ECTS CATALOGUE

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

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

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

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MASTER – Electrical Engineering

Code	Title - Portuguese	Title - English	ECTS	Term
1.º ano / 1st Year				
677801	Matemática Aplicada à Engenharia		6	Autumn
677802	Sistemas de Informação Aplicados	Applied Information Systems	6	Autumn
677803	Comunicações Industriais e Empresariais	Industrial and Enterprise Communications	6	Autumn
677804	Sistemas de Automação e Controlo	Automation and Control Systems	6	Autumn
677805	Edifícios Inteligentes e Domótica	Home Automation and Intelligent Buildings	6	Autumn
Opção ACSE- Comunicação e Sistemas de Energia | Option Power Systems and Communication				
677806	Energias Renováveis	Renewable Energies	6	Spring
677807	Mercados de Energia	Energy Markets	6	Spring
677808	Supervisão e Controlo de Sistemas de Energia	Power Systems Supervision and Control	6	Spring
677809	Tração e Veículos Elétricos	Electric Traction and Vehicles	6	Spring
677810	Gestão Ambiental e Desenvolvimento Sustentável	Sustainable Development and Environmental Management	6	Spring
Opção ACSI- Sistemas Industriais | Option Instustrial Systems				
677811	Sistemas Robóticos	Robotic Systems	6	Spring
677812	Sistemas Industriais Distribuídos	Distributed Industrial Systems	6	Spring
677813	Aplicações de Máquinas Elétricas		6	Spring
677814	Comunicações Sem Fios e Mobilidade	Wireless Communications and Mobility	6	Spring
677815	Visão e Multimédia	Computer Vision and Multimedia	6	Spring
2.º ano / 2nd Year				
677816	Gestão de Empresas	Corporate Management	6	Autumn

Title	**Project / Internship /Dissertation**
Scientific Area:	Electrical Engineering
Course:	6778 - Master Course in Electrical Engineering
Code:	**677817 - Project/Internship/Dissertation**
Year/Semester:	Second Year / First and Second Semester
ECTS:	54
Department:	Electrical Engineering
Instructor:	Project or Internship or Dissertation academic supervisor our supervisors plus Industrial/Company Supervisor in the case of Internship. Coordination Board: Fernando Lopes; Carlos Ferreira; Inácio Fonseca.
Study plan:	Project: Development of an individual technology project, involving subjects that embrace several areas of the master course, focusing on electrical engineering and related to real world applications. The project may be proposed by a member of the teaching staff, by the student or by a company. One or more supervisors, according to the areas involved in the project, will provide tutorial guidance throughout the year. The student and the supervisors will agree on a project work plan that must be approved by the school scientific council. The work plan includes the project objectives, the project scope and the time schedule. Students are introduced to the various phases of a project, namely: understanding the problem and developing an approach strategy, the conceptual design phase, the detailed design phase and the report phase. The students are encouraged to carry out bibliography reviews on the used technologies and visit industrial locations related to the project. The use and development of software tools for calculations or simulating, as well as experimental work and the construction of a prototype will be valued.
	Internship : Instead of a project, students may undertake an internship program. The internship may be proposed by a member of the teaching staff, by a company/institution or by the student. Each internship program is assigned to one or more academic supervisors, according to the areas involved in the field work, and one company supervisor. The student and the supervisors will agree on a work plan that must be approved by the school scientific council. The work plan includes the internship objectives, activities and the time schedule. The internship should lead to the production of a written report, which fulfills the academic requirements of the Master's degree.
	Dissertation: For the students with a more marked academic profile and high autonomy in terms of theoretical concepts, a dissertation on a specific subject may be proposed. The selected specific topic should be in the Electrical Engineering area and should have potential for future integration in the associated technology field. The recommended structure for the dissertation is as follows: motivation for the study of the specific subject; bibliographic summary of the state of the art; description of the investigation; presentation of results; analysis and critical discussion of the results in the face of bibliographic summary and potential applications; conclusions and future developments.
Language	Portuguese and/or English

