66344 - Energy efficiency in buildings

Información del Plan Docente

Academic Year	2017/18
Faculty / School	110 - Escuela de Ingeniería y Arquitectura
Degree	330 - Complementos de formación Máster/Doctorado 535 - Master's in Renewable Energies and Energy Efficiency
ECTS	5.0
Year	XX
Semester	Half-yearly
Subject Type	Optional, ENG/Complementos de Formación
Module	---

1.General information

1.1.Introduction

1.2.Recommendations to take this course

1.3.Context and importance of this course in the degree

1.4.Activities and key dates

2.Learning goals

2.1.Learning goals

2.2.Importance of learning goals

3.Aims of the course and competences

3.1.Aims of the course

3.2.Competences

4.Assessment (1st and 2nd call)

4.1.Assessment tasks (description of tasks, marking system and assessment criteria)

5.Methodology, learning tasks, syllabus and resources

5.1.Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as lectures, problem-solving sessions, computer practice sessions, guided assignments, and student participation.

In the **lectures,** the basic concepts are explained and interrelated with short exercises on the board. This serves as

support to assure the understanding of the concepts explained.

The **computer practice sessions** consist on practical cases more complex than those presented on the board. Thus, these sessions reinforce and complete the contents developed during the lectures. In these sessions, several cases will be solved through the use of various computer tools, with the support and help of the teacher. Students will have instructions for each session, which they will have previously read and prepared.

The **guided assignments** will be individually made by each student, as an expansion of the practice sessions, solving larger problems than those solved in class. Thus, the autonomous learning of the students is encouraged. Students will be provided with the necessary tools for the development of these tasks. Although the work to be performed is intended as an autonomous activity, it will be presented during the classroom sessions. These assignments will be supervised by the teacher, who will solve any doubts that may arise during its development.

In **tutorials**, the students can voluntarily attend to the teacher's office during office hours in order to ask questions about the course contents. Its is highly recommended to ensure adequate progress in the learning process.

5.2.Learning tasks

The course includes the following learning tasks:

- A01 Lectures (25 hours). Presentation of theoretical contents by a faculty or by external experts to all students enrolled in the course. Although it is not a mandatory activity, regular attendance is highly recommended.
- A02 Problem and case solving (13 hours). Solve practical problems and exercises with all the students. Although it is not a mandatory activity, regular attendance is highly recommended.
- A03 Laboratory sessions (12 hours). Students will work actively in groups to solve practical exercises.
- A06 Guided assignments (20 hours). Students will complete assignments, problems and exercises related to concepts seen in laboratory sessions and lectures.
- A07 Autonomous work (50 hours). Students are expected to spend about 50 hours to study theory, solve problems and prepare lab sessions
- A08 Assessment (5 hours).

The indicated hours are for guidance and will be adjusted depending on the academic calendar.
At the beginning of the course, lecturers will communicate the schedule of practice sessions, which will be set according to the syllabus and the availability of laboratories and computer rooms.

5.3.Syllabus

The course will address the following topics:

Topic 1. Introduction: building and sustainability.

Topic 2. Definition of the constructive elements in the thermal envelope of a building. Thermal transmittance and thermal bridges.

Topic 3. Analysis of regulations on energy efficiency in buildings: Technical Building Code - Basic Document of Energy Saving. Limits on energy consumption and thermal demand in buildings (HE0 and HE1), energy efficiency in heating, ventilation and air conditioning -HAVC- systems (HE2), energy efficiency in lighting (HE3), integration of solar thermal energy in buildings (HE4).

Topic 4. Energy balance in a building: heat loss and gain. Calculation of the thermal demand of a building.

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Topic 5. Energy certification of buildings. Calculation of the energy rating of a building: Use of the unified tool LIDER-CALENER - solving of practical examples.

Topic 6. Bioclimatic architecture and passive strategies for energy savings in buildings: shape and orientation, climate adaptation, thermal comfort, microclimates, thermal insulation, openings (windows), thermal storage, ventilation, passive heating / cooling, natural lighting, Passive House standard.

Topic 7. Energy Simulation of Buildings: basic concepts. Use of DesignBuilder: geometric definition, thermal demand calculation, improvements' assessment in the buildings envelope. Solving practical examples of energy refurbishment of buildings.

Topic 8. Measuring equipment for buildings: Light-meter, network analyser, clamp meter, thermal imaging camera, thermal transmittance measurement, combustion gas analyser and blower door.

Topic 9. Sustainable building - life-cycle assessment: general methodology, application to products, constructive solutions (EPD) and buildings. Basic principles of bioconstruction.

