240IEE31 - Microcomputers

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering
Academic year: 2017
Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Teaching unit Optional)
ECTS credits: 4.5
Teaching languages: English

Learning objectives of the subject
To become acquainted with the architecture of a modern microcontroller. To become acquainted with the design of basic combinational and sequential arithmetic modules: adders and multipliers. To learn to program in assembly language. To learn to develop simple applications using a modern microcontroller through assembly language and through a high-level language.

Requirements
gate level digital design; enhancement MOSFET transistors; basic concepts of computer architecture; programming in a high-level language; intermediate english level.

Teaching methodology
There will be 19 theory lectures and 6 lab lectures. In the latter, the students will have to debug several simple applications using the microcontroller on which the course is based. Both theory lectures and lab lectures will be held using the time slots planned by the School. Lab sessions will be held in "Laboratori docent d'Electrònica II", located in Llobregat side of 9th floor of building H of the School in the days that will be announced with enough anticipation through ATENEA. Attendance to all theory lectures and all lab lectures is strongly advised.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 112h 30m</th>
<th>Hours large group:</th>
<th>27h</th>
<th>24.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours small group:</td>
<td>13h 30m</td>
<td></td>
<td>12.00%</td>
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<tr>
<td>Guided activities:</td>
<td>0h</td>
<td></td>
<td>0.00%</td>
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<tr>
<td>Self study:</td>
<td>72h</td>
<td></td>
<td>64.00%</td>
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</tbody>
</table>

Opening hours
Mondays and Wednesdays from 12 to 14 in office 9.53 on Llobregat side of 9th floor of building H of the School. There is internal phone to call me up at the entrance of the departamental section of "Departament d'Enginyeria Electrònica", on Besòs side of 9th floor of building H of the School.

Coordinating unit:
JUAN ANTONIO CARRASCO LÓPEZ
Others:
JUAN ANTONIO CARRASCO LÓPEZ
### Content

<table>
<thead>
<tr>
<th>Section</th>
<th>Learning time</th>
<th>Theory classes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basic concepts</strong></td>
<td>1h</td>
<td>1h</td>
</tr>
<tr>
<td><strong>Basic architectural elements of the microcontroller PIC18F458</strong></td>
<td>6h</td>
<td>6h</td>
</tr>
<tr>
<td>Specific objectives:</td>
<td>To know the basic architectural elements of microcontroller PIC18F458.</td>
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<tr>
<td><strong>Basic architectural elements of a processor</strong></td>
<td>7h 30m</td>
<td>7h 30m</td>
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<tr>
<td>Description:</td>
<td>Two’s complement code from the required perspective. Design of a simple ALU including the analysis of its static delay. Design of a carry lookahead adder including the analysis of its static delay. Design of an enhanced version of the ALU incorporating the carry lookahead adder including the analysis of its static delay. Design a Booth sequential multiplier. Design of several combinational binary multipliers including the analysis of their static delays. Design of a combinational two’s complement multiplier including the analysis of its static delay. Design of a combinational universal multiplier including the analysis of its static delay.</td>
<td></td>
</tr>
<tr>
<td>Specific objectives:</td>
<td>To understand the design of several elements of a processor with justification of the correctness of the design. To know techniques for reducing the static delay of several elements of a processor.</td>
<td></td>
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<tr>
<td><strong>Programming of subroutines in assembly language</strong></td>
<td>4h 30m</td>
<td>4h 30m</td>
</tr>
<tr>
<td>Description:</td>
<td>Programming of subroutines of increasing complexity in assembly language.</td>
<td></td>
</tr>
<tr>
<td>Specific objectives:</td>
<td>To learn to program subroutines of medium complexity in assembly language.</td>
<td></td>
</tr>
</tbody>
</table>
### Programming of applications in assembly language

**Learning time:** 4h 30m  
Theory classes: 4h 30m

**Description:**  
Development in assembly language of three variants of an "electronic dice" application.

**Specific objectives:**  
To learn to program in assembly language simple applications.

### Programming of applications in a high level language

**Learning time:** 3h  
Theory classes: 3h

**Description:**  
Programming in a C dialect of a "digital thermometer" application.

**Specific objectives:**  
To learn to program a simple application using a high-level language.

### Development of applications in assembly language and in a high-level language

**Learning time:** 9h  
Laboratory classes: 9h

**Description:**  
Development of variants of the applications programmed in assembly language and in a C dialect explained in theory classes.

**Specific objectives:**  
To become acquainted with the development tools available for the microcontroller used in the course.

### The standard IEEE 754 for floating point arithmetic

**Learning time:** 1h  
Theory classes: 1h

**Description:**  

**Specific objectives:**  
To know the more important elements of IEEE 754 standard, version 1985.
There will be a written midterm examination and a written final examination. The midterm examination will have a duration of one hour and a half and will be held on November 7th from 14:30 to 16 in class 6.1. The final examination will have a duration of three hours in the date and place determined by the School. In addition, the activity carried out in the lab sessions will be evaluated based on the results obtained in those sessions. The grade will be the average rounded to 0.1 points with ties up of the grade of the final examination, the grade of the midterm examination, and the grade obtained in the lab sessions with weights 50%, 25% and 25%, respectively.

**Qualification system**

There will be a written midterm examination and a written final examination. The midterm examination will have a duration of one hour and a half and will be held on November 7th from 14:30 to 16 in class 6.1. The final examination will have a duration of three hours in the date and place determined by the School. In addition, the activity carried out in the lab sessions will be evaluated based on the results obtained in those sessions. The grade will be the average rounded to 0.1 points with ties up of the grade of the final examination, the grade of the midterm examination, and the grade obtained in the lab sessions with weights 50%, 25% and 25%, respectively.

**Regulations for carrying out activities**

The students will be allowed to use a standard pocket calculator in the midterm examination and in the final examination. An enough to solve the requested programming problems summary of the instructions of the microcontroller used in the course will be handed in to the students in the midterm examination and in the final examination.

**Bibliography**

**Others resources:**

Slides sets and class notes that will be published through ATENEA.