<table>
<tr><td></td><td></td></tr>
<tr><td>Type of instruction:</td><td>
<table>
<tr><th>Activities</th><th>Total Hours</th><th>Hours/week</th><th>Comments</th></tr>
<tr><td>Theoretical</td><td></td><td></td><td></td></tr>
<tr><td>Theoretical-Practical</td><td></td><td></td><td></td></tr>
<tr><td>Practical:</td><td></td><td></td><td></td></tr>
<tr><td>Tutorial guidance</td><td>90</td><td>—</td><td>Project or Internship or Dissertation supervision
(plus 1080 hours Project /Internship/Research plus 234 hours study/report)</td></tr>
</table>
</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Learning objectives:</td><td>The main aims of the Project are:
To provide the student the opportunity to demonstrate autonomy and originality;
To develop the capacity to plan and organize a large project over a long period;
To put into practice the knowledge and techniques acquired throughout the course;
To prepare the student for project development in a company/industry.</td></tr>
<tr><td></td><td>The main aims of the Internship are:
To gain relevant work experience in industrial or company context that will give the student an important foothold in the job market;
To provide the required knowledge and transferable skills which enable the students to pursue their careers;
To put into practice the knowledge and techniques acquired throughout the master course.</td></tr>
<tr><td></td><td>The main aims of the Dissertation are:
Developing skills for research students who demonstrate interest in pursuing academic careers or research, namely applied research;
To develop local know-how as a basis for future dissertations, projects or internships;
To contribute to the development of innovative technologies in the field of Electrical Engineering.</td></tr>
<tr><td>Generic learning outcomes and competences:</td><td>At the end of the Project the student is expected to be able to:
Participate on design, select components, supervise the installation and assure the efficient operation and maintenance of equipments and systems;
Apply critical analysis and demonstrate applied research skills;
Use knowledge integration in complex problem solving.</td></tr>
<tr><td></td><td>At the end of the Internship the student is expected to be able to:
Work on teams, be an effective communicator and be prepared for leadership roles;
Apply scientific and technical knowledge in the resolution of real world problems;
Have an interdisciplinary perspective.</td></tr>
<tr><td></td><td>At the end of the Dissertation the student is expected to be able to:
Have an overall knowledge of the state of the art in the study area;</td></tr>
</table>

	Ability to conduct research in a structured way, leading to the presentation of scientific results and critically compare them with other works in the area; Detailed understanding of the main scientific concepts and techniques in the field and study area.
Bibliography:	Specific bibliography will be proposed according to the Project or Internship or Dissertation areas.
Progress assessment:	Progress monitored by the Scientific/Academic Supervisors and the Company Supervisor (if applicable); Public examination with an oral presentation and discussion of the Project Work or the Internship Report or the Dissertation in front of a jury appointed by the Scientific Council and in accordance with the Master Rules.

	Distributed Industrial Systems
	677812 - Distributed Industrial Systems
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)#	**Activities** / **Total Hours** / **Hours/week** / **Comments** **Theoretical** / 28 / 2 / Classroom **Theoretical-Practical** / -- / -- / -- **Practical** / 28 / 2 / Laboratory **Tutorial guidance** / -- / -- / Students have weekly support through the office hours of teachers
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Coimbra Institute of Engineering

Course Unit Description

Subject Title:	**Robotic Systems**
Scientific Area:	Electrical Engineering
Course:	6778 - Master Course in Electrical Engineering
Code:	**677811 - Robotic Systems**
Year/Semester:	1st / 2nd
ECTS:	6
Department:	Department of Electrical Engineering
Instructor:	João Paulo Morais Ferreira, PhD; Fernanda Madureira Coutinho , PhD.
Study plan:	1. Introduction to Robotics 2. Main configurations of robots 3. Fundamentals of robotics 4. Sensors for industrial robots 5. Safety systems for the protection of robotic cells 6. Teleoperation and telepresence 7.Paths planning 8. Mobile robotic systems 9. Robots programming languages 10. Simulation tools for robotics systems
Language:	Portuguese and/or English
Type of instruction:	

