International Semesters for Students
Academic Year 2013/2014

Electrical Engineering
Spring Semester

<table>
<thead>
<tr>
<th>Semester title</th>
<th>Course title</th>
<th>Name of the lecturer</th>
<th>ECTS points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optional</td>
<td>Electrical Power Management and Quality</td>
<td>Eduardo Gouveia</td>
<td>6,0</td>
</tr>
<tr>
<td>Optional</td>
<td>Microgeneration and Microgrids</td>
<td>Paulo Moisés</td>
<td>6,0</td>
</tr>
<tr>
<td>Optional</td>
<td>Electric Mobility and Energy Storage</td>
<td>Joaquim Delgado</td>
<td>6,0</td>
</tr>
<tr>
<td>Optional</td>
<td>Signal Processing</td>
<td>Daniel Albuquerque</td>
<td>5,5</td>
</tr>
<tr>
<td>Optional</td>
<td>Industrial Robotics</td>
<td>António Ferrolho</td>
<td>6,0</td>
</tr>
<tr>
<td>Optional</td>
<td>Control Systems</td>
<td>Miguel Lima</td>
<td>5,0</td>
</tr>
<tr>
<td>Optional</td>
<td>Educational Machines and Installations</td>
<td>Vasco Santos/José Silva</td>
<td>6,0</td>
</tr>
<tr>
<td>Optional</td>
<td>Project</td>
<td>A tutor will be assigned</td>
<td>10,0</td>
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</tbody>
</table>

Note:

a) The total ECTS credits must be at least equal to 30 chosen from the 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.
<table>
<thead>
<tr>
<th>Course title</th>
<th>Electrical Power Management and Quality</th>
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</thead>
<tbody>
<tr>
<td>Teaching method</td>
<td>Classes (theoretical and practical) and labs.</td>
</tr>
<tr>
<td>Person responsible for the course</td>
<td>Eduardo Gouveia</td>
</tr>
<tr>
<td>E-mail address</td>
<td><a href="mailto:egouveia@estv.ipv.pt">egouveia@estv.ipv.pt</a></td>
</tr>
<tr>
<td>Language of instruction</td>
<td>English</td>
</tr>
<tr>
<td>ECTS points</td>
<td>6</td>
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<tr>
<td>Semester</td>
<td>Spring</td>
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<tr>
<td>Type of course</td>
<td>optional</td>
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<tr>
<td>Hours per week</td>
<td>2T + 1,5 TP + 1,5 P</td>
</tr>
<tr>
<td>Hours per semester</td>
<td>26T + 19,5TP+19,5P</td>
</tr>
</tbody>
</table>

**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)
Schlabbach J., Blume D., Stephanblome T., “Voltage quality in electrical power systems”, Stevenage 2001 (ESTGV library - 621.3.05 SCH)
<table>
<thead>
<tr>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press, 2008 (ESTGV library - 620.9 ENE)</td>
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</tbody>
</table>
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
   - Virtual power 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

**Additional information**
<table>
<thead>
<tr>
<th>Course title</th>
<th>Electric Mobility</th>
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<tbody>
<tr>
<td>Teaching method</td>
<td>During the course different teaching methods will be used: lectures, case studies, discussions, movies, self study and Test-Drive.</td>
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<tr>
<td>Person responsible for the course</td>
<td>Joaquim Delgado</td>
</tr>
<tr>
<td>Language of instruction</td>
<td>English</td>
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<tr>
<td>Semester</td>
<td>Spring</td>
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<tr>
<td>Hours per week</td>
<td>1,5T + 1TP</td>
</tr>
<tr>
<td>Objectives/skills of the course</td>
<td>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.</td>
</tr>
<tr>
<td>Entry requirements</td>
<td>There aren’t any.</td>
</tr>
</tbody>
</table>
### 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.

### 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.
<table>
<thead>
<tr>
<th>Course title</th>
<th><strong>Signal Processing</strong></th>
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</thead>
<tbody>
<tr>
<td>Teaching method</td>
<td>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, tests and analyzed some signal processing tools to solve a proposed practical problem.</td>
</tr>
<tr>
<td>Person responsible for the course</td>
<td>Daniel Filipe Albuquerque</td>
</tr>
<tr>
<td>E-mail address</td>
<td><a href="mailto:dfa@estv.ipv.pt">dfa@estv.ipv.pt</a></td>
</tr>
<tr>
<td>Language of instruction</td>
<td>English</td>
</tr>
<tr>
<td>ECTS points</td>
<td>5.5</td>
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<tr>
<td>Semester</td>
<td>Spring</td>
</tr>
<tr>
<td>Type of course</td>
<td>optional</td>
</tr>
<tr>
<td>Hours per week</td>
<td>1.5T + 1TP + 2P</td>
</tr>
<tr>
<td>Hours per semester</td>
<td>19.5T + 13TP + 26P</td>
</tr>
<tr>
<td>Objectives/skills of the course</td>
<td>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.</td>
</tr>
<tr>
<td>Entry requirements</td>
<td>There aren’t any.</td>
</tr>
</tbody>
</table>
| 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%.

