Polytechnic Institute of Viseu

International Semesters for students

Electrical Engineering

Spring Semester

Semester title	Electrical Engineering	Semesters	Spring
Person responsible	**António Ferrolho**	**E-mail address**	antferrolho@estv.ipv.pt
Coordinator	**Daniel Albuquerque**	**E-mail address**	dfa@estgv.ipv.pt
Language of instruction	**English**	**ECTS points**	**a)**
Course type	**Course title**	**Name of the lecturer**	**ECTS points**
Optional	Electrical Power Management and Quality	Eduardo Gouveia	6,0
Optional	Microgeneration, Microgrids and Smart Grids	Paulo Moisés	6,5
Optional	Electric Mobility and Energy Storage	Joaquim Delgado	6,0
Optional	Signal Processing	Daniel Albuquerque	5,5
Optional	Modern Control	Miguel Lima	5,0
Optional	Industrial Robotics	António Ferrolho	6,0
Optional	Electrical Machines and Installations	Vasco Santos/ José Silva	6,0
Optional	Project	A tutor will be assigned	10,0

Notes:

a) The total ECTS credits must be at least equal to 30 chosen from de available offer (51 ECTS - previous table).

b) The student has the opportunity to sign up also courses taught by the Department of Mechanical Engineering and Industrial Management, in order to complement their training since there exists an interdepartmental protocol accordingly. Similarly, the student can also register at courses belonging to international semesters of other departments.

Course title	**Electrical Power Management and Quality**		
Teaching method	Classes (theoretical and practical) and labs.		
Person responsible for the course	**Eduardo Gouveia**	E-mail address:	egouveia@estv.ipv.pt
Language of instruction	English	ECTS points	6,0
Semester	Spring	Type of course	optional
Hours per week	2T + 1,5 TP + 1,5 P	Hours per semester	26T + 19,5TP+19,5P
Objectives/skills of the course	Main objectives/skills of the course: Understand the energy markets; Understand and apply electric tariffs; Developing strategies for the purchase / sale of electricity; Understanding the differences between classical and high performance equipments; Define rationalization plans of consumption taking into account current legislation and incentive programs that may exist; Accomplish power quality measurements; Assess the results of measurements and identify appropriate ways of act in accordance with the legislation; i) Knowing, select and implement solutions to mitigate power quality problems; Be able to build solutions for managing electricity using commercially available resources;		
Entry requirements	There aren't any.		
Course contents	1. Electricity markets Access to electricity grids Regulation (quality of service, tariff) Traders Tariff System 2. Rationalization of energy consumptions Survey and energy audit; Rationalization Plans Measurement of electrical consumptions Energy Management systems Solutions (including economic analysis). 3 – Power Quality Quality and reliability provided by the electrical distributor Quality disturbances, its causes and consequences Behavioral of electrical loads under power quality disturbances Identification and measurement of power quality at industrial facilities Standards for power quality Solutions New technologies in power quality.		
Assessment methods	Will be admitted to the evaluation all students who attend at least 2/3 of practical classes (performing all reports successfully). Minimum score (for admission to the written test) in practical reports is 9,5 (0 to 20)values. Minimum score on the written test is 8 values. Final classification provided by (1). Final classification = 60% written test + 40% practical work (1)		
Recommended readings	Arrilaga J; Watson N. R., "Power System Harmonics", John Wiley & Sons Ltd, 2003 (ESTGV library - 621.3.05 ARR) Dugan R. C. "Electrical power systems quality", McGraw-Hill, 2003 (ESTGV library: 621.3.05 ELE) Seip, Gunter G, "Electrical Installations Handbook" Siemens, 2000 (ESTGV -621.3 SEI) Schlabbach J., Blume D., Stephanblome T., "Voltage quality in electrical power systems",		