Activities	Total Hours	Hours/week	Comments
Theoretical	28	2	Classroom, Lectures
Theoretical-Practical			
Practical	26	2	Classroom, Laboratory work
Seminar	2		Specific topic industrial seminar
Tutorial guidance			Students have weekly voluntary support through instructor's office hours (6 hours availability, overall)

Learning objectives:	This course on Robotic Systems aims to provide students with an overview of issues and technologies involved in designing and implementing robots in industrial systems. Students examine and evolve on the understanding of these topics through the implementation of real systems.
Generic learning outcomes and competences:	At the end of this course unit the learner is expected to be able to: Program robots; Develop control of an existing robot in the robotic simulator; Identify the more adequate robot, safety systems, sensors and tools for different applications. The teaching method is conventional, based on the exposure of the subjects in lectures, problem solving in practical classes and laboratory demonstrations. As basic text book [1] in the bibliography is used. In addition to being an easy reading text, it covers the entire course. Exposure of the topics is preferably carried out in the blackboard. The study of topics is accompanied by laboratory work, so students can execute numerous experiments.
Bibliography:	1. Fu, K.-S., Gonzalez, R. C., and Lee, C. S. G. Robotics: Control, Sensing, Vision and Intelligence.

	McGraw-Hill series in CAD/CAM, robotics and computer vision. McGraw-Hill, 1987. 2 Robotics Industries Association. American national standard for industrial robots and robot systems—Safety requirements, ANSI/RIA R15.06, 1992. 3. John j. Craig, “Introduction to Robotics Mechanics and Control”, Addison-Wesley Publishing Company, 1989. 4. L. Sciavicco. B. Siciliano, ”Modelling and Control of Robot Manipulators”, Springer, ISBN 1-85233-221-2, 2001. 5. Introduction to Robotics Mechanics & Control, John Craig, Addisson-Wesley. 6. Introduction to Robotics, Phillip John Mckerrow. 7. J. Ferreira, Notes of the lectures and practices. 8. Inform manual and Motoman guide.
Progress assessment:	Practical work carried out represents 50% of the final grade. The remaining 50%, result from a written exam. In any of these assessments it is necessary to obtain a rating equal to or higher than 8 (in a scale of 20). There are two opportunities to complete the written exam, 1st call and time of appeal within the time limits set by the Pedagogical Council. Each written test will include theoretical and theoretical-practical questions and will last for 2 hours.

Subject Title:	**Sustainable Development and Environmental Management**
Scientific Area:	Electrical Engineering
Course:	6778 - Master Course in Electrical Engineering
Code:	**677810 - Sustainable Development and Environmental Management**
Year/Semester:	First Year / Second Semester
ECTS:	6
Department:	Electrical Engineering
Instructor:	Luís Castro, Phd; Dulce Coelho, Phd;
Study plan:	Part I – Sustainable Development The concept of sustainability and sustainable development. Principles of Sustainable Development: economic development, social development and environmental protection. International activities. The local context. Local Agenda 21. The Covenant of Mayors. Sustainable Energy Action Plans. The use of indicators. Energy and Sustainable Development. Principles of sustainable energy. Energy Efficiency: The role of energy efficiency in achieving sustainable development; End-use efficiency. Renewable energy: The role of technological development. Integrated resource planning. Sustainable Urban Energy Planning. A Methodology to Support Sustainable Urban Energy Planning.
	Part II - Environmental Management Introduction to Environmental Management Systems. Motivation for the implementation of an Environmental Management System. The NP EN ISO 14001:2012 standard and the European Eco-Management and Audit Scheme – EMAS. Design and implementation of Environmental Management Systems. The requirements of the standard NP EN ISO 14001:2012. Environmental Certification Process. Environmental Audits: The NP EN ISO 19011:2012 standard.
Language	Portuguese and/or English
Type of instruction:	

