



DEGREE CURRICULUM **SUSTAINABLE CONSTRUCTION III**

Coordination: BARRAU , JEROME

Academic year 2023-24

Subject's general information

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|--|---|--------|-----------|------------------|
| Subject name | SUSTAINABLE CONSTRUCTION III | | | |
| Code | 101433 | | | |
| Semester | 1st Q(SEMESTER) CONTINUED EVALUATION | | | |
| Typology | Degree | Course | Character | Modality |
| | Bachelor's Degree in Architectural Technology and Building Construction | 4 | OPTIONAL | Attendance-based |
| | Bachelor's Degree in Energy and Sustainability Engineering | 4 | OPTIONAL | Attendance-based |
| | Bachelor's Degree in Mechanical Engineering | 4 | OPTIONAL | Attendance-based |
| Course number of credits (ECTS) | 6 | | | |
| Type of activity, credits, and groups | Activity type | PRAULA | TEORIA | |
| | Number of credits | 3 | 3 | |
| | Number of groups | 1 | 1 | |
| Coordination | BARRAU , JEROME | | | |
| Department | ENVIRONMENT AND SOIL SCIENCES AND CHEMISTRY | | | |
| Teaching load distribution between lectures and independent student work | 60 h in the classroom (40%) 90 h self employment (60%) | | | |
| Important information on data processing | Consult this link for more information. | | | |
| Language | English | | | |
| Distribution of credits | Dr. Jérôme Barrau Adrià Mateo | | | |

| Teaching staff | E-mail addresses | Credits taught by teacher | Office and hour of attention |
|---------------------|-----------------------|---------------------------|------------------------------|
| BARRAU , JEROME | jerome.barrau@udl.cat | 1,2 | |
| MATEO FORNÉS, ADRIÀ | adria.mateo@udl.cat | 3,6 | |
| MATEO FORNÉS, ADRIÀ | adria.mateo@udl.cat | 2,4 | |

Subject's extra information

Subjects to be taken in the 1st semester of the 4th year of teaching. It belongs to the module "Optional Training", specifically in the subject "Sustainable Construction".

The course is based on the Spanish legislation on the limitation of demand and consumption of buildings (Technical Building Code, Basic Document saving: CTE-DB-HE) and energy certification of new and existing buildings. The tools used for the practical sessions in the computer room are the official ones in Spain. Thus, the course is aimed at achieving the skills that will enable, in the current job market, the development of different tasks related to the energy efficiency of buildings, some of which are mandatory for the real estate market.

We suggest you the joint realization of Sustainable Construction 2 (Buildings Energy Almost Nul·la- NZEB for its acronym in English), due to the complementarity of the tools used in this subject in terms of the evaluation and optimization of the energy efficiency of buildings. The project that should be done for this course can be done in conjunction with the one of Sustainable Construction 2.

You can find educational materials and other documents related to the subject on the Virtual Campus: <http://cv.udl.cat>

Learning objectives

- Assess the main parameters that affect the energy efficiency of buildings.
- Know the different standards of sustainable construction and the differences between national regulations on energy efficiency in buildings.
- Interpret the main concepts related to energy certification and energy audits.
- Apply the state, regional and local rules and regulations.
- Know and use the tools to study the improvement of energy efficiency of buildings.
- Take measurements to analyze the energy efficiency of buildings.
- Develop procedures for energy rating and energy audits of buildings.
- Generate documents of energy certification of buildings from government programs.

Competences

Strategic competences of UdL

- UdL2 Command of a foreign language.

Cross-disciplinary competences

- EPS3. Capacity to convey information, ideas, problems and solutions to both a specialized and no specialized public.
- EPS7. Capacity to work in situations with a lack of information and/or under pressure.
- EPS8. Capacity of planning and organizing the personal work.
- EPS9. Capacity for unidisciplinary and multidisciplinary teamwork.
- EPS13. Capacity to consider the socioeconomic context as well as the sustainability criteria in engineering solutions.

Specific competences

- GEE12. Manufactured or traditional constructive systems and materials knowledge, its varieties and physics and mechanical characteristics that define them.
- GEE13. Capacity to adapt the materials of construction to the typology and use of buildings; manage the reception and the quality control of the materials, its use in the building works, the execution control of the units of work and the performance of tests and final proofs.
- GEE20. Knowledge of the environmental impact evaluation for building and demolition process, of sustainability in buildings, and of the procedures and techniques to determine the energy efficiency in buildings.
- GEE21. Capacity to apply technical rules to the building process, and produce documents of technical specification of the procedures and constructive methods of buildings.

Subject contents

Unit 1. INTRODUCTION

- 1.1. Comfort and energy
- 1.2. Energy and Environment
- 1.3. Residential Sector
- 1.4. Environmental assessment of buildings

Unit 2. ENERGY EFFICIENCY

- 2.1. Definition
- 2.2. Regulations
- 2.3. Energy certificates
- 2.4. Energy audits
- 2.5. Standards of energy efficient buildings

Unit 3. PARAMETERS AFFECTING THE ENERGY PERFORMANCE OF BUILDINGS

- 3.1. Classifications
- 3.2. Parameter Description

Unit 4. MEASUREMENT TECHNIQUES FOR THE ANALYSIS OF THE ENERGY BEHAVIOUR OF A BUILDING

- 4.1. Thermography
- 4.2. Thermal equipment measurements
- 4.3. Electrical equipment measurements
- 4.4. Analysis by thermal flow meters
- 4.5. Renovations and infiltration measurements
- 4.6. Monitoring

Unit 5. ENERGY AUDITS

- 5.1. Introduction
- 5.2. Procedure to conduct an energy audit
- 5.3. Relationship between energy audits (EN 216 501), control and regulation systems (UNE EN 15232) and energy management systems (UNE 216301)
- 5.4. Criteria for evaluating proposals for improvement