	Stevenage 2001 (ESTGV library - 621.3.05 SCH) Kreith F., Goswami D., " Energy management and conservation handbook", Boca Raton : CRC Press , 2008 (ESTGV library - 620.9 ENE) Sumper A., Baggini A., "Electrical Energy Efficiency: Technologies and Applications", Willey 2012 (available at http://books.google.pt/)
Additional information	

Course title	**Microgeneration, Microgrids and Smart Grids**		
Teaching method	The contents of the course will be studied by using different teaching methods, namely: lectures based on power point presentations; case studies and respective discussion, movies, group assignment.		
Person responsible for the course	**Paulo Moisés Costa**	E-mail address:	paulomoises@estv.ipv.pt
Language of instruction	English	ECTS points	6,5
Semester	Spring	Type of course	optional
Hours per week	1T + 1,5TP	Hours per semester	13T + 19,5TP
Objectives/skills of the course	It is intended to provide students with a set of skills related to emerging concepts of microgeneration, microgrids , and smart grids, including: - Knowledge about most promising microgeneration units - Selection and optimization of microgeneration units - Sizing microgeneration infrastructures - Constitution and characteristics of microgrids - Integration of microgeneration and microgrids in electric power systems - Knowledge about smart grids and the potential benefits they may bring, namely concerning demand response, new arrangements for electricity purchase, systems services provision, etc.		
Entry requirements	There aren't any.		
Course contents	1. Microgeneration and minigeneration - Concept and Legislation; - Technologies (solar photovoltaic, micro-wind turbines, small scale hydroelectricity, micro-CHP (cogeneration), including biomass heating systems; - Design, optimization and operation of microgeneration units - Sizing microgeneration hybrid systems - Economic analysis of microgeneration units; - Technical impacts on electrical networks; 2. Microgrids - Concept, constitution and characteristics; - Advantages for electrical systems from different point of views: consumers, investors, society and network operators; - Integration of microgrids on electric power systems; - Energy condominiums: concept and sizing; 3. SmartGrids - Concept, constitution and characteristics; - Advantages for electrical systems from different point of views: consumers, investors, society and network operators; 4. The influence of Smartgrids on the new arrangements of the electrical system, namely concerning electric distribution networks - virtualpower plants - microgrids - load response - real-time prices - provision of system services. - Technical and economic challenges of the emerging concepts in the context of smart distribution networks.		

Assessment methods	Final classification = 60% final written exam + 40% practical work; Will be admit to the exam all students who attend at least to 2/3 of the classes. There is a minimum score on the written test equal to 9,5 points on a 0-20 scale.
Recommended readings	Dave Parker, "Microgeneration: Low energy strategies for larger buildings", Elsevier, 2009 Chris Kitcher, „A Practical Guide to Renewable Energy: Power Systems and Their Installation", Routledge, 2011 J. Duncan Glover,Mulukutla S. Sarma,Thomas Jeffrey Overbye, "Power System Analysis and Design", Cengage Learning, 2011 Hatem Hussein Magdy Zeineldin, „Distributed Generation Micro-grid Operation: Control, Protection, and Electricity Market Operation", University of Waterloo (Canada), 2006 James Momoh, „Smart Grid: Fundamentals of Design and Analysis", **Wiley, 2012**
Additional information	

