



Universitat de Lleida

DEGREE CURRICULUM  
**ENERGY EFFICIENCY AND  
CONTROL**

Coordination: DE GRACIA CUESTA, ALVARO

Academic year 2023-24

## Subject's general information

<b>Subject name</b>	ENERGY EFFICIENCY AND CONTROL			
<b>Code</b>	102149			
<b>Semester</b>	1st Q(SEMESTER) CONTINUED EVALUATION			
<b>Typology</b>	<b>Degree</b>	<b>Course</b>	<b>Character</b>	<b>Modality</b>
	Bachelor's Degree in Energy and Sustainability Engineering	3	COMPULSORY	Attendance-based
	Double bachelor's degree: Degree in Mechanical Engineering and Degree in Energy and Sustainability Engineering	3	COMPULSORY	Attendance-based
<b>Course number of credits (ECTS)</b>	6			
<b>Type of activity, credits, and groups</b>	<b>Activity type</b>	PRAULA		TEORIA
	<b>Number of credits</b>	3		3
	<b>Number of groups</b>	1		1
<b>Coordination</b>	DE GRACIA CUESTA, ALVARO			
<b>Department</b>	INDUSTRIAL AND BUILDING ENGINEERING			
<b>Teaching load distribution between lectures and independent student work</b>	Alvaro de Gracia (6 ECTS)			
<b>Important information on data processing</b>	Consult <a href="#">this link</a> for more information.			
<b>Language</b>	English			
<b>Distribution of credits</b>	40% attendance-based 60% student work			

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
DE GRACIA CUESTA, ALVARO	alvaro.degracia@udl.cat	3,6	
ORÓ PRIM, EDUARD	eduoro@diei.udl.cat	3,6	

## Subject's extra information

The course presents the concepts of efficiency and energy management and their application in different sectors such as buildings, industry, transport. The course also introduces the student in the energy audits, including procedures of sensorization and monitoring.

It is **COMPULSORY** that the students bring the following elements of individual protection (EPI) to the practices at the laboratory.

- Blue laboratory gown from UdL (unisex)
- Protection glasses
- Mechanical protection gloves

They can be purchased through the shop Údels of the UdL:

C/ Jaume II, 67 baixos  
Centre the Cultures i Cooperació Transfronterera

<http://www.publicacions.udl.cat/>

The use of other elements of protection (for example caps, masks, gloves of chemical or electrical risk, etc.) will depend on the type of practice to be done. In that case, the teacher will inform of the necessity of specific EPI.

Not bringing the EPI's described or not fulfilling the norms of general security that are detailed below imply that the student can not access to the laboratories or have to go out of them. The no realisation of the practices for this reason imply the **consequences in the evaluation** of the subject that are described in this course guide.

### GENERAL NORMS OF SECURITY IN LABORATORY PRACTICES

- Keep the place of realisation of the practices clean and tidy. The table of work has to be free from backpacks, folders, coats...
- No short trousers or short skirts are allowed in the laboratory.
- Closed and covered footwear is compulsory in the laboratory.
- Long hair needs to be tied.
- Keep the laboratoy gown laced in order to be protected from spills of chemicals.
- Bangles, pendants or wide sleeves are not allowed as they can be trapped.
- Avoid the use of contact lenses, since the effect of the chemical products is much bigger if they enter between the contact lense and the cornea. Protection over-glasses can be purchased.

- No food or drink is allowed in the laboratory.
- It is forbidden to smoke in the laboratories.
- Wash your hands whenever you have contact with a chemical product and before going out of the laboratory.
- Follow the instructions of the teacher and of the laboratory technicians and ask for any doubt on security.

For further information, you can check the following document of the *Servei de Prevenció de Riscos Laborals de la UdL*: <http://www.spri.udl.cat/alumnes/index.html>

## Learning objectives

### GENERAL OBJECTIVE OF THE COURSE

Provide students with the knowledge, as well as the techniques, tools, skills and abilities necessary to be able to efficiently develop professional activities related to energy efficiency and control

The achievement of this general objective is specified in:

- To understand the electricity market
- To know the importance of energy management
- To know the different types of sensors as well as data acquisition systems
- To introduce students to energy audits
- To know how to evaluate and improve energy systems in buildings
- To know how to evaluate and improve energy systems in the transport sector
- To know how to evaluate and improve energy systems in the industrial sector
- To introduce students in the smart cities concept

## Competences

### Basic Competences (Annex I section 3.3 of Royal Decree 861/2010)

- CB2. That students know how to apply their knowledge to their work or vocation in a professional way and possess the skills that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study.
- CB3. That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant issues of a social, scientific or ethical nature.
- CB5. That the students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.

