

66335 - Energy efficiency

Información del Plan Docente

Academic Year	2016/17
Academic center	110 - Escuela de Ingeniería y Arquitectura
Degree	535 - Master's in Renewable Energies and Energy Efficiency 330 - Complementos de formación Máster/Doctorado
ECTS	8.0
Course	---
Period	Indeterminate
Subject Type	ENG/Complementos de Formación, Compulsory
Module	---

1. Basic info

1.1. Recommendations to take this course

1.2. Activities and key dates for the course

2. Initiation

2.1. Learning outcomes that define the subject

2.2. Introduction

3. Context and competences

3.1. Goals

3.2. Context and meaning of the subject in the degree

3.3. Competences

3.4. Importance of learning outcomes

4. Evaluation

5. Activities and resources

5.1. General methodological presentation

The teaching-learning process is structured in four main activities: lectures, classes for problem solving, computer practices and development of tutored works.

In the **theory sessions** the basics are explained and interrelated, solving short exercises on the board. This serves as support to assure the understanding of the concepts explained. The methodology used for these sessions are master

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classes.

The **practical sessions** consist of computer sessions in which more complex practical cases than those presented on the board are studied. Thus, these practical sessions reinforce and complete the contents developed during the theory sessions. 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 be provided with a script of each practice, which they will have previously read and prepared.

The **tutored works** are an expansion of the practical sessions, solving larger problems than solved in practical sessions. Thus, the autonomous learning of the students is encouraged. Students will be provided with the necessary tools for the development of these works. A unique work will be considered in thermal energy efficiency, related to a cogeneration system. In case of electrical energy efficiency, a number of small tutored works will be requested.

In **tutorial sessions**, the students can voluntarily attend to the teacher office in order to ask questions about the subjects' contents. There will be a tutorial timetable for these sessions. The use of these tutorial sessions is highly recommended to ensure adequate progress in the learning process.

5.2.Learning activities

1: Lectures: will be held at 2 weekly sessions lasting five (three + two) and two hours each. In this activity the fundamental contents of the subject are explained and some practical exercises are solved. The most representative and relevant exercises are selected to be solved in order to facilitate understanding and contents' assimilation. Student participation in the resolution process is intended. This activity takes place in-person classes.

2: Practical sessions: These sessions are essential in order to assure a correct application of the theoretical concepts presented in lectures. A total of 3 sessions will be planned in a computer room (2 h).

5.3.Program

The program of this subject includes the next contents:

THERMAL SYSTEMS ENGINEERING (5 ECTS)

COMBUSTION TECHNOLOGY AND ITS APPLICATIONS

- Basic Thermodynamics (supplementary material).

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- Mass and energy balance in combustion.
- Boilers. Classification and types. Fuels.
- Thermal efficiency in boilers. Calculations and methods.
- Energy saving in boilers.
- Energy saving in boilers. Industrial experiences

THERMAL INSULATION

- Insulation materials.
- Economic optimization of insulation thickness.
- Insulation application and protection.

HEAT EXCHANGER NETWORKS

- Heat carrying medium.
- Pumping devices.
- Ducts, valves and ancillary devices.
- Design and optimization of heat exchanger networks.

COOLING

- Cooling technologies depending on applications.
- Basic engineering in cooling installations.
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Refrigerants to use in cooling technologies.

POWER GENERATION

- Introduction to thermal turbomachinery: turbines and compressors.
- Integration of thermal machinery in power generation systems: steam cycles, gas turbines, internal combustion engines, fuel cells...

ENERGY EFFICIENCY IN BUILDINGS

1. Fundamentals and Energy Performance Certification Regulations

- Certification procedures for new and existing buildings: general and simplified options.
- Rating scale and energy indicators.
- Basics of energy efficiency in buildings.

2. Simplified Methodology for Energy Performance Certification of Existing Buildings - CE3X

- General data.
- Definition of the thermal envelope and installations.
- Rating and assessment of improvements.
- Economic analysis and resolution of practical exercises: residential, small and large tertiary buildings.

3. Energy Audits in Buildings

- Identification of thermal and electrical energy consumptions.
- Measurement and quantification of energy consumption. Energy flows diagram.
- Energy Billing.
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Techniques for the development and presentation of an energy audit.

- UNE 216501 and UNE-EN 16247-2 - Energy Audits.

ELECTRICAL ENGINEERING (3 ECTS)

Energy Efficiency in electrical systems

1. Introduction

Definitions.

Current situation of the Energy Efficiency in electrical systems

Mechanisms of electrical losses

2. Efficiency in generation systems and in power lines

Efficiency in power generation

Efficiency in transport lines

Efficiency in distribution systems

Efficiency in inner lines

Inefficiencies and non-active component of the current

Power factor compensation

Demand side management and supply side management

3. Efficiency in electrical machines

Efficiency in design of electrical motors

Efficiency in adjustable speed drives

Efficiency in power Transformers

4. Efficiency in lighting systems, domestic appliances and other electric equipment

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5.4.Planning and scheduling

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

In order to know the starting date of the course, the schedules of in-person classes, as well as the examination sessions, please visit the EINA website.

5.5.Bibliography and recommended resources

During the course, communication between the student and the teacher is managed through 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 will be included in the main training materials.

Other reference books are:

- A. ARANDA, F. BARRIO, I. ZABALZA, S. DIAZ "TECNICAS PARA LA ELABORACION DE AUDITORIAS ENERGETICAS EN EL SECTOR INDUSTRIAL". SERIE EFICIENCIA ENERGETICA. ISBN: 978-84-92521-12-8.
- A. ARANDA, I. ZABALZA, S. DIAZ, E. LLERA "EFICIENCIA ENERGETICA EN INSTALACIONES Y EQUIPAMIENTO DE EDIFICIOS". SERIE EFICIENCIA ENERGÉTICA. ISBN: 978-84-92774-96-8.
- C. CORTÉS, I. ARAUZO, S. ESPATOLERO, A. GIL. "CENTRALES TÉRMICAS DE CARBÓN PULVERIZADO". SERIE TÉCNICA (158). ISBN: 978-84-92774-22-7.
- J. PALLARÉS, S. ESPATOLERO, L. I. DIEZ, I. ARAUZO. "CASOS PRÁCTICOS DE TECNOLOGÍA ENERGÉTICA". SERIE TÉCNICA (156). ISBN: 978-84-92774-10-4.
- I. ZABALZA, S. DIAZ, A. ARANDA, F. BARRIO. "METODOLOGIAS DE ANALISIS PARA LA CALIFICACION ENERGETICA DE EDIFICIOS". SERIE EFICIENCIA ENERGÉTICA. ISBN: 978-84-15031-79-6.
- J. M. MERINO, "EFICIENCIA ENERGÉTICA ELÉCTRICA" ISBN 84-314-0480-9
- V. LEON, J. GINER, J. MONTAÑANA, A. CAZORLA, "INEFICIENCIAS DE LOS SISTEMAS ELÉCTRICOS", ISBN: 84-9705-121-1