. Jurgen, Automotive Electronics Handbook, McGraw-Hill, Inc., 1995. (BPG-SDUM 134598)
<b>Teaching methods</b>	Lectures, tutorials and laboratory sessions
<b>Assessment methods</b>	Written test and laboratory assignments.
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Machine Parts II
<b>Course code</b>	912363
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	II
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Teresa Leonor Ribeiro C. M. Morgado
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Basics of selection and design of clutches, brakes, mechanical drives, chain transmission, transmission by gears and gear trains. Select and design mechanic elements. Basic concepts of lubrication.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Clutches, brakes, Couplings and flywheels: Classification, selection and design. Bearings: Different types of bearings; Bearing selection. Mechanical drives: selection principles. Comparative analysis of the different kinds of mechanical drives. Designing belt drives, chain drives, and gear drives. Speed reducers.
<b>Recommended reading</b>	J. E. Shigley - "Mechanical engineering Design", McGraw-Hill C. Moura Branco, J. Martins Ferreira, J. Domingos da Costa, A. Silva Ribeiro – "Projecto de Órgãos de Máquinas", Fundação Calouste Gulbenkian, 2005
<b>Teaching methods</b>	Lectures and tutorials.
<b>Assessment methods</b>	Written test, reports and its presentation.
<b>Language of instruction</b>	Portuguese

	<b>B - Description of individual course units</b>
<b>Course title</b>	Industrial Automation
<b>Course code</b>	912358
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	5
<b>Name of lecturer</b>	Toni Santos Alves
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The students should acquire abilities that allow them to identify equipments and master programming techniques in order to be prepared to solve future professional problems.
<b>Prerequisites</b>	Not Applicable
<b>Course contents</b>	Automation fundamentals. Industrial sensors. Sequences circuits of relay. Programmable automatons. Execution of a PLC. Programming language of programmable automatons. Automatic control.
<b>Recommended reading</b>	Datashow prepared by the lecturer. J.Novais, "Método Sequencial para Automatização Electropneumática", 3 <sup>a</sup> Edição, Fundação Calouste Gulbenkian, 1997. António Francisco, "Autómatos Programáveis – Programação, Grafcet e Aplicações", ETEP (Edições Técnicas e Profissionais), 2002
<b>Teaching methods</b>	Lectures, tutorials and laboratory sessions.
<b>Assessment methods</b>	Exams and practical assignments.
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Turbomachines (Option V e VI)
<b>Course code</b>	912346
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	4
<b>Name of lecturer</b>	Maurício Baptista Carlos
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The various types of Turbomachines. Foundations required to be able to characterise Turbomachines, including the use of dimensionless coefficients and operation curves. Training in the draft pipes, standards and apply codes. Characterization of valves and other accessories needed for water projects. Knowledge of software for designing fluid networks.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Characteristics of Global Operations of Turbomachines; New dimensionless coefficients; Specific speed; Definition of geometry; Cavitation; Equipment and Security; Pumping facilities; Draft piping; Sizing of valves; Separators and filters; Expansion joints; CADVENT (Industrial Ventilation Networks and fluids).
<b>Recommended reading</b>	Notes of Hydraulic Machinery (ISEC) – Mendes, J., 2002. Notes of Fluid Networks (ISEL) – CESE 1994/95 – compilação efectuada pelo professor da disciplina - Turbomáquinas); <i>Manual do CADVENT</i> , Bombas Grundfos Portugal Lda, (1999). <i>Manual de Engenharia – Sistemas com Bombas Submersíveis</i> . Bombas Grundfos Portugal Lda, (1988). Abastecimento de Água Doméstica; Centrifugal Pump Lexicon – KSB; Mecânica dos Fluidos – Streer; <i>Hidráulica</i> 7 <sup>a</sup> Ed. – Quintela, A., Fundação Calouste Glubenkian; <i>Mechanics of Fluids</i> – Massey <i>Mecânica dos Fluidos e Hidráulica</i> – Giles, R., Schaum; <i>Mecânica dos Fluidos</i> 4 <sup>a</sup> Ed. – White, F., McGraw-Hill; UK National Engineering Laboratory “Steam Tables 1964”; Smithsonian Physical Tables, Mark’s Engineers Handbook; J. A. Fox, “Hydraulic Analysis”
<b>Teaching methods</b>	Lectures including datashow, practical exercises.
<b>Assessment methods</b>	Written test and theoretical and practical work.
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Plastic Conformation Processes (Option V e VI)
<b>Course code</b>	912343
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	4
<b>Name of lecturer</b>	Isabel Ludovino
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The students will be provided with knowledge of plastic behaviour of materials; plastic deformation mechanisms; manufacturing processes involving plastic deformation of materials.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Basics of plasticity. Plastic deformation mechanisms. Shape-forming processes by plastic deformation: Forging; Lamination; Extrusion and Wire-Drawing; Folding; Drawing; Blanking; Conventional blanking; Shaving or Trimming; Precision Cutting. Stress Calculus: Uniform-deformation energy method; Slice Method; Lower-Limit Method; Higher-Limit Method.
<b>Recommended reading</b>	Handouts prepared by the lecturer; Fernandes, V. - "Plasticidade", Universidade de Coimbra; Chiaverini, V.- "Tecnologia Mecânica", Makron Books; Smith, W. F. - "Princípios de Ciência e Engenharia dos Materiais", Mc. Graw Hill; Dieter, G. - "Metalurgia Mecânica", Aguilar
<b>Teaching methods</b>	Lectures making use of media resources. Practical sessions including exercise solving.
<b>Assessment methods</b>	Final grade (NFinal) is calculated as follows: tests (Nprovas) are worth 70% of final grade + individual assignments (Ntrab) are worth 30% of final grade.  NFinal=0,7xNprovas+0,3xNtrab
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Engine Testing (Option V e VI)
<b>Course code</b>	912341
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	4
<b>Name of lecturer</b>	Lecturer of the Energetic and Fluid Technologies (TEF) Area
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The students should familiarise themselves with the existing standards on engine testing, the devices and equipment used, the response of the various engines and determination of its properties.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Applicable standards, equipment used and essays on thermal combustion and electrical engines. Result analysis: Characteristic curves and emissions.
<b>Recommended reading</b>	Heywood, John B.; Internal Combustion Engine Fundamentals; McGraw-Hill Ensaios de Máquinas Elétricas; Martignoni, A.; Editora Globo
<b>Teaching methods</b>	Lectures, tutorials and laboratory sessions.
<b>Assessment methods</b>	Written test and practical assignments
<b>Language of instruction</b>	Portuguese