5.5. Examples

Unit 6. BASIC DOCUMENT OF ENERGY SAVING (DB-HE); THE TECHNICAL BUILDING CODE

6.1.DB-HE0: Limitation of energy consumption

6.2.DB-HE1: Limitation of energy demand

6.3. DB-HE2: Efficiency of thermal installations

6.4. DB-HE3: Energy efficiency of lighting installations

6.5. DB-HE 4: Minimum solar contribution to hot water

6.6. DB-HE 5: Minimum PV contribution to electricity

6.7. Relationship between the DB-HE and reducing the environmental impact of building

Unit 7. ENERGY CERTIFICATION

7.1. Introduction

7.2. Procedure for energy certification of buildings

7.3. Scale and energy indicators of the grade

7.4. Specifics of the software CALENER GT

7.5. Other tools for building simulations

Methodology

The main methodology of the course will be divided into:

1.-Sessions of theoretical lectures, where the teacher will expose theoretical concepts required for the acquisition of knowledge and for the proper conduct of the practical sessions.

2.-Problem sessions, where the teacher will make some examples, but where the students will take an active part in the learning process, by working in small groups or individually.

3.-Laboratory sessions, where the students will work in group some practices related to the topics covered in the theoretical sessions.

Development plan

| Week | Methodology | Content | Classroom hours | Independent work hours | Professor |
|------|--------------------------------|---|-----------------|------------------------|----------------------|
| 1-2 | Lecture | Unit 1. INTRODUCTION Unit 2. ENERGY EFFICIENCY | 6 | 12 | J.Barrau |
| 2-6 | Lecture Problems | Unit 3. PARAMETERS AFFECTING THE ENERGY PERFORMANCE OF BUILDINGS | 12 | 18 | J.Barrau A. Mateo |
| 7-8 | Lecture Laboratory sessions | Unit 6. BASIC DOCUMENT OF ENERGY SAVING (DB-HE); THE TECHNICAL BUILDING CODE Unit 7. ENERGY CERTIFICATION | 8 | 12 | A.Mateo |
| 9 | Evaluation: Written exam | | | | J.Barrau A. Mateo |
| 10 | Practices | Unit 6. BASIC DOCUMENT OF ENERGY SAVING (DB-HE); THE TECHNICAL BUILDING CODE Unit 7. ENERGY CERTIFICATION | 4 | 8 | A.Mateo |

| Week | Methodology | Content | Classroom hours | Independent work hours | Professor |
|-------|-------------------|---|-----------------|------------------------|----------------------|
| 11-12 | Lecture Practices | Unit 4. MEASUREMENT TECHNIQUES FOR THE ANALYSIS OF THE ENERGY BEHAVIOUR OF A BUILDING | 6 | 10 | A. Mateo |
| 13 | Lecture Problems | Unit 5. ENERGY AUDITS | 4 | 6 | A. Mateo |
| 14-15 | Team work | All units | 6 | 24 | A.Mateo |
| 16-17 | Evaluation | | | | J.Barrau A. Mateo |
| 18-19 | Recovery | | | | J.Barrau A. Mateo |

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| Unit 6. BASIC DOCUMENT OF ENERGY SAVING (DB-HE); THE TECHNICAL BUILDING CODE |
| Unit 7. ENERGY CERTIFICATION |

Evaluation

| Objectives | Evaluation Activities | Criteria | % | Dates | O/V(1) | I/G(2) | Observations |
|--------------|--|----------|----|-------------|--------|--------|---|
| Units 1-3 | Written exam (PA1) | (*) | 30 | Week 9 | O | I | |
| Units 1.7 | Project (AA1) Energy Demand limitation, Energy Certification and Energy Audit | | 30 | Weeks 16-17 | O | G | The activities will be delivered at the proposed date |
| Units 1-7 | Oral presentation Project AA2 | | 10 | Weeks 16-17 | O | G | |
| Units 1-7 | Test of skills related to the project (PA2) | | 30 | Weeks 16-17 | O | I | |
| Recovery PA1 | Written exam (PA3) | | 30 | Week 19 | O | I | |
| Recovery AA1 | Project | | 30 | Week 19 | O | G | The activities will be delivered at the proposed date |
| Recovery PA2 | Test of skills related to the project (PA4) | | 30 | Week 19 | O | I | |

(1) Obligatory / Voluntary.

(2) Individual / Group.

(*) This test (50% of the final grade) is divided into two sections:

- Concepts: 60% Note: Minimum mark of 5/10 in this section
- Problems: 40% Note.

Bibliography

Eficiencia energética en edificios: Certificación y auditorías energéticas. Francisco Javier Rey Martínez, Eloy Velasco Gómez. Madrid. Thomsoncop., 2006.

Análisis y gestión energética de edificios: métodos, proyectos y sistema de ahorro energético. William H. Clark II. Mac Graw Hill. 1998.

Guías Técnicas para la Rehabilitación de la Envolvente Térmica de los Edificios. Asociación Nacional de Industriales de Materiales Aislantes (ANDIMA). 2007.

Els graus-dia de calefacció i refrigeració de Catalunya. Resultats a nivell municipal. Generalitat de Catalunya. Departament de Treball, Indústria, Comerç i Turisme. Institut Català d'Energia. 2003

Institute for Energy Diversification and Saving, IDAE. <http://www.idae.es/>

Building Technical Code (SPAIN) <http://www.codigotecnico.org/>

Sustainable Construction Webpage <http://www.csostenible.net/>

Passivhaus SPAIN <http://www.plataforma-pep.org/>