Course title	**Electric Mobility and Energy Storage**		
Teaching method	During the course different teaching methods will be used: lectures, case studies, discussions, movies, self study and Test-Drive.		
Person responsible for the course	**Joaquim Delgado**	E-mail address:	jdelgado@estv.ipv.pt
Language of instruction	English	ECTS points	6,0
Semester	Spring	Type of course	optional
Hours per week	1,5T + 1TP	Hours per semester	19,5T + 13 TP
Objectives/skills of the course	Main objectives of the course: Comprehend the fast ongoing changes in the paradigm of mobility systems and acquire knowledge to act as high skilled player in this emerging strategic domain. Specific skills to obtain: - Understand clearly the energy and environmental contexts that are provoking the challenge. - Acquire capability to understand how the car body and shape, weight, rolling friction and power drive can be used to improve the energy efficiency. - Acquire competence to project the energy storage system, as well the propulsion drive system to reach a specified autonomy and performance. - Select all the necessary components. - Program the controllers to optimize the propulsion and regeneration. - Evaluate the overall life cycle operating costs of one electric vehicles fleet compared with a similar conventional fleet. - Quantify the effective emissions of CO2 for each alternative considering the energy *mix* of the source from where the electric vehicle is feed. - Act with efficacy at the maintenance level of the energy storage system, power drive and other strategic components of the electrical vehicles that are arriving.		
Entry requirements	There aren't any.		
Course contents	1. Introduction – The ongoing energy shift paradigm and the evolution of the electro mobility transport sector. 2. Cinematic of the vehicles. 3. Power Drive architectures. 4. Batteries used in electric vehicles. 5. Battery Management Systems (BMS). 6. Supercapacitors as alternative energy storage devices. 7. Controllers. 8. Electric Motors (AC induction motors and Permanent Magnet Motors). 9. Recharging alternatives and required infrastructures. 10. Inductive recharging systems. 11. Overall environmental impact of the electric vehicles. 12. Electric Vehicles *versus* conventional mobility, evaluation of Total Cost of Ownership. 13. The ongoing hybridization of conventional vehicles. 14. Evolutions in electric mobility. 15. Conclusions.		

Assessment methods	Will be admitted to the evaluation all students who attend at least 2/3 of practical classes (performing all reports successfully). Minimum score (for admission to the written test) in practical reports is 9,5 (0 to 20) values. Minimum score on the written test is 9,5 values. Final classification = 60% written test + 40% practical work.
Recommended readings	Joaquim Delgado, "Electric Mobility" internal publication of ESTGV prepared for support of the Electric Mobility course, December/2012. Gary Kendall, "PLUGGED IN – The end of Oil Age", WWF European Policy Office edition, 2008. James Larminie and John Lowry, "Electric Vehicle Technology Explained", John Wiley and Sons Publication, ISBN 0-470-85163-5, 2003. Seth Leitman and Bob Brant , "Build your own Electric Vehicle", second edition, Mac Graw Hill, 2009. Nuno Melo, "Potential of PEV to provide ancillary services in a smart grid context – the Portuguese case", Msc. Thesis on Energy Systems Policies; January/2012. Robert L. Evans, "Fuelling Our Future – An introduction to Sustainable Energy", Cambridge University Press, 2008. (All available in digital support).
Additional information	At the end of the course we will have one commercial electric vehicle available to observe the state of this technology and perform a short Test-Drive in the ESTGV campus.

Course title	**Signal Processing**		
Teaching method	During the course, it will be implemented the follow teaching method: It will start by subject exposition using several practical examples wherever it is possible. Followed by some exercises that must be solved both in groups and individually. Finally, it will be implemented, testes and analyzed some signal processing tools to solve a proposed practical problem.		
Person responsible for the course	**Daniel Filipe Albuquerque**	E-mail address:	dfa@estv.ipv.pt
Language of instruction	English	ECTS points	5,5
Semester	Spring	Type of course	optional
Hours per week	1,5T + 1TP + 2P	Hours per semester	19,5T + 13TP + 26P
Objectives/skills of the course	The course Signal Processing has the main goal of transmitting the basic concepts in the signal processing area with a special emphasis on the digital signal processing, as well as, signal acquisition, representation and transmission. The topics to be address include: analog to digital signal conversion and representation; signal processing in time and frequency domain; digital signal transmission and sharing the transmission channel. The course aims to provide students with the ability of design; analyze several simple signal processing algorithms that are applied in several practical situations from the acquisition point to the transmission point, always encouraging critical thinking in proposals as well as in the techniques used in some equipment that surround us.		
Entry requirements	There aren't any.		
Course contents	1. Systems and Signal Processing in time and frequency domain 1.1. System/signal notion and analysis 1.2. Z and Fourier transforms 1.3. Fourier series 2. Signal Sampling 2.1. Sampling Theory (time/frequency) 2.2. Aliasing; quantification; conditioning 2.3. Signal reconstruction (time/frequency) 3. Signal Transmission 3.1. Information theory 3.2. Amplitude, phase and amplitude and phase modulation 4. Analog digital applications 4.1. Multiplexing and information codification 4.2. Time, frequency and code multiplexing 4.3. Data transmission and shared medium 5. Introduction to Numeric processing 5.1. Discrete system and discrete signal processing 5.2. Fast Fourier transform 5.3. Signal microprocessor 5.4. Software tools 5.5. Introduction discrete filters FIR and IIR		