Activities	Total Hours	Hours/week	Comments
Theoretical	28	2	Lectures
Theoretical-Practical			
Practical:	24	2	Work / Work Group, Laboratory work
Seminar	4	-	Specific Topic Seminar
Tutorial guidance			Students have weekly voluntary support through instructor's office hours (6 hours availability)

Learning objectives:	The main aims of this course unit are:
	To provide deeper knowledge of sustainable development;
	To understand the relationship between energy systems and sustainable development;
	To learn of sustainable energy options;
	To learn about technologies and systems for improving energy efficiency;
	To understand the basic concepts of Environmental Management Systems (EMS).
	To learn the how to implement an EMS.
	To understand the basic concepts of EMS auditing.
Generic learning outcomes and competences:	At the end of this course unit the learner is expected to be able:
	Have significant capacity to conceptualize energy activities and their link to development issues; Promote energy efficiency and renewable energy sources;
	Design and understand an EMS; Develop the interpersonal skills and experience necessary for effective teamwork; Apply safety concepts and develop the professional responsibility for the quality of engineering work performed.
Bibliography:	Bibliography adapted to each issue
Progress assessment:	Continuous evaluation with periodic tests (50%); One laboratory project (50%)

Subject Title:	**Electric Traction and Vehicles**
Scientific Area:	Electrical Engineering
Course:	6778 - Master Course in Electrical Engineering
Code:	**677809 - Electric Traction and Vehicles**
Year/Semester:	First Year / Second Semester
ECTS:	6
Department:	Electrical Engineering
Instructor:	Paulo Pereirinha, PhD.
Study plan:	PART 1 – TRANSPORTS AND MOBILITY IMPORTANCE AND MAIN PROBLEMS. Sustainable mobility solutions.
	PART 2 – ELECTRIC ROAD VEHICLES 1- Battery EV (BEV) and HEVs: types and components; history; 2- Dynamic model; 3- Batteries: working principles; types, parameters and characteristics; charge/discharge; chargers; available commercial models; 4- Fuel cells: working principles; fuel cell system; parameters; types; fuel cells and hydrogen issues. 5- Supercapacitors and flywheels; 6- HEVs types and levels; strategies for efficiency increase; some models; 7- Main DC and AC motors and drives.
	PART 3 – RAILWAY ELECTRIC TRACTION 1- Short history; technological evolution; 2- Traction in Portugal; 3- Electric traction characteristics: voltages worldwide; electric schematics, DC urban line case study; locomotives and trains classification; 4- Dynamic model of a train; 5- Motors and drives for trains; 6- High speed trains. PART 4 – INTRODUCTION TO ELECTRIC BOATS
Language	Portuguese and/or English
Type of instruction:	

Activities	Total Hours	Hours/week	Comments
Theoretical	28	2	Classroom, Lectures
Theoretical-Practical			
Practical:	28	2	Classroom, Laboratory work
Seminar			
Tutorial guidance			Students have weekly voluntary support through instructor's office hours (6 hours availability)