<b>B - Description of individual course units</b>	
<b>Course title</b>	Machine-Tools (Option V e VI)
<b>Course code</b>	912342
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	4
<b>Name of lecturer</b>	Luis Miguel Marques Ferreira
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The students will familiarise themselves with the fundamentals of technological processes and respective machine tools (conventional and CNC), its potential and limitations in industry in order to be prepared to solve industrial production related problems and maximize connection between the project and manufacturing as according to the "Design for Manufacturing" concept.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Motions and geometric relations in machining by stock removal. Cutting tools: materials and geometry. Cutting parameters: cutting speed, feed rate and cutting depth. Calculation of cutting power: turning, milling and drilling. Calculation of cutting times. Other conventional machine tools. CNC machines: programming and operation of turning and milling machines.
<b>Recommended reading</b>	Handouts prepared by the lecturer. Manual de operação do centro de maquinagem HAAS VF4. Máquinas Ferramentas, Ruy Mesquita, Jorge Rodrigues e Rui Baptista, 1997
<b>Teaching methods</b>	Lectures including datashow. Laboratory sessions including problem solving.
<b>Assessment methods</b>	An examination (50% of final grade - minimum pass mark 10 grade points). Individual assignment (50% of final grade - minimum pass mark 10 points).
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Industrial Robotics (Option V e VI)
<b>Course code</b>	912344
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	4
<b>Name of lecturer</b>	Toni dos Santos Alves
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Provide the students with the necessary information on the different types of robots, the constructive aspects, the form of programming and its application.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Part I: Systems control. Part II: Fundamentals of robotic systems, robot applications, robot mechanisms and categories, constituents of a robotic system, robot characteristics. Direct and inverse kinematics. Robot control. Robot mobile.
<b>Recommended reading</b>	J. Norberto Pires – “ <i>Automação Industrial</i> ”, ETEP, 2002, ISBN 972-8480-05-9. P. McKerrow – “Introduction to Robotics”, Addison-Wesley, 1993. R. Paul – “Robot Manipulators: Mathematics, Programming and Control”, MIT Press 1981. M. P. Grover et al., “Industrial Robotics: Technology Programming and Applications”, McGraw-Hill, 1986. Gregory Dudek, Michael Jenkin – “Computational Principles of Mobile Robotics”, Cambridge, 2000, ISBN 0-521-56876-5.
<b>Teaching methods</b>	Lectures and Tutorials.
<b>Assessment methods</b>	Exams and practical assignments
<b>Language of instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Data Acquisition Systems (Option V e VI)
<b>Course code</b>	912345
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	4
<b>Name of lecturer</b>	A lecturer from the Robotics, Instrumentation and Industrial Automation Area (RIAI)
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The students are expected to be able to understand, project and construct data acquisition systems. These systems are vital for the control and optimization of varied industrial processes or others. Therefore, the students should be able to select the system that best adapts to each application.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Basics of data acquisition, typical configurations, signal classification, sensors, signal conditioning, noise and interferences, PC acquisition, acquisition plates, data transmission networks types, autonomous controllers, microprocessors.
<b>Recommended reading</b>	Stuart R. Ball, Debugging Embedded Microprocessor Systems, Butterworth Heinemann, 1998 Mohammad. Farsi, Manuel. Barbosa, CANopen Implementation: Applications to Industrial networks, Research Studies Press, 2000. Practical Data Acquisition for Instrumentation and Control Systems, John Park, Steve Mackay, 2003
<b>Teaching methods</b>	Oral presentation resorting to audiovisual media.
<b>Assessment methods</b>	Mid-term test that exempts the students final exam. Final mark will be the average of mid-term test (NE) + assignments (NT) + individual participation (NA) according to the following formula: $NF = NE (70\%) + NT (30\%)$ As for examination, a grade higher than 10 (ten) is required to pass.
<b>Language of instruction</b>	Portuguese

