

29728 - Thermal Machines and Engines

Syllabus Information

Academic year: 2023/24

Subject: 29728 - Thermal Machines and Engines

Faculty / School: 110 - Escuela de Ingeniería y Arquitectura

Degree: 434 - Bachelor's Degree in Mechanical Engineering

ECTS: 6.0

Year: 3

Semester: Second semester

Subject type: Compulsory

Module:

1. General information

The subject is the culmination of the compulsory training block, which we could call energetic. It provides the fundamental principles to understand and design thermal machines and engines, as well as their optimized integration in power generation, transfer and use plants.

It is useful for the student to consolidate the basic concepts to understand specialized texts or manuals of the most common equipment in power plants, such as compressors, gas and steam turbines, diesel engines, gas engines, Stirling engines, etc

With this subject, the student deepens in the methodology of thermal analysis to approach, simulate, optimize and design complex energy facilities that integrate thermal machines for generating work, heat and cold. The subject is essential to take the subsequent subjects of the Energy Module (electives).

2. Learning results

The understanding and optimal design of energy facilities is of vital importance for the Graduate in Mechanical Engineering since this type of facilities undoubtedly contributes to the development of advanced societies. In accordance with the professional competences of this degree, the future graduate must be able to select the most suitable thermal engine for each need, and to deal with design and optimization projects of thermal machines as well as the installations where they are integrated. The subject of Thermal Engines and Machines provides the student with the basic tools to successfully address these tasks, deepening in key aspects and presenting advanced techniques and methods of analysis.

The subject has been designed so that, once the evaluation has been passed, the student will have achieved the following results:

1. Knows the fundamentals of thermal engines and machines and the different energy transformation technologies.
2. Has the capacity and criteria to analyse, dimension, select and design equipment for the use, production and transformation of mechanical energy.
3. Understands the analysis of work production cycles, integrating the operation of the main equipment.
4. Is capable of applying heat engines in combined heat and power systems for industry

3. Syllabus

Agenda

- Introduction to thermal engines and machines.
- Ideal and real cycles of reciprocating internal combustion engines (MACI).
- Subsystems and components of the MACI. Operating and design parameters.
- Applications and behavioural curves of MACI.
- Compressible flow. Nozzles and diffusers. Propulsion. Fundamentals of thermal turbomachines. Euler's equation. Velocity triangle.
- Degree of reaction and types of turbine staggering. Losses.
- Compressors: types, characteristics and selection criteria.
- Application of thermal machines and engines to electricity production.
- Combined heat and power production (Cogeneration).
- Criteria for selection and optimization of the operation of machines and thermal engines in energy production systems

Practical sessions

- Descriptive of MACIs and TMTs.
- Determination of a vehicle's MACI towing capacity.
- Basic design of an axial reaction gas turbine. Resolution of practical cases of MACIs and TMTs. Cycle Rankine.
- Effects of cooling water availability and temperature on the performance of a thermal power plant.

- Optimal sizing of a simple cogeneration system

4. Academic activities

Attendance to all learning activities is of special relevance to acquire the competencies of the subject.

Face-to-face class.

Expository sessions of theoretical contents and application. The basic concepts and fundamentals of the thermal engines and machines and their application in energy production systems will be presented.

Types of problems.

Problems and cases will be developed and temporally coordinated with the theoretical contents. The student will be encouraged to work the problems beforehand, for which they will be provided with the statements and the guidelines to solve them.

Laboratory practices.

Five practical sessions will cover the following aspects: Description of machines and thermal engines.

Design and analysis of the operation of positive displacement machines. Design and analysis of the operation of thermal turbomachines. Resolution of practical cases of thermal engines and machines. Analysis and optimization of power and cogeneration facilities.

Works.

Activities that the student will carry out individually or in groups of 2 students and that the teacher will propose along of the teaching period. With a certain frequency, the teacher will schedule tutoring sessions in order to follow up on the functioning of the groups and the progress achieved.

5. Assessment system

1st Call: The student who wishes to do so may carry out a continuous evaluation procedure that will contain the following elements

1º) Written tests. They will consist of theoretical questions and development problems and will represent 70-80% of the final grade, divided between 25-30% for the theoretical questions and 50-55% for the problems. There will be midterm exams

2º) Practices The attendance and the scripts handed in at the end of each of the practical sessions will have a weight of 20% in the final grade.

In order to pass the continuous evaluation it will be necessary to obtain a grade equal or higher than 4 out of 10 in each of the written tests and in the set of practices and a grade equal or higher than 5 out of 10 when considering them together.

Students who do not pass or do not wish to take the continuous evaluation will have the global evaluation to which they are entitled by the regulations of the University of Zaragoza . This evaluation will consist of a written test, which will take place on day assigned by the Centre for the 1st official call, in which questions may be asked about any of the contents of the subject.

2nd Call: the procedure followed will be in accordance with the regulations of the University of Zaragoza, which in the Regulation of Learning Assessment Standards establishes that a global test will be carried out consisting of an exam on all the contents of the subject and will take place on the day assigned by the centre in the 2nd official call.