Assessment methods	The assessment imposes to the student a minimum attendance of 75% in practical and theoretical-practical lectures. The final grading is composed by the grade obtained in a written exam and the grade obtained in the practical component. In any written exam moment the practical component has a 40% weight and the written exam a 60% weight of the final mark. The minimum required mark for the written exam is 40%.
Recommended readings	J. G. Proakis, D. G. Manolakis, *Digital Signal Processing: Principles, Algorithms and Applications.* Prentice Hall, 3a Edição, 1996 J. G. Proakis, M. Salehi. *Communication Systems Engineering.* Prentice Hall, 1994 S. K. Mitra. *Digital Signal Processing - A computer based Approach.* McGraw Hill, 1998 A. V. Oppenheim, A. S. Willsky. *Signal & Systems*. Prentice Hall, 1996 S. Haykin, *Communication systems*, New York: John Wiley & Sons, 1994 P. Denbigh. *System Analysis & Signal Processing*. Addison - Wesley, 1998
Additional information	

Course title	**Industrial Robotics**		
Teaching method	During the course many different teaching methods will be used: self study, case studies, lectures, discussions, movies, group assignment and field trips.		
Person responsible for the course	**António Ferrolho**	E-mail address:	antferrolho@estv.ipv.pt
Language of instruction	English	ECTS points	6,0
Semester	Spring	Type of course	optional
Hours per week	1T+1,5TP+2P	Hours per semester	13T+19,5TP+26P
Objectives/skills of the course	Main objectives/skills of the course: - Identify the advantages resulting from the use of robots in modern manufacturing processes; - Knowing how use actuators and sensors in industrial robotics; - Learning to program industrial robots; - Know and to use communicating with industrial robots; - Integrate and control robots in industrial systems; - Know the inspection techniques used in quality control.		
Entry requirements	There aren't any.		
Course contents	1 - Introduction to Industrial Robotics 1.1-Areas of application for robots 1.2-Anatomies and different types of robots 1.3-Coordinate systems and workloads 1.4-Examples of applications in industry 2 - Safety in the operation of industrial robots 2.1-Safety Rules 2.2 Security procedures 3 - Programming of industrial robots 3.1-Mode programming: techniques and languages 3.2-RAPID - programming language ABB robots 4 - Kinematics and Dynamics 5 - Computer Numerical Control (CNC) 5.1-Direct Numerical Control (DNC) 5.2-Introduction to programming CNC machines 5.3-Computer-Aided Design and Computer-Aided Manufacturing (CAD/CAM) 6 - Technical inspection in quality control 6.1-Technical inspection by contact versus non-contact 6.2-Coordinate Measuring Machines (CMM) 6.3-Other inspection techniques 7 - Integration and control of robots in industrial systems 7.1-Flexible Manufacturing Systems (FMS)		
Assessment methods	Evaluation methodology: 1. Evaluation by frequency (frequency written) with the minimum score of 9.5 out of 20. 2. Evaluation through practical work - reports, work in classrooms, computer programs and presentations (30%). 3. A final exam during the regular evaluation period with the minimum score of 9.5 out of 20. 4. A final exam with the minimum score of 9.5 out of 20.		

