## 240406 - Electrical Workshop

<table>
<thead>
<tr>
<th>Coordinating unit:</th>
<th>240 - ETSEIB - Barcelona School of Industrial Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching unit:</td>
<td>709 - EE - Department of Electrical Engineering</td>
</tr>
<tr>
<td>Academic year:</td>
<td>2017</td>
</tr>
<tr>
<td>Degree:</td>
<td>BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2010). (Teaching unit Optional)</td>
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<tr>
<td></td>
<td>BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Optional)</td>
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<tr>
<td></td>
<td>BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional)</td>
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<tr>
<td>ECTS credits:</td>
<td>3</td>
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<tr>
<td>Teaching languages:</td>
<td>Catalan</td>
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</table>

### Teaching staff

<table>
<thead>
<tr>
<th>Coordinator:</th>
<th>Boix Aragonès, Oriol</th>
</tr>
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<tbody>
<tr>
<td>Others:</td>
<td>Boix Aragonès, Oriol</td>
</tr>
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</table>

### Opening hours

<table>
<thead>
<tr>
<th>Timetable:</th>
<th>To be determined with students</th>
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240406 - Electrical Workshop

Requirements

Per GR ENG TECN INDUSTR
- ADVANCED CHEMISTRY - Equivalent
- ADVANCED MECHANICS - Equivalent
- COMMUNICATING TECHNICAL INFORMATION - Equivalent
- COMPUTER GAMES. STRUCTURE AND DEVELOPMENT - Equivalent
- COMPUTER-AIDED DESIGN - Equivalent
- DEBATES ON TECHNOLOGY AND SOCIETY - Equivalent
- DIGITAL TECHNOLOGIES FOR THE REPORTING OF THE PROJECTS - Equivalent
- ENTREPRENEURSHIP - Equivalent
- HISTORY OF INDUSTRIAL ENGINEERING. SCHOOL BARCELONA - Equivalent
- HUMAN PREPARATION FOR WORKPLACE - Equivalent
- INORGANIC CHEMICAL SYSTEMS TECHNOLOGY FORWARD - Equivalent
- MANUFACTURING WORKSHOP - Equivalent
- TECHNOLOGY OF LIGHT - Equivalent
- THE ORIGINS OF MODERN ENGINEERING - Equivalent

Per GR ENG QUIMICA
- ADVANCED CHEMISTRY - Equivalent
- COMMUNICATING TECHNICAL INFORMATION - Equivalent
- COMPUTER GAMES. STRUCTURE AND DEVELOPMENT - Equivalent
- COMPUTER-AIDED DESIGN - Equivalent
- DEBATES ON TECHNOLOGY AND SOCIETY - Equivalent
- DIGITAL TECHNOLOGIES FOR THE REPORTING OF THE PROJECTS - Equivalent
- ENTREPRENEURSHIP - Equivalent
- HISTORY OF INDUSTRIAL ENGINEERING. SCHOOL BARCELONA - Equivalent
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- TECHNOLOGY OF LIGHT - Equivalent
- THE ORIGINS OF MODERN ENGINEERING - Equivalent

Per GR ENG MATERIALS
- ADVANCED CHEMISTRY - Equivalent
- COMMUNICATING TECHNICAL INFORMATION - Equivalent
- COMPUTER GAMES. STRUCTURE AND DEVELOPMENT - Equivalent
- COMPUTER-AIDED DESIGN - Equivalent
- DEBATES ON TECHNOLOGY AND SOCIETY - Equivalent
- DIGITAL TECHNOLOGIES FOR THE REPORTING OF THE PROJECTS - Equivalent
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- THE ORIGINS OF MODERN ENGINEERING - Equivalent

Degree competences to which the subject contributes

Transversal:
1. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.
240406 - Electrical Workshop

Teaching methodology

Workshop sessions. The students have a set of materials and some activities as homework (alone or in groups) for the preparation of each session.