<table>
<thead>
<tr>
<th>Recommended readings</th>
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</thead>
</table>

| 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

**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**

<table>
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<tr>
<th>Additional information</th>
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</table>
## Control Systems

**Teaching method**

During the course many different teaching methods will be used: self study, case studies, lectures, discussions, movies.

<table>
<thead>
<tr>
<th>Person responsible for the course</th>
<th>Miguel Lima</th>
<th>E-mail address: <a href="mailto:lima@estv.ipv.pt">lima@estv.ipv.pt</a></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Language of instruction</strong></td>
<td>English</td>
<td>ECTS points: 6</td>
</tr>
<tr>
<td><strong>Semester</strong></td>
<td>Spring</td>
<td>Type of course: optional</td>
</tr>
<tr>
<td><strong>Hours per week</strong></td>
<td>2T + 2TP</td>
<td>Hours per semester: 26T + 26TP</td>
</tr>
</tbody>
</table>

### Objectives/skills of the course

Main objectives/skills of the course:

- Know and have capabilities to work with software tools in helping solving control problems
- Learn to distinguish between a system with and without feedback
- Understand the structure of a control system
- Know and learn basic mathematical tools used to implement control systems
- Learn to use the classic control approach
- Know and learn to choose the appropriate control system for a process
- Know how to parameterize and/or program most widely used industrial controllers

**Entry requirements**

There aren’t any.

### Course contents

1-Introduction
- Concepts of system and control system
- Input and output of a system
- Systems with and without feedback
- Linear and time-invariant systems
- Fundamental elements of the control systems
- Software tools used in theory and control systems

2-System modeling
- Applications of Laplace transform
- Transfer function of a system: concept and its calculus
- Concept of order, type, poles and zeros of a system
- Models of electrical and mechanical systems
- Representation using block diagrams

3-Response time analysis of systems
- Algebra of block diagrams
- Response time: transient and steady state responses
- Routh stability criterion
- Concept of dominance

4-Root Locus
- Concepts
- Rules of construction

5-Controllers and control actions
- Control compensators
- Study of the control actions and tuning of PID controller
### 6-Frequency domain analysis
- **Bode diagrams:**
  - **Concepts**
  - **Rules for constructing Bode diagrams (modulus and phase)**

### Assessment methods
To a student be admitted to the written tests, must perform the individual works. To a student be approved in the discipline must:
- Satisfy the rules of the practical part (individual works)
- Perform a written test (2.5 hours) achieving a minimum of 40%.
The rules for admission to assessment are valid for all exams during this school year.
Final mark: 60% written test + 40% individual works

### Recommended readings
- **GENE F. FANKLIN , J. DAVID POWELL, ABBAS EMAMI-NAEINI;** “Feedback control of dynamic systems”, 3rd edition
- **K. OGATA,** “Modern Control Engineering”, Prentice-Hall
- **K. DUTTON, STEVE THOMPSON, BILL BARRACLOUGH;** “The Art of CONTROL ENGINEERING”; Addison-Wesley (1997)

### Additional information
Note: All the books exist in the ESTGV library, except [6]
# Electrical Machines and Installations

**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
- jjsilva@estv.ipv.pt

**Language of instruction**

English

**ECTS points**

6,0

**Semester**

Spring

**Type of course**

optional

**Hours per week**

<table>
<thead>
<tr>
<th>Hours per semester</th>
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<tbody>
<tr>
<td>13T+32,5TP+19,5P</td>
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</tbody>
</table>

**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**
- **MODULE 2- TRANSFORMERS**
- **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**
- **MODULE 6- COMMAND DEVICES AND PROTECTION**
- **MODULE 7- SECURITY SYSTEMS**
- **MODULE 8- QUALITY OF THE ENERGY**

**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**

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<tr>
<td><strong>Objectives of the course</strong></td>
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<td><strong>Entry requirements</strong></td>
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<tr>
<td><strong>Course contents</strong></td>
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<tr>
<td><strong>Assessment methods</strong></td>
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