Learning objectives:	The main aims of this course unit are to lead the students to: - Be aware of transports importance and issues; - Learn the advantages of electric traction; understand the need for new mobility concepts; - Learn the technologies used in electric vehicles (EV) and hybrid (HEV) for road, railway and water transportation; recognize the main technical issues related to the electric traction (specially for road EV); - Acquire technical knowledge and competences to embrace a career in this expanding area; - To learn how to seek information on this area.
Generic learning outcomes and competences:	At the end of this course unit the learner is expected to be able to: - present the importance and main problems of transportation and defend sustainable mobility solutions; - Know the technologies used in EV and HEV for road, railway and water transportation; - Size and simulate simplified traction systems for EVs; - Continue to follow and study the subject on its own after the end of the course.
Bibliography:	Teacher Lecture Slides and Laboratory Papers (with extensive selection of papers and webpages). - Mehrdad Ehsani, Yimin Gao, Ali Emadi: Modern electric, hybrid electric, and fuel cell vehicles: fundamentals, theory, and design, 2nd ed., CRC Press, 2010. - Leonard J. Beck MBA, V2G-101: A text about Vehicle-to-Grid (...), BookSurge Publishing, 2009. - Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, 2nd ed., CRC Press, Boca Raton, Florida, USA, 2010. - Pedro Granchinho, Sebenta de Tracção Eléctrica (cap. II e III), IPT, Tomar, 2004. - Bob Brant, Build Your Own Electric Vehicle, McGraw-Hill; 2nd ed, 2009. - C.P. Cabrita, "Princípios fundamentais da Tracção Ferroviária", Electricidade, nº 375, Março 2000. - James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons, New York, 2003. - Roger Kaller, Jean-Marc Allenbach, "Traction électrique", Vol. I, 2eme ed. 2008, Vol. II, 1995, Presses Polytechniques et Univ. Romandes. - Railway Technical Web Pages.
Progress assessment:	Final formal written exam (is worth 10 points over 20, which is the total grade; minimum score: 4.2 points over 10); Work/Project assessment with final report and oral presentation (is worth 10 points over 20; minimum score: 4.2 points over 10).

Subject Title:	**Power Systems Supervision and Control**
Scientific Area:	Electrical Engineering
Course:	6778 - Master Course in Electrical Engineering
Code:	**677808 - Power Systems Supervision and Control**
Year/Semester:	First Year/Second Semester
ECTS:	6
Department:	Electrical Engineering
Instructor:	Carlos Manuel Borralho Machado Ferreira, PhD
Study plan:	1. Supervision, control and protection of a Power System 2. Control Centres: Supervisory Control and Data Acquisition (SCADA); Energy Management Systems (EMS); Distribution Management Systems (DMS) 3. Load forecast 4. Electric Power Systems State Estimation: Introduction to State Estimation in Power Systems; Weighted Least Squares Estimation; State Estimation of an AC Network; Fast Decoupled State Estimation Methods; State Estimation by Orthogonal Decomposition; Network Observability and Pseudo-measurements, Detection and Identification of Bad Measurements 5. Electric Power Systems Stability: State Transition Diagram; Steady-state and Transient Stability; Multimachine Time Domain Solution by Numerical Integration; Classic Model and Detailed Model of the electric power network components; Techniques to Improve the Transient Stability of an EPS; Voltage Stability; Frequency Stability 6. Integration of Renewable Energy in Electric Power Systems
Language:	Portuguese and/or English
Type of instruction:	

Activities	Total Hours	Hours/week	Comments
Theoretical	28	2	Classroom, Lectures
Theoretical-Practical			
Practical	28	2	Classroom, Laboratory work
Tutorial guidance			Students have weekly voluntary support through instructor's office hours (6 hours availability, overall)

Learning objectives:	The main aims of this course unit are: To understand and explain the SCADA/EMS/DMS. To understand the main load forecasting techniques. To understand and explain the automatic generation control and carry out a small-signal analysis of a multi-area system. To understand and to explain dynamic mechanisms behind angle stability problems in electric power systems, including physical phenomena, modelling issues and simulations. To understand the weighted least-squares state estimation method of an electric power system. To understand the main issues related to the integration of alternative sources of energy into the electric power grid.

