

## **69963 - High efficiency heat pumps in dual mention**

### **Syllabus Information**

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**Academic year:** 2024/25

**Subject:** 69963 - High efficiency heat pumps in dual mention

**Faculty / School:** 110 - Escuela de Ingeniería y Arquitectura

**Degree:** 657 - Master in Mechanical Engineering

**ECTS:** 3.0

**Year:** 1

**Semester:** Second semester

**Subject type:** Optional

**Module:**

### **1. General information**

#### **Objectives of the subject**

The main objective of the course is to learn about heat pump technology: fundamentals, types and applications, as well as its possibilities of integration with renewable energies and with ambient air (aerothermal energy) or underground air (geothermal).

The Dual Mention takes advantage of the knowledge and human and material resources available to the company to strengthen the integration of the learning of technologies with their practical application in a company.

### **2. Learning results**

1. Recognise and assess the fundamentals of the different types of heat pumps, both thermally and electrically activated.
2. Recognise and assess the different techniques for integrating heat pumps, both in aerothermal and geothermal energy.
3. Recognise and value the techniques for integrating renewable energies with heat pumps.
4. Recognise and assess aspects of regulations and applications of heat pumps to improve the energy efficiency of installations that consume heat or cold.

### **3. Syllabus**

In each Individual Training Plan, the specific objectives and milestones of the subject in the company are specified. There is a tutor in the company, who ensures the learning of technologies and work methodologies and their application to the company's production processes and products.

#### **Syllabus**

- Electrically and gas-powered heat pumps.
- Thermally driven heat pumps. Absorption and adsorption.
- Aerothermal heat pump.
- Geothermal heat pump.
- Wet geothermal energy. Exchange to well.
- Dry geothermal. Exchange in the field.
- Components and coolants.
- Integration of renewable energies with heat pumps.
- Regulations.
- Heat pump applications.

### **4. Academic activities**

- Participatory master class. (20 hours)
- Troubleshooting and technical cases. (2.5 hours)
- Laboratory practices. (7.5 hours) Practical exercises in small groups of students of the subject using specific software or laboratory facilities.
- Personalized teacher-student tutoring. The teacher will publish a schedule of tutorials.
- Practical application or research work (13 hours).
- Autonomous study by the student (30 hours).
- Evaluation tests. (2 hours)

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

This subject is English Language Friendly (ELF). The study and class material is available in English and the teaching staff will attend tutorials and carry out assessment tests in English for students who do not speak Spanish.

The alternating contract includes the schedule that the student must remain at the university centre to attend training activities. During the working day in the company, a programme of activities is also agreed to achieve the objectives and milestones specified in the Individual Training Plan.

## **5. Assessment system**

The assessment of the subject will follow a continuous assessment, which combines the following activities:

- Open-ended written test (E3), which will account for 65% of the total.
- Cases (E6) raised in the practical sessions, which will account for 15% of the total.
- Academic work (E7), which will be developed throughout the semester and will account for 20% of the total. The subject work is developed on technical cases of the company. The adjustment of its scope and the assessment criteria are established between the professor responsible for the subject and the company tutor.

To pass the subject, a minimum grade of 4 in the written test, a minimum grade of 4 in the cases and an overall grade equal to or greater than 5 will be required.

In addition, according to the regulations of the University of Zaragoza, the student can pass the subject through a global exam (E3) that includes theoretical concepts (85%) and practical applications (15%); It will be necessary to obtain at least a 4 in each of the parts and an average grade equal to or greater than 5.

In the second call, the evaluation will be carried out according to the global exam explained in the previous paragraph.

## **6. Sustainable Development Goals**

7 - Affordable and Clean Energy

9 - Industry, Innovation and Infrastructure

11 - Sustainable Cities and Communities