<b>B – Description of individual course units</b>	
<b>Course Title</b>	Technical English (Option VII)
<b>Course Code</b>	912352
<b>Type of Course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of Study</b>	3rd
<b>Semester/Trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	2
<b>Name of Lecturer</b>	Zélia Patrocínio
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The English course is intended to provide the students with skills that enable them to understand technical texts dealing with course content topics and familiarise themselves with specific vocabulary. Upon completion of course the students should be able to express themselves in English fluently both orally and in writing.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Grammar structures Technical languages
<b>Recommended Reading</b>	Due to its length, the reading list was not included here.
<b>Teaching Methods</b>	Lectures and tutorials.
<b>Assessment Methods</b>	Final grade is the weighted average of a mid-term test, compulsory coursework and participation/assiduity. Minimum passing grade is 10 out of 0-20 scale.
<b>Language of Instruction</b>	English

<b>B – Description of individual course units</b>	
<b>Course Title</b>	French (Option VII)
<b>Course Code</b>	912351
<b>Type of Course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of Study</b>	3rd
<b>Semester/Trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	2
<b>Name of Lecturer</b>	Sofia Mota
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	The course Foreign Language-French aims at providing the students with language skills needed by an adult possessing a medium-level culture.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Study of French Civilization, Society and Literature. Civilization and Society Contemporary Literature Comprehension and documentary interpretation Grammar structures Discourse functions
<b>Recommended Reading</b>	Due to its length, the reading list was not included here.
<b>Teaching Methods</b>	Lectures and tutorials.
<b>Assessment Methods</b>	Final grade is the weighted average of a mid-term test, compulsory coursework and participation/assiduity. Minimum passing grade is 10 out of 0-20 scale.
<b>Language of Instruction</b>	French

