Universidad Zaragoza

Academic Year/course: 2022/23

66369 - Low emission power plants

Syllabus Information

Academic Year: 2022/23
Subject: 66369 - Low emission power plants
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 636 - Master's in Renewable Energies and Energy Efficiency
ECTS: 3.0
Year: 1
Semester: Second semester
Subject Type: Optional
Module:

1. General information

1.1. Aims of the course

The course and its expected outcomes pursue the following objectives:

As a first objective, the student must be able to complete calculations of classical thermochemistry and energy balance and identify the main environmental impacts of large thermal plants (with emphasis on gaseous emissions into the atmosphere).

As a second objective, the student must know the degree of technological development of CO2 capture systems (pre-combustion, post-combustion and oxy-combustion systems), storage and uses of CO2, comparing their energy and economic impact.

These approaches and objectives are aligned with some of the Sustainable Development Goals, GSD, of the 2030 Agenda (https://www.un.org/sustainabledevelopment/es/) and certain specific goals, in such a way that the acquisition of learning outcomes of the subject provides training and competence to the student to contribute to some extent to their achievement:

Goal 7: Affordable and clean energy

- Goal 7.1. By 2030, ensure universal access to affordable, reliable and modern energy services
- Goal 7.2. By 2030, substantially increase the share of renewable energy in the energy mix
- Goal 7.3. By 2030, double the global rate of improvement in energy efficiency

Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

- Target 9.5. Increase scientific research and improve the technological capacity of industrial sectors in all countries, in particular developing countries, including by promoting innovation and substantially increasing, by 2030, the number of people working in research and development per million inhabitants and public and private sector expenditures on research and development

1.2. Context and importance of this course in the degree

The subject is given in the second semester, as an optional subject of the thermal itinerary. The student has already acquired the necessary knowledge in the fundamental subjects of the first semester, which must now be applied and analysed in the systems studied in the subject. The subject is related to other subjects of the master's degree, fundamentally those related to combustion, energy use of biomass and energy efficiency in thermal systems and processes.

1.3. Recommendations to take this course

To take this module, advanced knowledge of thermal engineering is required, as well as basic knowledge of chemical engineering.

2. Learning goals

2.1. Competences

Upon passing the course, the student will have acquired the following skills:

BASIC SKILLS

CB6.- Possess and understand the knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context.

CB7.- That students know how to apply the knowledge acquired and their ability to solve problems in new or little-known environments within broader (or multidisciplinary) contexts related to their area of study.

CB10.- That students have the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.

GENERAL COMPETENCIES

CG1.- Carry out research, development and innovation in products, processes and methods in relation to energy efficiency.

CG5.- Apply knowledge of advanced sciences and technologies to the professional or investigative practice of efficiency.

CG7.- Assess the application of emerging technologies in the field of energy and the environment.

CG9.- Solve complex problems in the field of energy efficiency and sustainability.

SPECIFIC COMPETENCES

CE1.- Use and develop methodologies, methods, techniques, programs for a specific use, norms and computing standards.

CE4.- Assess the environmental impact associated with a RES installation or energy efficiency action.

CE5.- Identify the processes of energy management, improvement and optimization in the industry.

CE9.- Analyse energy consumption and its associated costs and prepare energy audits.

2.2. Learning goals

The student, to pass this course, must demonstrate the following results...

- Know the main environmental impacts derived from the generation of electricity based on combustion and their mitigation systems, related to combustion control and gas cleaning equipment.
- Know the phenomenon of the greenhouse effect, the repercussions that its alteration has on global climate change and the main agents that cause such alteration.
- Analyse and criticize the policies aimed at mitigating climate change and controlling emissions, and relate the different international positions with the economic and social interests of the parties involved.
- Know and describe the main technologies aimed at capturing CO2 emissions, in use and emerging, that can be applied in energy-intensive industrial installations.
- Know the alternatives of transport, permanent storage and uses of CO2.

2.3. Importance of learning goals

Knowledge of combustion processes is essential to determine the energy efficiency of thermoelectric generation and industrial processes, as well as the environmental impacts caused by polluting gaseous emissions. The synergy between fuels with different characteristics also depends on their behaviour during the combustion process. Likewise, there is a connection with the fundamental subjects of this field (thermodynamics, heat transfer), which provides a broad vision, both theoretical and practical, of the field of study.

CO2 capture technologies constitute an emerging solution to mitigate the greenhouse effect, as pointed out by the IPCC and the International Energy Agency. The knowledge acquired in this subject will give the student a complete perspective of the matter, which can be helpful when joining research teams or R&D companies that work directly on these issues.

3. Assessment (1st and 2nd call)

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

The student must demonstrate that they have achieved the expected learning outcomes through the following assessment activities

Continuous evaluation

In order to encourage continued work throughout the teaching period, activities distributed throughout the semester will be carried out, consisting of solving various practical problems related to the contents of the subject.

They will be graded from 0 to 10 points. All deliveries will have the same weight in the final grade. To pass the practices, a minimum average grade of 5 points will be required. In case of not passing this note, the student will be able to attend a final exam, in the ordinary calls for evaluation of the subject.

The weight of the evaluation of the practices will be 40% of the total mark.

The weight of the evaluation of the exam, consisting of a test of the theoretical-practical contents seen during the course (grading from 0 to 10 points and a minimum score of 5 points), will be 60% of the total mark for those students who have passed the practices.

Overall evaluation

Consists of a test of the theoretical-practical contents seen during the course.

Rating from 0 to 10 points. To pass the exam a minimum score of 5 points will be required.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The learning process that has been designed for this subject is based on the following:

The development of the subject is structured around theory sessions and practical sessions.

In the theory sessions, the basic concepts are explained and related to the technical characteristics of the processes, using short exercises that are solved on the blackboard, serving as support to establish the understanding of the topics. In both cases, the methodology is master classes.

In the practical sessions, different aspects of the reduction of SO2, NOx and CO2 emissions will be analysed, as well as the techniques to be adopted to reduce their emission into the atmosphere.

4.2. Learning tasks

In order for students to achieve the learning outcomes described above and acquire the skills designed for this subject, the following training activities are proposed:

- A01 Master class (20 hours): presentation of contents by the teaching staff or external experts to all the students of the subject.
- A02 Resolution of problems and cases (5 hours): carrying out practical exercises with all the students of the subject.
- A03 Laboratory practices (5 hours): carrying out practical exercises in small groups of students of the subject.
- A07 Study (40 hours).
- A08 Evaluation tests (5 hours).

The hours indicated are indicative and will be adjusted depending on the academic calendar of the course.

4.3. Syllabus

Subject syllabus:

1) Training and control of gaseous emissions in industrial processes.

2) Climate change: international strategy.

3) CO2 capture technologies.

- 3.1) Oxyfuel combustion.
- 3.2) Capture in post-combustion.
- 3.3) Capture in pre-combustion.

4) Storage and uses of CO2.

4.4. Course planning and calendar

Calendar of sessions and presentation of works

On the first day of class will be informed of the calendar and planning according to the program shown in the previous point.

February - Beginning of Course and first Delivery of Practical Cases.

March - Second Delivery of Practical Cases.

June - First Call for Final Exam.

July - Second Call for Final Exam.

4.5. Bibliography and recommended resources

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=66369