Learning objectives of the subject

When finished, the student can:

1. Identify the different protection of electrical circuits (single phase or three phases) and associate the disconnections of them with the possible defects that cause it.
2. Connect an electrical circuit (single phase or three phases) following a schema. Interpret the behavior of the circuit.
3. Draw electric schemes and GRAFCET symbology keeping the rules and representations.
4. Program a PLC and a programmable relay at intermediate level and connect input and output elements to it. Interpret the behavior of the team when execute the program and correct undesired behaviors.
5. Configure and program at a basic level for a supervision terminal for a PLC.
6. Connect and program KNX domotic systems in an intermediate level.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 75h</th>
<th>Hours large group:</th>
<th>0h</th>
<th>0.00%</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Hours small group:</td>
<td>30h</td>
<td>40.00%</td>
</tr>
<tr>
<td></td>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>45h</td>
<td>60.00%</td>
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</table>
## Content

### 1. Electrical circuits and their protections

<table>
<thead>
<tr>
<th>Description:</th>
<th>Electrical circuits and their protections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Related activities:</td>
<td>Activity 1</td>
</tr>
</tbody>
</table>
| Specific objectives: | · Understand the overloads and short circuits  
· Know the basic operation of fuses and circuit breakers  
· Know the effects of electric current in the human body  
· Know the basic operation of circuit breakers  
· Understand and know domestic electrical circuits |

<table>
<thead>
<tr>
<th>Learning time:</th>
<th>6h 30m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory classes:</td>
<td>2h</td>
</tr>
<tr>
<td>Self study:</td>
<td>4h 30m</td>
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</tbody>
</table>

### 2 Electromechanical Automation

<table>
<thead>
<tr>
<th>Description:</th>
<th>Automation with relays and contactors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Related activities:</td>
<td>Activity 2</td>
</tr>
</tbody>
</table>
| Specific objectives: | · Understand, at a basic level, three-phase systems and operation of electric motors  
· Know the operation of contactors, relays, thermal relays and timers, and know how to connect, from a scheme, to do automatisms  
· Know the basic elements of Boolean algebra applied to electrical circuits and understand the workings of combinational automatisms  
· Learn to draw, at the intermediate level, electrical circuits  
· Know, at a basic level, discharge lamps as well as know, at intermediate level, fluorescent lights and know how to connect its circuit with reactance |

<table>
<thead>
<tr>
<th>Learning time:</th>
<th>18h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory classes:</td>
<td>10h</td>
</tr>
<tr>
<td>Self study:</td>
<td>8h</td>
</tr>
</tbody>
</table>
### 3 PLCs and dialogue terminals

**Description:**
PLC automation

**Related activities:**
Activity 3

**Specific objectives:**
- Understand the operation of PLCs and know how to program it in ladder diagram (LD)
- Know the most significant presence sensors and know how to connect them to PLC inputs
- Know how to connect preactuators and actuators to the outputs of the PLC
- Learn and know how to use the language grafcet to represent and programming of sequential automatisms
- Know how dialogue terminals work and do simple programming of them
- Understand the operation of a flexible manufacturing cell

**Learning time:** 30h
- Laboratory classes: 10h
- Self study: 20h

### 4 Automation with Programmable Relays

**Description:**
Programmable relays

**Related activities:**
Activity 4

**Specific objectives:**
- Know programmable relays and how to program it in combinational and sequential automation

**Learning time:** 13h
- Laboratory classes: 4h
- Self study: 9h

### 5 Home automation

**Description:**
KNX domotics

**Related activities:**
Activity 5

**Specific objectives:**
- Know the KNX home automation system and learn how to program it at the intermediate level

**Learning time:** 7h 30m
- Laboratory classes: 4h
- Self study: 3h 30m
## Planning of activities

| **1 ELECTRICAL CIRCUITS AND THEIR PROTECTION** | **Hours:** 6h 30m  
Laboratory classes: 2h  
Self study: 4h 30m |
|---|---|

**Description:**
The students, independently, learn the concepts of overload, short circuit, earth leakage and effects of electrical current in the human body and devices that protect against them. After, in the laboratory, mounted some domestic circuits that incorporate the protections studied.

**Support materials:**
Notes and videos from the course

**Descriptions of the assignments due and their relation to the assessment:**
Evidence:  
The completion of the practice assembly.

**Specific objectives:**
- Understand the overloads and short circuits  
- Know the basic operation of fuses and circuit breakers  
- Know the effects of electrical current the human body  
- Know the basic operation of circuit breakers  
- Understand and know domestic electrical circuits

| **2 ELECTROMECHANICAL AUTOMATION** | **Hours:** 18h  
Laboratory classes: 10h  
Self study: 8h |
|---|---|

**Description:**
The students, independently, learn the concepts of three-phase systems, electric motors, discharge lighting, electromechanical automation, contactors, relays, thermal relays and timers. After, in the lab, mount some circuits of combinational and sequential automation with relays and contactors.