Recommended readings	CRAIG, John G. - Introduction to robotics: mechanics & control. Reading: Addison-Wesley Publishing Company, 1986. ISBN 0-201-10326-5. GROOVER, Mikell - Automation, production systems, and computer-integrated manufacturing / Mikell P. Groover. 2ª ed. New Jersey: Prentice-hall, 2001. ISBN 0-13-088978-4. FU, K.S.; GONZALEZ, R.C.; LEE, C.S.G. - Robotics: control, sensing, vision, and intelligence. New York: McGraw-Hill, 1987. ISBN 0-07-022625-3. KIEF, Hans B.; WATERS, T. Frederick - Computer numerical control. Illinois: Glencoe, 1992. ISBN 0-07-112673-2. MCKERROW, Phillip John - Introduction to robotics. Singapore: Addison-Wesley, 1990. ISBN 0-201-18240-8.
Additional information	

Course title	**Modern Control**		
Teaching method	Methodologies used: Lectures – expository method using the video projector and black/white board. Practical lessons – The students implement practical works that contribute to the final evaluation. The practical works allow students to consolidate knowledge on the subjects taught in Lectures At the end of the semester all the workgroups present the own work, so that all students have a view of the different works done.		
Person responsible for the course	Miguel Lima	E-mail address:	lima@estv.ipv.pt
Language of instruction	English	ECTS points	5,0
Semester	Spring	Type of course	optional
Hours per week	1,5T + 2TP	Hours per semester	19,5T + 26P
Objectives/skills of the course	Study of the mathematical tools for the performance analysis of the continuous systems, including methods for controllers design, both with the output feedback and with the state space. These tools allow the improvement of the industrial systems performance, both in the transient and in the steady-state responses. Additionally, after completing this course, students should be able to design observers to estimate the states of industrial systems. Competencies to acquire: O1- Analysis and design of controllers for linear systems using the state space representation. O2- Design observers for linear systems. O3- Capability to relate the modern control approach and the industrial processes. O4- Ability to apply the learned tools to improve the industrial processes.		
Entry requirements	Knowledge of classical control is recommended.		
Course contents	1. Mathematical model of the control systems a. State space and transfer function representation b. Multivariable control systems c. State space d. Resolution of the state equation e. Transfer function versus state equations f. Canonical form representations of the state space 2. Design of controllers a. Performance specifications b. Output feedback c. State feedback: controllability and observability 3. State variable feedback a. Pole placement b. The problem of regulation and tracking c. Multivariable systems d. Eigen vectors of the plant matrix and their contribution to the time response 4. Observers and state estimation a. Simple, full and reduced order observers b. Use of observers in close-loop systems c. Design of observers. Separation theorem.		

Assessment methods	The final grade of the students will be based on three components: - a written exam - 50% - a project work - 40% - the attendance and the participation – 10% Each evaluation component will receive a grade between 0 and 20. The students must achieve a minimum of 9.5 on each component. The students will be approved if their final grade is equal or superior to 9.5 on a 0-20 scale.
Recommended readings	- A. FRANK D'SOUZA, Design of Control Systems, Prentice-Hall International, Inc, (1988) - JOHN J. D'AZZO, CONSTANTINE H. HOUPIS, Linear Control System Analysis and Design - Conventional and Modern, McGraw-Hill, 3 Edition (1988) - GENE F. FANKLIN , J. DAVID POWELL, ABBAS EMAMI-NAEINI, Feedback control of dynamic systems, 3rd edition - K. OGATA, Engenharia de Controle Moderno, Prentice-Hall Brasil, 2edição, (1990) - J. L. MARTINS DE CARVALHO, Dynamical Systems and Automatic Control, Prentice-Hall International Series in systems and Control Engineering - RICHARD C. DORF, ROBERT H. BISHOP, Modern Control Systems, Addison-Wesley, 8th edition (1998) - NORMAN S. NISE, Control systems engineering, Addison-Wesley, 2nd edition (1995) - K. DUTTON, STEVE THOMPSON, BILL BARRACLOUGH, The Art of CONTROL ENGINEERING, Addison-Wesley (1997) - Teacher-prepared notes
Additional information	

