

## 820771 - CAPUEE - Control and Automation for the Efficient Use of Energy

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering  
Teaching unit: 709 - EE - Department of Electrical Engineering  
Academic year: 2019  
Degree: MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2013). (Teaching unit Optional)  
MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2013). (Teaching unit Optional)  
ECTS credits: 5 Teaching languages: English

### Teaching staff

Coordinator: ANDREAS SUMPER  
Others: Munné Collado, Ingrid

### Opening hours

Timetable: Thursdays 16h-17h

### Prior skills

Knowledge of basic energy equipment.

### Requirements

Energy efficiency basics

### Degree competences to which the subject contributes

Specific:

- CEMT-9. Undertake projects related to energy management in production and service sectors, recognise and value advances and developments in the field and contribute innovative ideas.
- CEMT-7. Analyse the performance of equipment and facilities in operation to carry out a diagnostic assessment of the use system and establish measures to improve their energy efficiency.

Transversal:

- CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.
- CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.
- CT2. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.
- CT1a. ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding how companies are organised and the principles that govern their activity, and being able to understand employment regulations and the relationships between planning, industrial and commercial strategies, quality and profit.

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### Teaching methodology

Teaching methodology:

The course teaching methodologies are as follows:

- Online Lectures and conferences: presentation of knowledge by lecturers or guest speakers.
- Participatory sessions: collective resolution of exercises, debates and group dynamics, with the lecturer and other students in the classroom; classroom presentation of an activity individually or in small groups.
- Theoretical/practical supervised work (TD): classroom activity carried out individually or in small groups, with the advice and supervision of the teacher.
- Homework assignment of reduced extension: carry out homework of reduced extension, individually or in groups.
- Homework assignment of broad extension: design, planning and implementation of a project or homework of broad extension by a group of students, and writing a report that should include the approach, results and conclusions.
- Evaluation activities (EV).

Training activities:

The course training activities are as follows:

- Face to face activities
  - o Online Lectures and conferences: learning based on understanding and synthesizing the knowledge presented online by the teacher or by invited speakers.
  - o Participatory sessions: learning based on participating in the collective resolution of exercises, as well as in discussions and group dynamics, with the lecturer and other students in the classroom.
  - o Presentations (PS): learning based on presenting in the classroom an activity individually or in small groups.
  - o Theoretical/practical supervised work (TD): learning based on performing an activity in the classroom, or a theoretical or practical exercise, individually or in small groups, with the advice of the teacher.
- Study activities
  - o Project Work (PW)
  - o Homework assignment of reduced extension (PR): learning based on applying knowledge and presenting results.
  - o Homework assignment of broad extension (PA): learning based on applying and extending knowledge.
  - o Self-study (EA): learning based on studying or expanding the contents of the learning material, individually or in groups, understanding, assimilating, analysing and synthesizing knowledge.

### Learning objectives of the subject

To understand and be able to develop automation systems for efficient use of energy

### Study load

Total learning time: 120h	Hours small group:	30h	25.00%
	Guided activities:	10h	8.33%
	Self study:	80h	66.67%

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### Content

<p>Introduction to automation and control theory review</p>	<p>Learning time: 32h Theory classes: 10h Guided activities: 2h Self study : 20h</p>
<p>Description:</p> <ul style="list-style-type: none"> <li>- Automated systems, automatic control and automatisms</li> <li>- Sensors and instrumentation, drives, actuators, SCADA and communications</li> <li>- Control theory, design process, system representation, Laplace transform, transfer function</li> </ul> <p>Specific objectives: Learning by doing with a project work</p>	
<p>Signal Conditioning and Energy Measurement</p>	<p>Learning time: 16h Theory classes: 2h Practical classes: 2h Laboratory classes: 0h Guided activities: 2h Self study : 10h</p>
<p>Description:</p> <ul style="list-style-type: none"> <li>- Online sessions + laboratory sessions</li> <li>? Introduction to sensors: transducer, sensor, detectors, etc.</li> <li>? Basic sensors: light, position, speed, humidity, ...</li> <li>? Voltage and current transformers</li> <li>? Signal conditioning: voltage reference</li> <li>? Main concepts &amp; definitions: energy, power, AC vs DC, single phase vs three?phase, RMS value, etc.</li> <li>? Voltage sensing</li> <li>? Current sensing</li> <li>? Measuring DC current with CHIP ACS 712</li> <li>? Measuring AC current with CHIP ACS712.</li> <li>- Practical session: measurement of different types of current with ACS712.</li> </ul> <p>Specific objectives: Knowing the techniques for signal conditioning and measurements</p>	

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<p>Programming for energy efficiency applications</p>	<p>Learning time: 77h</p> <p>Theory classes: 3h          Practical classes: 3h          Laboratory classes: 10h          Guided activities: 11h          Self study : 50h</p>
<p>Description:</p> <ul style="list-style-type: none"> <li>- Arduino microcontroller programming</li> <li>- Arduino starter kit, functions and components</li> <li>- Building an Arduino project</li> <li>? Main concepts: ISO OSI Reference model</li> <li>? Physical medium:</li> <li>? Data link layer: error detection, network topologies</li> <li>? Data link layer II: Communication models (hyerarchy, exchange methods,...)</li> <li>? TCP/IP: DataGram, MAC/IP, Networks and routing, ...</li> <li>? Communications Arduino Library. Example.</li> <li>? Introduction to</li> <li>? Introduction to Node?Red</li> <li>? Introduction to Embedded systems: Raspberry Pi, ... ? Big Data</li> <li>? Cloud storage, data bases: (MySQL, MogoDB)</li> <li>? Integration with Node?Red</li> </ul> <p>Specific objectives:</p> <p>Knowing the most important programming and data storage tools for energy efficiency applications</p>	

### Qualification system

Project Work (PW). 40%

Work performed individually or in groups (TR). 30%

Attendance and participation in practical activities and class project work (AP). 30%

### Regulations for carrying out activities

Assistance mandatory, presentation via PPT and delivery of reports

### Bibliography