**Support materials:**
Notes and videos from the course

**Descriptions of the assignments due and their relation to the assessment:**
Evidence:  
The performance of the assemblies of the practices and, the design of the modification of a practice circuit.

**Specific objectives:**
- Understand, at a basic level, three-phase systems and operation of electric motors  
- Know the operation of contactors, relays, thermal relays and timers, and know how to connect, from a scheme, to do automatisms  
- Know the basic elements of Boolean algebra applied to electrical circuits and understand the workings of combinational automatisms  
- Learn to draw, at the intermediate level, electrical circuits  
- Know, at a basic level, discharge lamps as well as know, at intermediate level, fluorescent lights and know how to connect its circuit with reactance
| 3 PROGRAMMABLE LOGIC CONTROLLERS | Hours: 30h  
Laboratory classes: 10h  
Self study: 20h |
<table>
<thead>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>The students, independently, learn the concepts of PLCs, the wiring of sensors and programming in ladder diagram. After, at the laboratory, they program the PLCs.</td>
</tr>
<tr>
<td><strong>Support materials:</strong></td>
<td>Notes and videos from the course</td>
</tr>
<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong></td>
<td>Evidence: The realization of practices programs and the preparation of parts of programs.</td>
</tr>
</tbody>
</table>
| **Specific objectives:**        | · Understand the operation of PLCs and know how to program it in ladder diagram (LD)  
· Know the most significant presence sensors and know how to connect them to PLC inputs  
· Know how to connect preactuators and actuators to the outputs of the PLC |

| 4 AUTOMATION WITH PROGRAMMABLE RELAYS | Hours: 13h  
Laboratory classes: 4h  
Self study: 9h |
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>The students, independently, learn the basics of programmable relays and prepare some of the programs needed for practices. After, at the laboratory, program various functions on a programmable relay.</td>
</tr>
<tr>
<td><strong>Support materials:</strong></td>
<td>Notes and videos from the course</td>
</tr>
<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong></td>
<td>Evidence: The realization of practices programs and the preparation of parts of programs.</td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td>· Know programmable relays and how to program it in combinational and sequential automation</td>
</tr>
</tbody>
</table>

| 5 HOME AUTOMATION | Hours: 7h 30m  
Laboratory classes: 4h  
Self study: 3h 30m |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>The students, independently, learn the basics of home automation. After, at the laboratory, program various functions on an automated system.</td>
</tr>
<tr>
<td><strong>Support materials:</strong></td>
<td>Notes and videos from the course</td>
</tr>
<tr>
<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong></td>
<td>Evidence: System programming for the functions described in the practice.</td>
</tr>
</tbody>
</table>
Specific objectives:
- Know the KNX home automation system and learn how to program it at the intermediate level

Qualification system

The student will have a punctuation of each practice (NLi) and a punctuation of each of the previous preparation practices that have (NPi). From each of these concepts the average grade (NL and NP) is calculated. Unrealized activities have a punctuation of zero.

In punctuation will be considered punctuality, the completion of each of the parties (regardless of the time it takes), the attitude and originality. Punctuality is very important because in the beginning there are some security indications.

The final grade will be calculated, in principle, with the expression:

\[ NF = 0.7 \cdot NL + 0.3 \cdot NP \]

To pass the course with this calculation one must have completed at least 80% of practices.

The course has no midterm exam. In principle, it has no final exam. Those students who wish may choose to attend the final examination of the subject that would only be to those who have expressed their desire to attend a week in advance. This examination will consist of a part type test (NET) and part of laboratory practice (NEL). The laboratory part consists in the realization (during two hours) of individual of any of the practices of the subject chosen by lot from which the teacher is no longer prepared for this purpose and will be evaluated with the same criteria as applied to practice during the course.

If present at the examination, the final grade is calculated by the expression:

\[ NF = 0.25 \cdot NL + 0.15 \cdot NP + 0.4 \cdot NEL + 0.2 \cdot NET \]

To pass the course with this calculation one must have completed at least 70% of practices.

Bibliography

Others resources:
- NOTES AND VIDEOS OF THE SUBJECT TO BE ACCESSIBLE FROM DIGITAL CAMPUS