<b>B – Description of individual course units</b>	
<b>Course Title</b>	German (Option VII)
<b>Course Code</b>	912348
<b>Type of Course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of Study</b>	3rd
<b>Semester/Trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	2
<b>Name of Lecturer</b>	Marta Dionísio de Azevedo
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Knowledge of German Language and an improvement of general communication skills – oral and written comprehension and expression.
<b>Prerequisites</b>	NA
<b>Course contents</b>	<p>Course contents</p> <ul style="list-style-type: none"> <li>1.1. Personal Identification</li> <li>1.3. School life</li> <li>1.4. Interpersonal relationships</li> <li>1.5. Work</li> <li>1.6. Leisure</li> </ul> <p>Morphosyntatic Component</p>
<b>Recommended Reading</b>	<p>Behal-Thomsen, H., Lundquist-Mog, A., Mog, P., Typisch Deutsch, Langenscheidt KG, Berlin</p> <p>Bohn, R., Probleme der Wortschatzarbeit, Langenscheidt KG, Berlin</p> <p>Borbein, V., Menschen in Deutschland, Langenscheidt KG, Berlin</p> <p>Griesbach, H., Die Bundesrepublik Deutschland, Langenscheidt KG, Berlin</p>
<b>Teaching Methods</b>	Lectures: written and oral practice. Worksheets and projects
<b>Assessment Methods</b>	Written test and practical assignments
<b>Language of Instruction</b>	Portuguese and German

<b>B - Description of individual course units</b>	
<b>Course title</b>	Engineering Ethics (Option VII)
<b>Course code</b>	912350
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	2
<b>Name of lecturer</b>	João Paulo Tomás Henriques
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	An introduction to ethics for engineers.
<b>Prerequisites</b>	NA
<b>Course contents</b>	The course deals with ethics and good practices applied to the engineering profession.
<b>Recommended reading</b>	<b>Ética para engenheiros</b> Arménio Rego/ Jorge Braga Lidel ISBN : 972-757-341-X
<b>Teaching methods</b>	Lectures and case studies.
<b>Assessment methods</b>	Practical assignment.  Final grade is awarded on a 0-20 scale basis.
<b>Language of instruction</b>	Portuguese

<b>B – Description of individual course units</b>	
<b>Course Title</b>	Oral and Written Communication (Option VII)
<b>Course Code</b>	912349
<b>Type of Course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of Study</b>	3rd
<b>Semester/Trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	2
<b>Name of Lecturer</b>	Maria Romana
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Understand the Portuguese Language as a means to access forms of representation of different world views. Expand writing and oral skills that enable the students to understand and interpret complex current texts and follow the evolution of Portuguese Language.
<b>Pré-requisitos</b>	NA
<b>Conteúdos da Unidade Curricular</b>	Communication forms Morphology Lexicology Utterance Text and discourse Oral expression Written expression
<b>Recommended Reading</b>	Barroso, Henrique – “O Aspecto Verbal Perifrástico em Português Contemporâneo”, Porto Editora, 1994. Campos, Maria H. C. – “Tempo, aspecto e Modalidades”, Porto Editora, Porto, 1996. Jakobson, Roman – “Linguística e Comunicação”, Cultrix, S. Paulo 1969. Rodrigues, Adriano Duarte, “A Partitura Invisível – Para a abordagem interactiva da linguagem” Edições Colibri, Lisboa, 2001 Vilela, Mário – “Estruturas Léxicas do Português”, ed. Almedina Coimbra.
<b>Teaching Methods</b>	Lectures and practical exercises. Conferences.
<b>Assessment Methods</b>	Written test and practical assignments
<b>Language of Instruction</b>	Portuguese