### General Competences according to Order CIN / 311/2009 and EPS criteria

- CG12. To have knowledge about the fundamentals of automatisms and control methods.

### Specific Competences according to Order CIN / 311/2009

- CE12. To have applied knowledge about renewable energies.
- CE15. To acquire the ability to understand, interpret and apply the legislation on energy and environment.
- CE19. Acquire capacity for the control of installations and energy systems and their energy efficiency

### Transversal Competences approved by the Plenary Committee of the Degrees of Industrial Engineering, Computer Engineering and Building Engineering, meeting on June 16, 2008

- CT2. Master a foreign language, especially English.
- CT5. Acquire basic knowledge on scientific thinking.

## Subject contents

- Chapter 1. Introduction to efficiency and energy management
- Chapter 2. Spanish electric market
- Chapter 3. Energy audits.
- Chapter 4. Efficiency and energy control in buildings.
- Chapter 5. Efficiency and energy control in the transport sector.
- Chapter 6. Efficiency and energy control in the industry.
- Chapter 7. Smart cities.

## Methodology

The methodological axes of the subject will be divided into:

- Lectures: Lectures are taught orally by the teacher without the active participation of the students.
- Problem solving: In the problem-solving activity, teachers present a complex issue that students must solve, whether working individually or in a team.
- Group work: Learning activity that must be done through collaboration between the members of a group.
- Laboratory: They allow to apply and configure, at a practical level, the theory of a field of knowledge in a specific context.

## Development plan

The development plan will follow the order of the contents. This plan may be subject to modifications throughout the course, depending on the number of students, the work groups, and the evolution of the group. All classes will be taught by Professor Alvaro de Gracia.

Week	MethodologyConcept		Attendance based hours	Students own work hours
1	Master class	Presentation of the course	2	3
1-2	Master class and resolution of problems	Introduction to energy efficiency and energy management	8	12
3-4	Master class and resolution of problems	Spanish energy market	8	12

5	Master class and resolution of problems	Energy auditing	4	6
6	Laboratory	Energy auditing - Visit to industrial facility	2	3
6-7	Master class and resolution of problems	Energy efficiency in buildings	8	12
8		Written evaluation	2	3
9-12	Master class and resolution of problems	Energy efficiency in transport	12	18
13	Laboratory	Guidance on the Project	2	3
13-14	Master class and resolution of problems	Energy efficiency in industry	4	6
14-15	Master class and resolution of problems	Smart cities	4	6
15	Laboratory	Oral presentation - Evaluation	2	3
16-17		Written evaluation	2	3
19		Written evaluation - Recovery	2	3

## Evaluation

Block 1. Written exam. Chapters 1, 2, 3 and 4. (E1) 25%

Block 2. Written exam. All chapters (E2) 45%

Block 3. Activity 1. Written project for groups of 2 students. "Energy study on industrial plant Proposal of measures of energy efficiency" (P1) 20%

Block 3. Activity 2. Oral defense of the project for groups of 3 students (15 min exposition + 10 min questions). (P2) 10%

Course qualification=  $0.25 * E1 + 0.45 * E2 + P1 * 0.2 + P2 * 0.1$

Only the written test E2 can be recovered

Alternative evaluation will be based on an exam of all the contents of the course.

## Bibliography

### 1. Energy Efficiency. Benefits for Environment and Society

Authors: Yang, Ming, Yu, Xin

ISBN 978-1-4471-6665-8

## **2. Energy Performance of Buildings Energy. Efficiency and Built Environment in Temperate Climates**

Authors: Boemi, Sofia-Natalia, Irulegi, Olatz, Santamouris, Mattheos (Eds.)

ISBN: 978-3-319-20830-5

## **3. Analysis of Energy Efficiency of Industrial Processes**

Author: Vladimir S. Stepanov

ISBN: 978-3-642-77150-7

## **4. Data Acquisition for Sensor Systems**

Author: [H.R. Taylor](#)

ISBN: 978-1-4419-4729-1

## **5. Energy and Climate change**

Author: [David Coley](#)

ISBN: 978-0-470-85312-2