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.

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

Teaching staff
Coordinator: SEBASTIAN TORNIL SIN - ANTONIO CALOMARDE PALOMINO

Others:
Primer quadrimestre:
ANTONIO CALOMARDE PALOMINO - T11, T12, T13
EDMUNDO GUERRA PARADAS - T11, T12, T13

Segon quadrimestre:
ANTONIO CALOMARDE PALOMINO - M13, M14, M15
EDMUNDO GUERRA PARADAS - M11, M12
SEBASTIAN TORNIL SIN - M11, M12, M13, M14, M15

Degree:
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Compulsory)

ECTS credits: 6  Teaching languages: Catalan, Spanish
### Study load

<table>
<thead>
<tr>
<th></th>
<th>Hours large group:</th>
<th>45h</th>
<th>30.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours medium group:</td>
<td>0h</td>
<td></td>
<td>0.00%</td>
</tr>
<tr>
<td>Hours small group:</td>
<td>15h</td>
<td></td>
<td>10.00%</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>0h</td>
<td></td>
<td>0.00%</td>
</tr>
<tr>
<td>Self study:</td>
<td>90h</td>
<td></td>
<td>60.00%</td>
</tr>
<tr>
<td>Tema 1: Introduction</td>
<td>Learning time: 2h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Theory classes: 1h</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Self study: 1h</td>
<td></td>
<td></td>
</tr>
</tbody>
</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>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 6h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Self study: 6h</td>
</tr>
</tbody>
</table>

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

Related activities:
- Individual study
- Solving exercises
- Laboratory session
<table>
<thead>
<tr>
<th>Tema 3: Estructura dels microcontroladors.</th>
<th>Learning time: 14h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 6h</td>
</tr>
<tr>
<td>Block diagram.</td>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Processor registers.</td>
<td>Self study : 6h</td>
</tr>
<tr>
<td>Memory and addressing.</td>
<td></td>
</tr>
<tr>
<td>Instruction set.</td>
<td></td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Tema 4: Digital inputs and outputs</th>
<th>Learning time: 14h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 6h</td>
</tr>
<tr>
<td>Hardware.</td>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Programming.</td>
<td>Self study : 6h</td>
</tr>
</tbody>
</table>

**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
### Tema 7: Timers and PWM

**Description:**
- Compare mode.
- Capture mode.
- Pulse width modulation.

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

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

### Tema 8: Serial communications

**Description:**
- UART
- SPI bus
- I2C bus

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

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

### Tema 9: Conceptes avançats

**Description:**
- Direct Memory Access.
- High performance and low power.

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

**Learning time:** 3h
- Theory classes: 1h
- Self study: 2h
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.

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

Description:
Design and prototyping of a microcontroller based system.