Course guides
295117 - 295II232 - Mechatronics

Unit in charge: Barcelona East School of Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering.
707 - ESAII - Department of Automatic Control.
712 - EM - Department of Mechanical Engineering.

Degree: MASTER'S DEGREE IN INTERDISCIPLINARY AND INNOVATIVE ENGINEERING (Syllabus 2019). (Optional subject).
MASTER'S DEGREE IN RESEARCH IN MECHANICAL ENGINEERING (Syllabus 2021). (Optional subject).

Academic year: 2021  ECTS Credits: 6.0  Languages: English

LECTURER
Coordinating lecturer:
Others:

PRIOR SKILLS
Basic analysis of mechanical systems, electrical and electronic circuits.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEMUEII-15. Design and implement acquisition, actuation and control systems that integrate electronic, electrical and mechanical technology in the field of intelligent production systems. (Specific competence of the Advanced Manufacturing Systems specialty)

Generical:
CGMUEII-01. Participate in technological innovation projects in multidisciplinary problems, applying mathematical, analytical, scientific, instrumental, technological and management knowledge.
CGMUEII-05. To communicate hypotheses, procedures and results to specialized and non-specialized audiences in a clear and unambiguous way, both orally and through reports and diagrams, in the context of the development of technical solutions for problems of an interdisciplinary nature.

Transversal:
05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
TEACHING METHODOLOGY

The methodologies used for the development of the subject are as follows:
- Lecture with multimedia support, in order to provide information to the student so synthesized and organized.
- Class participatory exhibition, in which and in order that the student is not merely a passive element in the learning process, the teacher performs direct questions or debates on points considered particularly relevant or conceptual difficulty proposed.
- Problem-based learning, either individually or in a group in which the teacher proposes solving exercises outside the classroom so that the student can assess the degree of understanding of the subject.
- In the experimental laboratory sessions the methodology adopted is that of small cooperative groups in which students acquire skills in simulation techniques and testing of circuits.

LEARNING OBJECTIVES OF THE SUBJECT

That the student will be able to:
- integrate in the design of a mechanical system the technologies of electricity, electronics, computers and communications,
- automate the operation of mechanical systems and communicate them with their environment,
- design mechatronic systems adapted to the needs of the product.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Hours small group</td>
<td>22,0</td>
<td>14.67</td>
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<tr>
<td>Hours large group</td>
<td>22,0</td>
<td>14.67</td>
</tr>
<tr>
<td>Self study</td>
<td>102,0</td>
<td>68.00</td>
</tr>
<tr>
<td>Guided activities</td>
<td>4,0</td>
<td>2.67</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

**T1.- Mechanical Systems Engineering**

**Description:**
T1.- Introduction to mechanical systems engineering  
T1.- Constructive structure of machines

**Full-or-part-time:** 21h  
Theory classes: 6h  
Self study : 15h

**T2.- Electric Machines and Actuators**

**Description:**
T2.- Electric machines and actuators. Revision of the machines  
T2.- Equations and static and dynamic models  
T2.- Dimensioning of electrical machines

**Full-or-part-time:** 21h  
Theory classes: 6h  
Self study : 15h
### T3. - Sensor elements

**Description:**
T3.- Voltage and current sensor elements, and signal conditioning  
T3.- Temperature sensors, force, position, limit switch, acceleration, encoders, ...

**Full-or-part-time:** 14h
Theory classes: 4h  
Self study: 10h

### T4. - Acquisition and Control Systems

**Description:**
T4.- Overview to acquisition systems and control strategies  
T4.- Closed-loop control and Digital control

**Full-or-part-time:** 7h
Theory classes: 2h  
Self study: 5h

### T5. - PLCs systems

**Description:**
T5.- Introduction to small PLCs  
T5.- Basic programming and input-output availability

**Full-or-part-time:** 7h
Theory classes: 2h  
Self study: 5h

### T6. - Basics communications

**Description:**
T6.- Basics communications  
T6.- Differential transmissions and wireless transmissions

**Full-or-part-time:** 2h
Theory classes: 2h
T7.- Arduino and Raspberry Pi Boards

Description:
T7.- Introduction to Arduino and Raspberry Pi boards, and its programming
T7.- Accessories shields and its connectivity
T7.- Introduction to microcontrollers PIC and its programming

Related activities:
Laboratory sessions 1 to 5:
- Session 2: Arduino board II. AD conversion programming and signal acquisition.
- Session 3: Introduction to the Raspberry Pi board and its programming environment.
- Session 4: Raspberry Pi board II. Control of a stepper motor or DC with its driver.
- Session 5: Introduction to PIC microcontrollers and their programming environment. Basic programming and prototyping of the PIC microcontrollers.

Full-or-part-time: 33h
Laboratory classes: 10h
Self study : 23h

T8.- Small Applications Design

Description:
T8.- Introduction to Printed Circuit Board design software
T8.- Design and implementation of one application

Related activities:
Laboratory sessions 6 to 11:
- Session 6: Introduction to basic PCB software.
- Session 7: Introduction to advanced PCB software.
- Session 8: Design an application for Arduino or Raspberry Pi (I Schematic).
- Session 9: Design an application for Arduino or Raspberry Pi (II Layout).
- Session 10: Design an application for Arduino or Raspberry Pi (III implementation of the board).
- Session 11: Assembly and verification.

Full-or-part-time: 42h
Laboratory classes: 12h
Self study : 30h

GRADING SYSTEM

The evaluation system consists on the following ratings with the partial weights:
- A Partial Test: 25%.
- A Final test: 25%.
- Laboratory: 25%.
- Monitoring exercises: 25%.
EXAMINATION RULES.

The realization of the different tests consists of:
- The partial or final tests are individual written tests based on the theory and problems worked on in the course.
- Laboratory activities are compulsory assistance to students. Although they are worked in groups, they will be assessed individually, considering the cooperative work mode, the degree of involvement, the rate of progress and the degree of completion of the work carried out.
- The activities of follow-up exercises are individual. They will be carried out after school hours and will usually be delivered through the ATENEA application.

RESOURCES

Other resources:
Arduino boards. Raspberry Pi boards. Different commercial shields of this boards.
PC computer. Basic equipment of electronic laboratory.