Universidad Zaragoza

Academic Year/course: 2023/24

66420 - Numerical and experimental methods in thermal engineering

Syllabus Information

Academic year: 2023/24
Subject: 66420 - Numerical and experimental methods in thermal engineering
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 536 - Master's in Mechanical Engineering
ECTS: 6.0
Year: 1
Semester: First semester
Subject type: Compulsory
Module:

1. General information

Objectives of the subject

The student will become familiar with the most common methods of thermal engineering in order to approach, analyse, model, and simulate energy equipment and facilities with a level of complexity greater than that of a degree. These equipment and facilities include boilers, heat exchangers, solar panels, heat production systems, work, cold and air conditioning, etc.

Sustainable Development Goals of the 2030 Agenda (https://www.un.org/sustainabledevelopment/es/) : Goal 7: Objective 7.2 and Objective 7.3; Goal 9: Objective 9.4; Goal 11: Objective 11.6; Goal 12: Objective 12.2

Recommendations to take the subject.

In order to follow this subject, it is important that the students have some solid knowledge in the use of basic calculation tools, especially numerical calculation and statistics, as well as in the main notions of thermodynamics and heat transfer. Active participation, continued study and preparation for practical problems that may be solved in further sessions are recommended. When doubts arise, it is important to solve them as soon as possible with the advice of the teacher.

2. Learning results

1. Acquisition of skills for the analysis of the behaviour of materials and thermal components.
2. Acquisition of practical skills for the application of experimental and computational methods to the study of the behaviour of thermal equipment and facilities.

3. Syllabus

Topics

Part I. Experimental techniques

1. Errors: generation and propagation.

2 Temperature.

3. Specific Heat and enthalpy

4 Thermal conductivity

5 Rheological properties.

6. Detection and measurement of combustion gases

7. Measurement of basic properties of fuels

8 Applications

Part II. Numerical techniques

1. Differential equations of heat transport

2. Numerical methods in advective-diffusive problems

3 Numerical methods in heat radiation

Laboratory practices

1. Measurement of temperature.
2. Measurement of specific heat and thermal conductivity of substances of interest.
3. Experimental analysis of a fuel: calorific value, immediate composition and granulometry.
4. CFD simulation of a convective-diffusive problem
5. CFD simulation of a radiative problem

4. Academic activities

- Master classes. (15 hours)
- Types of problems and practical cases. (15 hours)

The teacher explains to the whole group the basic principles of the subject and solves representative problems of the application to realistic professional cases. Students are encouraged to participate. Simultaneously, the student must do personal work for the better use of the classes.

- Laboratory and computer practices, in small groups. (25 hours)
- Personalized teacher-student tutoring. The professor will publish office hours. (5 hours)

Tutored work in small groups: using a computer tool, students will analyse and solve a problem related to the subject. Autonomous learning and teamwork are encouraged.

- Special practices. Visits to companies, laboratories and research centres. (5 hours)
- Practical works. (40 hours)

Formulation of exercises, questions, and additional problems to those solved in class. This encourages independent work, so that students apply what they have studied to solve the proposed exercises. This activity, both tutored but executed autonomously by the students, is fundamental in their learning process and to help them pass the assessable activities.

- Study and personal work. (at least, about 42 hours, necessary for the study of theory, preparation of a project and practical reports)
- Assessment tests. (3 hour)

5. Assessment system

The subject is preferably evaluated with a **continuous assessment** that consists of three blocks:

Block 1 : Evaluation of practices. (20% of the final grade)

1. Laboratory practices: The student becomes familiar with experimental thermal systems and with the collection and analysis of experimental data. They apply the procedures inherent to the subject and deliver a report of results.
2. Practice with computer tools: the student learns to solve problems specific to thermal engineering using computer tools. Students solve problems and issues and deliver a report of results.

Block 2 : Tutored works (20% of the final grade)

The student, with the guidance of the teacher, solves one or two problems of certain complexity and submits a report of results on the dates indicated at the beginning of the subject. The script for the assignments is handed out and explained in a session, doubts are addressed personally in tutorials and, if necessary, a collective doubt session is held.

Block 3 : Exam (60% of the final grade)

Written test on the contents explained during the term, on the assigned date within the official exam periods.

Alternatively, the student has the possibility of passing the subject by means of the **global evaluation** in the official calls for exams. Knowledge will be assessed through a theoretical-practical test on the dates established by the centre.