Course title	**Electrical Machines and Installations**		
Teaching method	Self study, case studies, lectures, discussions, group assignment, laboratory exercises with reports and course work with description and defense.		
Person responsible for the course	**Vasco Santos, José Silva**	E-mail address:	vasco@estv.ipv.pt, jsilva@estv.ipv.pt
Language of instruction	English	ECTS points	6,0
Semester	Spring	Type of course	optional
Hours per week		Hours per semester	13T+32,5TP+19,5P
Objectives/skills of the course	Main objectives/skills of the course: To introduce students to the general issues concerning the design, principle of operation and characteristics of the following types of electrical machines – transformers, DC motors, induction motors, special induction motors and induction micro-motors. The physical nature of electromagnetic phenomena in electrical machines is discussed on the basis of the respective mathematical apparatus. The main relationships from electrical machines theory are derived. The lecture material is presented from both the viewpoint of design and practical application of electrical machines in electric power engineering and electric drives.		
Entry requirements	There aren't any.		
Course contents	MODULE 1- THREE FASE ELECTRICAL SYSTEM Voltage. Electrical current. Electrical power. Power factor. Problems of resolution. MODULE 2- TRANSFORMERS Introduction to transformers. Voltage and Current Transforms. Transformers selection. Problems. MODULE 3- ROTATING MACHINES Electromechanical conversion principles. DC Motors. AC Motors. Servomotors. MODULE 4- SPEED AND TORQUE CONTROL Techniques for control of electric machines. Control of DC Motors. Different type of load. Variable speed drives. MODULE 5- ELECTRIC CONDUCTORS Nomenclature. Nominal voltages and maximum intensities. Dimensioning. Short-circuit intensity. MODULE 6- COMMAND DEVICES AND PROTECTION Operating principle and device classification. Contactors. Relays. Timers. Discontactor. Circuit breaker. Fuses and differentials. MODULE 7- SECURITY SYSTEMS Types of contacts. Electrical shock in body. Methods of protection. Index of protection. MODULE 8- QUALITY OF THE ENERGY Compensation of electrical power. Lighting. Rational use of energy in lighting. Tariffs. Sale of power to the electrical grid. Power quality disturbances.		
Assessment methods	Will be admitted to the evaluation all students who attend at least 2/3 of practical classes (performing all reports successfully). Minimum score (for admission to the written test) in practical reports is 9,5 (0 to 20)values. Minimum score on the written test is 8 values. Final classification provided by (1). Final classification = 60% written test + 40% practical work (1)		

Recommended readings	Fitzgerald A. E., Kingsley J.C., "Electric Machinery", McGraw-Hill, 2003, ISBN: 0-07-366009-4. Seip, Gunter G.; "Electrical Instalations Handbook"; John Wiley & Sons, 2000. Nasar, Syed A.; "*Electric Machines and Power Systems*", vol 1; McGraw-Hill, 1988. Charles I Hubert; "*Electric Machines – Theory, Operation, Applications, Adjustment and Control*", Pearson US Imports & PHIPEs, 1991
Additional information	

Course title	**Project**		
Teaching method	Besides the formal classes, during the course the teaching method will be mostly self study and project development with a supervisor choose according with the project's area.		
Person responsible for the course	**A tutor will be assigned**	E-mail address:	
Language of instruction	English	ECTS points	10,0
Semester	Spring	Type of course	optional
Hours per week	1T+4PL+2OT	Hours per semester	13TP+52PL+26OT
Objectives of the course	Promoting working experience in an enterprise scenario or in ESTGV laboratories, applying competences acquired in other courses of this international semester.		
Entry requirements	There aren't any.		
Course contents	Project planning, development and implementation; Write reports; Public presentation.		
Assessment methods	Students will present and discuss their project it in a public session and the final grade will be decided by a jury evaluation		
Recommended readings			
Additional information			