<b>B – Description of individual course units</b>	
	Introduction to Law (Option VII)
<b>Course Code</b>	912353
<b>Type of Course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of Study</b>	3rd
<b>Semester/Trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	2
<b>Name of Lecturer</b>	Paula Almeida
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	Provide an overview of legal system: its different meanings, sources, branches, law interpretation and integration and its application in time and space.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Chapter I – Introductory notions; Chapter II – Sources of Law; Chapter III – Branches of Law; Chapter IV – Law interpretation and integration; Chapter V – Application of law in time; Chapter VI – Application of law in space; Chapter VII – Acting according to law; Chapter VIII – Acting against law; Chapter IX – Legal coercion; Chapter X – Juridical relation
<b>Recommended Reading</b>	Castro Mendes, João de “ Introdução ao Estudo do Direito”, PF, Lisboa,1994; Telles, Inocêncio de Galvão, “ Introdução ao Direito”, Coimbra Editora, 2004; Telles, Inocêncio Galvão, “ Direito das Obrigações”, Coimbra Editora, 2006; Sousa, Marcelo Rebello de, “ Introdução ao Estudo do Direito”.
<b>Teaching Methods</b>	Lectures and teamwork.
<b>Assessment Methods</b>	Mid-term test that exempts the students from taking exam. Final mark is the average of mid-term test(NE)+assignments(NT)+individual participation(NA) according to the following formula: $NF = NE (70\%)+ NT (20\%)+NA (10\%)$ Using this formula, a minimum mark of 10.00 (ten) in mid-term test is required to pass. As for final examination, a grade higher than ten is required to pass.
<b>Language of Instruction</b>	Portuguese

<b>B – Description of individual course units</b>	
<b>Course Title</b>	Public Relations (Option VII)
<b>Course Code</b>	912354
<b>Type of Course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of Study</b>	3rd
<b>Semester/Trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	2
<b>Name of Lecturer</b>	Lecturer from the Economical and Social Sciences Area.
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	<p>The students should be able to:</p> <ul style="list-style-type: none"> <li>• Position public relations in the context of the organizational communication and organizational studies;</li> <li>• Approach public relations as a strategic management function;</li> <li>• Analyse/apply professional public relations strategies, techniques and routines.</li> </ul>
<b>Prerequisites</b>	NA
<b>Course contents</b>	<p>PR, organizational communication and study. Theoretical principles, history, models and key topics for Public Relations. PR strategy, programmes and campaigns. Organise the Public Relations function.</p>
<b>Recommended Reading</b>	<p>Heath, Robert (2001) (org.), Handbook of public relations, Sage Publications. Hunt, Todd; Grunig, James E. (1994), Public relations techniques, Harcourt Brace College.</p>
<b>Teaching Methods</b>	Lectures and case studies.
<b>Assessment Methods</b>	Written test and practical assignments.
<b>Language of Instruction</b>	Portuguese

<b>B - Description of individual course units</b>	
<b>Course title</b>	Training (Option VIII)
<b>Course code</b>	912355; 912356; 912357; 912358; 912359; 912360
<b>Type of course</b>	One-semester course
<b>Level of Course</b>	NA
<b>Year of study</b>	3 <sup>rd</sup>
<b>Semester/trimester</b>	2 <sup>nd</sup>
<b>Number of credits</b>	11
<b>Name of lecturer</b>	Several lecturers from various scientific areas of the degree.
<b>Objectives of the course (preferably expressed in terms of learning outcomes competences)</b>	This Training Period aims to provide the students direct contact with some Mechanical Engineering tasks. They should be able to integrate and apply the knowledge and skills acquired during the degree in the resolution of real problems. Joint actions are established in collaboration with industries, IPT laboratories and other institutions in areas such as total or partial design of mechanical systems, production management, quality management, industrial maintenance, industrial automation, thermal and fluid selection of materials and systems.
<b>Prerequisites</b>	NA
<b>Course contents</b>	Building on knowledge and skills acquired during the degree, this discipline aims to provide the students with an overall concept of a mechanical project in order to facilitate their integration in a prospect career as an engineer. Data are provided that relate to a mechanical systems project as a whole or part of it, which is suggested by industrial companies as possible. For the calculation of machine parts, development of industrial-oriented software programmes is encouraged. Apart from usual supervision of the works in course, useful data are provided such as standards, manufacturing codes and construction details.
<b>Recommended reading</b>	Bibliography and authorized elements of study are in accordance with the individual training plan.
<b>Teaching methods</b>	A training period in an enterprise or institution with personalized supervision.
<b>Assessment methods</b>	Evaluation of work carried out during training and of presentation of Training Report.
<b>Language of instruction</b>	Portuguese

