Universidad Zaragoza

Academic Year/course: 2024/25

66235 - Combustion Science and Technology

Syllabus Information

Academic year: 2024/25
Subject: 66235 - Combustion Science and Technology
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 531 - Master's in Chemical Engineering
ECTS: 3.0
Year:
Semester: Second semester
Subject type: Optional
Module:

1. General information

The main objective of this subject is to familiarize students with combustion, allowing them to approach any case of combustion from the point of view of chemical engineering. The basic phenomena necessary to understand the combustion process are addressed: thermochemistry, matter transfer and chemical kinetics, including the description of detailed mechanisms. Practical applications are also discussed. We begin by studying the different types of flames: premixed and non-premixed laminar flames, and turbulent flames. All this is integrated in the study of the main combustion technologies (engines, chambers, etc.), integrating aspects of pollutant minimization.

2. Learning results

To develop kinetic mechanisms for combustion processes from kinetic and thermodynamic data, managing thermodynamic and kinetic parameter databases and implementing them in programs to solve these mechanisms.
To pose and solve conservation equations of different combustion systems with different complexity levels and to determine the possible simplifications.
To assimilate theoretical concepts of the different types of flames and solve numerical problems related to: i) laminar flames, ii) diffusion flames, iii) determination of adiabatic flame temperatures.
To assimilate theoretical concepts of different types of combustion processes and identify the most appropriate operating conditions. To solve problems of varying complexity related to system selection and optimization, including contaminant formation and destruction.
To quantify the formation of pollutants in the different combustion systems. To know and choose (for specific cases) the pollutant control systems in combustion systems.

3. Syllabus

1. Introduction to combustion.
2. Thermochemistry of combustion: Stoichiometry. Enthalpies of formation. Combustion heat. Adiabatic flame temperature.
3. Homogeneous chemical kinetics: Elemental reactions. Non-elemental reactions. Most typical reactions in combustion processes. Important mechanisms.
4. Types of flames: premixed, diffusion, turbulent. Flame theory. Stability. Combustion in gas turbines. Otto combustion engines. Burners with premixed. Diffusion burners.
5. Droplets evaporation. Diesel combustion engines.
6. Combustion of solids. Combustion technologies and strategies.
7. Minimization of contaminants. A case study: emissions minimization in diesel engines.

4. Academic activities

Participative master classes (18h) Expository sessions of theoretical and practical content.

Problem solving and case studies (8 h) There will be exercises and/or specific practical cases of direct or complementary application to what has been covered in the master classes. They will also be used to monitor teaching work

Special Practices (4 h) Visits to facilities related to combustion processes, on a voluntary basis, whenever feasible.

Teaching assignments (10 h)

Individual study (26 h)

Personalized tutoring (6 h)

Assessment (3 h)

5. Assessment system

There are two assessment options:

Continuous assessment Based on work, attendance and participation:

1 Class attendance and participation (10%).

2 Individual and/or group work, presentations or demonstrations of the work performed, discussion with peers and teaching staff. (90 %).
The student must attend to/participate in at least 80% of the classes in order to be evaluated through activities 1 and 2

2. Evaluation by means of a global test:
The test consists of the same type of exercises that students have been doing throughout the subject, since these tests are directly related to the learning results expected for the subject.

6. Sustainable Development Goals

7 - Affordable and Clean Energy
9 - Industry, Innovation and Infrastructure
13 - Climate Action