### 820226 - IIEIA - Industrial Computer Science

<table>
<thead>
<tr>
<th>Coordinating unit:</th>
<th>295 - EEBE - Barcelona East School of Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching unit:</td>
<td>707 - ESAII - Department of Automatic Control</td>
</tr>
<tr>
<td>Academic year:</td>
<td>2019</td>
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<tr>
<td>Degree:</td>
<td>BACHELOR’S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)</td>
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<tr>
<td>ECTS credits:</td>
<td>6</td>
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<tr>
<td>Teaching languages:</td>
<td>Catalan, Spanish</td>
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</tbody>
</table>

### Teaching staff

**Coordinator:** Calomarde Palomino, Antonio  
Tornil Sin, Sebastian

**Others:** Calomarde Palomino, Antonio  
Tornil Sin, Sebastian  
Guerra Paradas, Edmundo

### Prior skills

1. Basic background on electronic systems.
2. Basic background on digital electronics.

### Requirements

Prerequisite: Digital Electronics (EDEIA)  
Co-requisite: Analog Electronics (EAEIA)

### Degree competences to which the subject contributes

**Specific:**

3. Apply their knowledge to industrial informatics and communications.

**Transversal:**

1. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.

### Teaching methodology

The course uses the methodology of exhibitions in 28% (theoretical and laboratory sessions), monitoring of activities aimed at 12%, individual in 17.3%, the project-based learning by 40% evaluation sessions and 2.7%.

### Learning objectives of the subject

1. Introduce students to basic concepts of microcontrollers, its architecture, its programming and the connection with the elements of their environment.
2. Acquire skills to design, deploy and implement electronic systems based on microcontrollers.
## Study load

<table>
<thead>
<tr>
<th></th>
<th>Total learning time: 150h</th>
<th>Hours large group: 45h</th>
<th>30.00%</th>
<th>Hours medium group: 0h</th>
<th>0.00%</th>
<th>Hours small group: 15h</th>
<th>10.00%</th>
<th>Guided activities: 0h</th>
<th>0.00%</th>
<th>Self study: 90h</th>
<th>60.00%</th>
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<tbody>
<tr>
<td>Tema 1: Introduction</td>
<td>Learning time: 2h</td>
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<tr>
<td></td>
<td>Theory classes: 1h</td>
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<td></td>
<td>Self study: 1h</td>
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</table>

**Description:**
- Course overview.
- History and future of microcontrollers.
- Binary and hexadecimal codes.

<table>
<thead>
<tr>
<th>Tema 2: The C programming language</th>
<th>Learning time: 14h</th>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 6h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 2h</td>
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<tr>
<td></td>
<td>Self study: 6h</td>
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</tbody>
</table>

**Description:**
- Basic blocks and syntax
- Flow control.
- Strings and matrices.
- Pointers.
- Structs.

**Related activities:**
- Individual study
- Solving exercises
- Laboratory session
### Tema 3: Estructura dels microcontroladors

<table>
<thead>
<tr>
<th>Learning time: 14h</th>
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</thead>
<tbody>
<tr>
<td>Theory classes: 6h</td>
</tr>
<tr>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Self study : 6h</td>
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</tbody>
</table>

**Description:**
- Block diagram.
- Processor registers.
- Memory and addressing.
- Instruction set.

**Related activities:**
- Individual study
- Solving exercises
- Laboratory session

**Specific objectives:**
At the end of this module, the student should be able to describe all the internal subsystems of a microcontroller.

### Tema 4: Digital inputs and outputs

<table>
<thead>
<tr>
<th>Learning time: 14h</th>
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<tbody>
<tr>
<td>Theory classes: 6h</td>
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<tr>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Self study : 6h</td>
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</tbody>
</table>

**Description:**
- Hardware.
- Programming.

**Related activities:**
- Individual study
- Solving exercises
- Laboratory session
### Tema 5: Interrupts and low power characteristics.

**Description:**
- Interrupts?
- Programming with interrupts.
- Examples.

**Related activities:**
- Individual study.
- Solving exercises.
- Searching for information.
- Laboratory sessions.

**Learning time:** 14h
- Theory classes: 6h
- Laboratory classes: 2h
- Self study: 6h

### Tema 6: Analog inputs and outputs.

**Description:**
- Analog to digital conversion.
- Digital to analog conversion.
- Programming and examples.

**Related activities:**
- Estudi individual
- Resolució d’exercicis
- Pràctiques de laboratori

**Learning time:** 14h
- Theory classes: 6h
- Laboratory classes: 2h
- Self study: 6h
<table>
<thead>
<tr>
<th>Tema 7: Timers and PWM</th>
<th>Learning time: 14h</th>
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</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 6h</td>
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<tr>
<td>Compare mode.</td>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Capture mode.</td>
<td>Self study: 6h</td>
</tr>
<tr>
<td>Pulse width modulation.</td>
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</table>

**Related activities:**
- Individual study
- Solving exercises
- Laboratory session

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<thead>
<tr>
<th>Tema 8: Serial communications</th>
<th>Learning time: 14h</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 6h</td>
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<tr>
<td>UART</td>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>SPI bus</td>
<td>Self study: 6h</td>
</tr>
<tr>
<td>I2C bus</td>
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</table>

**Specific objectives:**
- Individual study
- Solving exercises
- Laboratory session

<table>
<thead>
<tr>
<th>Tema 9: Conceptes avançats</th>
<th>Learning time: 3h</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 1h</td>
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<tr>
<td>Direct Memory Access.</td>
<td>Self study: 2h</td>
</tr>
<tr>
<td>High performance and low power.</td>
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</tbody>
</table>

**Specific objectives:**
- Individual study
- Solving exercises.
Exercises: 10%
Midterm exam: 25%
Final exam: 25%
Laboratory: 20%
Final project: 20%

Qualification system

The evaluation method of this course meets the current academic regulations to be qualified as: NO REVALUABLE

Bibliography

Basic:


Complementary:


Others resources:

Final team project.

Description:
Design and prototyping of a microcontroller based system.

Learning time: 47h
  Theory classes: 1h
  Self study : 46h