Generic learning outcomes and competences:	At the end of this course unit the learner is expected to be able: To understand the main functions and issues involved in different activities associated with power systems supervision and control. To design, conduct experiments and solve practical real-world issues in power systems control and operation. To identify, formulate and solve engineering problems related to power system control and stability. To communicate in a professional and technical manner, both in written and oral form, the subjects related to this course.
Bibliography:	– Gómez-Expósito, A. Conejo, C. Cañizares, Electric Energy Systems: Analysis and Operation, CRC Press, 2008. – Wood, B. Wollenberg, G. Sheblé, Power Generation, Operation and Control, 3rd Edition, Wiley Interscience, 2013. – Fox, et al., Wind Power Integration: Connection and system operational aspects, 2nd Edition, IET, 2014. – H. Saadat, Power Systems Analysis, PSA Publishing, 3rd Edition, 2010. – J. P. Sucena Paiva, Redes de Energia Elétrica, uma Análise Sistémica, 3.ª Edição, IST Press, Coleção Ensino da Ciência e da Tecnologia, 2012. – J. Grainger, W. Stevenson, Jr., Power System Analysis, McGraw-Hill International Editions, 1994. – M. Bollen, F. Hassan, Integration of Distributed Generation in the Power System, IEEE Press Series on Power Engineering, Wiley-IEEE Press, 2011. – R. Castro, E. Pedro, Exercícios de Redes e Sistemas de Energia Elétrica, IST Press, Coleção Apoio ao Ensino, 2014.
Progress assessment:	The teaching methodologies, that promote active and collaborative learning, follow a temporal sequence that enables students to acquire theoretical concepts, solve a set of exercises and carry out practical case studies. In order to analyze some complex engineering problems dedicated software is introduced to the students. The continuous evaluation implies the completion of 2 tests during the semester (TE1 and TE2). The final grade (NF) is computed as: NF = 0.5 TE1 + 0.5 TE2, the minimum grade for theoretical component as well as for the practical component is 4 points, in each partial assessment. The evaluation by final exam (FE) has a written assessment that replaces the partial tests. In this case, the final grade is given on the basis of the examination alone, NF = FE. Approbation in the curricular unit is obtained if NF >= 9.5 points (scale 0-20).

Subject Title:	**Energy Markets**
Scientific Area:	Electrical Engineering
Course:	6778 - Master Course in Electrical Engineering
Code:	**677807 - Energy Markets**
Year/Semester:	First Year / Second Semester
ECTS:	6
Department:	Electrical Engineering
Instructor:	Adelino Pereira, PhD.
Study plan:	1. Evolution of energy systems in a market environment. 2. Market structures of electricity. 3. Regulatory policies. 4. Methods of assessment and justification of spot prices. 5. Markets energy production. 6. Tariff systems. 7. Structure and operation of MIBEL. 8. World energy situation. 9. Natural Gas Market. 10. Coal Market. 11. Oil Market. 12. Renewable Energy Market.
Language	Portuguese and/or English
Type of instruction:	

Activities	Total Hours	Hours/week	Comments
Theoretical	28	2	Classroom, Lectures
Theoretical-Practical	12	1	
Practical:	12	1	Classroom, Laboratory work
Seminar	4		Specific Topic Seminar
Tutorial guidance			Students have weekly voluntary support through instructor's office hours (6 hours availability)

Learning objectives:	The main aims of this course unit are: Analyze the most relevant models that have been used to form the new skeleton of power systems: restructuring of tariff systems; the Portuguese electricity sector and the MIBEL; regulation and regulatory approaches; the basic economics and engineering used to design power markets; nodal marginal pricing; and investment analysis; Analyze the natural gas coal, oil and renewable energy market; An important objective of this course is to contribute to develop the capacity of the students