Topic 10. Methodologies for environmental rating and certification of buildings: LEED and VERDE. Basic principles and assessment indicators. Certification Guides and practical exercises.

Topic 11. Sustainable Urban design: basic concepts.

Practice sessions

- Session 1. Using the unified tool LIDER-CALENER (4 sessions of 2 hours each: 8 hours in total).
- Session 2. Using the building energy simulation tool DesignBuilder (4 sessions of 2 hours each: 8 hours total).
- Session 3. Using the design support tool HADES and criteria assessment in VERDE certification scheme (1 session of 2 hours).

5.4.Course planning and calendar

The assignment reports must be submitted before the final written exam date, which will take place in the corresponding official calls.

Further information concerning the timetable, classroom, assessment dates and other details regarding this course, will be provided on the first day of class or please refer to the EINA website.

5.5.Bibliography and recommended resources

During the course, communication between the student and the teacher is managed thought the Moodle2 platform of the University of Zaragoza (http://moodle2.unizar.es). In this platform the teacher shares the main training materials (notes, questions, problems, previous exams, tables, etc.), and makes some announcements and notifications to students. He also sends and receives emails and offers students online tools for sending reports, works, etc.

Basic reference documents for the course are as follows:

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BB	Aranda Usón, Alfonso. Ecodiseño y Análisis de Ciclo de Vida / Alfonso Aranda Usón, Ignacio Zabalza Bribián . - 1ª ed. Zaragoza : Prensas Universitarias de Zaragoza, 2010
BB	Arquitectura bioclimática y urbanismo sostenible / José Antonio Turégano Romero, Maria del Carmen Velasco Callau y Amaya Martínez Gracia (editores) ; Sergio Díaz de Garaio ... [et al.] . - 1ª ed. Zaragoza : Prensas Universitarias de Zaragoza, 2009
BB	Eficiencia energética en instalaciones y equipamiento de edificios : eficiencia energética / Alfonso Aranda Usón, Ignacio Zabalza Bribián, Sergio Díaz de Garaio, Eva Llera Sastresa . - 1ª ed. Zaragoza : Prensas Universitarias de Zaragoza, 2010
BB	España. Ministerio de la Presidencia. Reglamento de Instalaciones Térmicas en Edificios. - 2013
BB	España. Ministerio de la Vivienda. Código Técnico de la Edificación / edición preparada por Departamento de Redacción Aranzadi. - 4ª ed. act. Cizur Menor (Navarra) : Aranzadi, 2013
BB	Metodologías de análisis para la calificación energética de edificios : eficiencia energética / Ignacio Zabalza ... [et al.] Zaragoza : Prensas Universitarias Universidad Zaragoza, [2010]
BB	Zabalza Bribian, Ignacio. Ecodiseño en la edificación / Ignacio Zabalza Bribián, Alfonso Aranda Usón . - 1ª ed. Zaragoza : Prensas Universitarias de Zaragoza, 2011
BC	Anderson, Bruce. Solar Energy : Fundamentals in Building Design / Bruce Anderson New York : McGraw-Hill,1977
BC	ASHRAE. Thermal Environment Conditions for Human Occupancy / American Society ofHeating, Refrigerating

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	and Air Conditioning Engineers Atlanta : American Society of Heating, Refrigerating and Air-Conditioning Engineers,2010
BC	BAHADORI, M. N. Y CHAMBERLAIN,M. J., A simplification of weather data to evaluate daily and monthly energy needs of residential buildings. En: Solar Energy, vol. 36, 1986. Phoenix, Ariz : Association for Applied Solar Energy, [1958- [Publicación periódica]
BC	García Arroyo, Arturo. Bases para el diseño solar pasivo / A. García Arroyo Madrid : CSIC,1983
BC	Markus, Thomas A. Buildings, Climate and Energy / Thomas A Markus, Edwin N Morris London ; Marshfield : Pitman, 1980
BC	Santamouris, Mat. Energy and Climate in the Urban Built Environment / Mat Santamouris London : James & James, 2001
BC	Santamouris, Mat. Passive Cooling of Buildings / M. Santamouris, D.N. Asimakopoulos London : James & James, 1996
BC	Técnicas para la elaboración de auditorías energéticas en el sector industrial / Alfonso Aranda Usón ... [et al.] . - 1ª ed. Zaragoza : Prensas Universitarias de Zaragoza, 2010
BC	Zabalza Bribian, Ignacio. Energía solar térmica / Ignacio Zabalza Bribian y Alfonso Aranda Usón . - 1ª ed. Zaragoza : Prensas Universitarias de Zaragoza, 2009