	to work autonomously, to do bibliographic research, to prepare written reports and to deliver oral presentations. At the end of this course unit the learner is expected to be able: To understand the Market structures of electricity. To understand the standard principles of bilateral markets, exchanges and pools. To understand the natural gas, coal, oil and renewable energy market. To understand the basic economics and engineering used to design energy markets.
Generic learning outcomes and competences:	The program contents have been defined in order to introduce students to the fundamental aspects associated the restructuring of the electric sector and the creation of a competitive market for electricity. In this perspective are presented several examples of market structures implemented in different countries, with emphasis on the structure and functioning of the MIBEL. Are addressed the aspects to be taken into account in developing new regulations, tariff systems and forms of energy transaction. Are presented the key concepts associated for natural gas, coal, oil and renewable energy markets. These concepts are presented using real examples and analysis of technical reports.
Bibliography:	Teacher Lecture Slides and Laboratory Papers. J. P. Sucena Paiva, Redes de Energia Eléctrica, uma Análise Sistémica, 2.ª Edição, IST Press, Dezembro de 2007. João Paulo Tomé Saraiva, J. Pereira da Silva, M. T. Ponce de Leão, Mercados de Electricidade – Regulação e Tarifação de uso das Redes, Edição da Faculdade de Engenharia da Universidade do Porto, 2002. Pedro Gonçalves, Regulação, Electricidade e Telecomunicações - Estudos de Direito Administrativo da Regulação, Coimbra Editora, 2008. Jorge Vasconcelos, Anos-Luz, A regulação da Energia Eléctrica em Portugal, Entrelinhas, Novembro de 2006. João J. E. Santana, Maria José Resende, Reflectir Energia, ETEP - Edições Técnicas e Profissionais, Setembro de 2006. Luís Mira Amaral, Energia e Mercado Ibérico, Booknomics, Junho de 2006. S. Hunt, G. Shuttleworth, Competition and Choice in Electricity, Wiley, 1996. Daniel S. Kirschen, Goran Strbac, Fundamentals of Power System Economics, Wiley, 2004. C. Harris, Electricity Markets: Pricing, Structures and Economics, Wiley, 2006. Documentação da ERSE (www.erse.pt) IEA - International Energy Agency (www.iea.org/) Biblioteca do conhecimento online (www.b-on.pt)
Progress assessment:	Laboratory work in group (50% of the evaluation); Final written exam (50% of the evaluation, minimum of 40%).

Subject Title:	**Renewable Energies**
Scientific Area:	Electrical Engineering
Course:	6778 - Master Course in Electrical Engineering
Code:	**677806 - Renewable Energies**
Year/Semester:	First Year / Second Semester
ECTS:	6
Department:	Electrical Engineering
Instructor:	Cristina Faustino Agreira, PhD; Paulo Fonte, PhD.
Study plan:	Part I Theoretical A minimum of thermodynamics The physical nature of energy Principles of thermodynamics Main variables and thermodynamic transformations Income thermal cycling Practical thermal cycles Global renewable energy resources. Practice Resolution of the illustrative problems
	Part II Theoretical Conventional electricity generation Small hydro wind energy Solar energy, Photo- electricity. Nuclear energy. Biomass energy , Geothermal energy , Energy of the waves. Hydrogen and fuel cells. Practice Exercises of Small Hydro for energy production. Exercises of wind power plant for energy production. Exercises of solar power for energy production. Group work on renewable energy with the Software RETScreen .
Language	Portuguese and/or English
Type of instruction:	

Activities	Total Hours	Hours/week	Comments
Theoretical	28	2	Classroom, Lectures
Theoretical-Practical			
Practical:	24	2	Classroom, Laboratory work
Seminar	4		Specific Topic Seminar
Tutorial guidance			Students have weekly voluntary support through instructor's office hours (6 hours availability)

Learning objectives:	The main aims of this course unit are: Understanding modern energy paradigm; To be able select the best solutions for any situation.
Generic learning outcomes and competences:	At the end of this course unit the learner is expected to be able: Solve any problem related to Renewable Energies.
Bibliography:	Teacher Lecture Slides and Laboratory Papers Renewable energy resources, John Twidell, Anthony D. Weir, Tony Weir, Taylor & Francis, 2006, ISBN 0419253203, 9780419253204. Renewable Energy, Godfrey Boyle, Open University, Oxford University Press, ISBN 0199261784, 9780199261789. Fundamentals of renewable energy processes, Aldo Vieira Da Rosa, Academic Press, 2005, ISBN 0120885107, 9780120885107. Renewable energy: technology, economics, and environment, Martin Kaltschmitt, Wolfgang Streicher, Andreas Wiese, Springer, 2007, ISBN 3540709479, 9783540709473. Renewable energy: its physics, engineering, use, environmental impacts, economy, and planning aspects, Bent Sørensen, Academic Press, 2004, ISBN 0126561532, 9780126561531. Handbook of Energy Efficiency and Renewable Energy, Frank Kreith, D. Yogi Goswami, CRC Press, 2007, ISBN 0849317304, 9780849317309. Fundamentals of renewable energy processes, Aldo Vieira Da Rosa, Academic Press, 2005, ISBN 0120885107, 9780120885107. Termodinâmica Técnica / U. A. Kirillin, V. V. Sichev, A. E. Sheindlin. - Moscú : Mir, 1976. Fundamentals of Engineering Thermodynamics, M. Moran and H. Shapiro, John Wiley & Sons. TEST – The Expert System for Thermodynamics, http://www.thermofluids.net/. Nuclear energy technology: theory and practice of commercial nuclear power / Ronald Allen Knief. - Washington : Hemisphere Publishing Corporation, 1981.
Progress assessment:	Module I Final written exam: 4 values. Module II Final Written for theoretical part: 10 values. Final exam on the practical part which includes group work: 6 Values. The works are made by groups of 2 students, and will be the subject of 15-minutes presentation (each group) to be held in the last practice session of the module.

<table>
<tr><td>Subject Title:</td><td>Industrial and Enterprise Communications</td></tr>
<tr><td>Scientific Area:</td><td>Electrical Engineering</td></tr>
<tr><td>Course:</td><td>6778 - Master Course in Electrical Engineering</td></tr>
<tr><td>Code:</td><td>677803 - Industrial and Enterprise Communications</td></tr>
<tr><td>Year/Semester:</td><td>First Year / FIrst Semester</td></tr>
<tr><td>ECTS:</td><td>6</td></tr>
<tr><td>Department:</td><td>Electrical Engineering</td></tr>
<tr><td>Instructor:</td><td>Alexandre Miguel de Gouveia e Melo (module 1) João Carlos Perdigoto (Module 2)</td></tr>
<tr><td>Study plan:</td><td>It is intended to introduce a broad set of concepts of communication technologies and telecommunications systems used in industrial environments and business. Also Data networks, the Internet and its essential services are covered.</td></tr>
<tr><td>Language:</td><td>Portuguese</td></tr>
<tr><td>Type of instruction:</td><td>
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<tr><th>Activities</th><th>Total Hours</th><th>Hours/week</th><th>Comments</th></tr>
<tr><td>Theoretical</td><td>28</td><td>2</td><td>Classroom, Lectures</td></tr>
<tr><td>Theoretical-Practical</td><td></td><td></td><td></td></tr>
<tr><td>Practical</td><td>26</td><td>2</td><td>Classroom, Laboratory work</td></tr>
<tr><td>Seminar</td><td>2</td><td></td><td>Specific topic industrial seminar</td></tr>
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<tr><td>Learning objectives:</td><td>To acquire knowledge of the communication systems principles technologies and solutions.
To acquire knowledge of the networking systems principles technologies and solutions.</td></tr>
<tr><td>Generic learning outcomes and competences:</td><td>Knowing and understanding the technologies available in the market.
Knowledge and understanding of industrial communication systems, using equipment available in the market.
Knowing and understanding, choosing, designing, implementing and maintaining local area networks, using equipment available in the market. Understand and perform diagnostic problems in communication networks and industrial sites.
Know and understand the systems and telecommunications services
Know, understand telephone systems and optical communication systems.
Know, understand data networks and Internet.</td></tr>
<tr><td>Bibliography:</td><td>Teacher Lecture Slides and Laboratory Papers
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<tr><td>Progress assessment:</td><td>Final classification: 20 points maximum
Final Exam: 14 points ;
Practical classes: 4 points;
Research work: 2 points;</td></tr>
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<tr><td>Subject Title:</td><td>Industrial and Enterprise Communications</td></tr>
<tr><td>Scientific Area:</td><td>Electrical Engineering</td></tr>
<tr><td>Course:</td><td>6902 - Master Course in Automation and Communications in Energy Systems</td></tr>
<tr><td>Code:</td><td>690203 - Industrial and Enterprise Communications</td></tr>
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