Universidad Zaragoza

Academic Year/course: 2022/23

30119 - Applied thermodynamics and heat transfer basics

Syllabus Information

Academic Year: 2022/23
Subject: 30119 - Applied thermodynamics and heat transfer basics
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
Degree: 425 - Bachelor's Degree in Industrial Organisational Engineering
ECTS: 6.0
Year: 2
Semester: Second semester
Subject Type: Compulsory
Module:

1. General information

1.1. Aims of the course

The aim of the course is to provide students with a solid foundation of the major concepts of THERMODYNAMICS and to prepare them to use TECHNICAL THERMODYNAMICS in their professional practice, as well as the concepts of heat transfer.

These approaches and objectives are in line with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/es/), in such a way that the acquisition of the course learning outcomes provides training and competence to contribute to their achievement to some degree.

4. Quality education.

> 4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.

13. Climate action.

> 13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

1.2. Context and importance of this course in the degree

This course belongs to the compulsory training module of the Business profile and it deals with the knowledge of applied thermodynamics and heat transmission: Basic principles and their application to solving engineering problems.

1.3. Recommendations to take this course

This course does not have any normative prerequisite, although, for its adequate progress, knowledge and strategies from the chapters on Thermodynamics of the subject of Physics I of the first year are an asset.

2. Learning goals

2.1. Competences

Upon passing the subject, the student will be more competent to ...

C04 Solve problems and make decisions with initiative, creativity and critical thinking.

C07 Use the required engineering techniques, skills and tools.

C11 Keep a lifelong learning approach and develop self-learning strategies.

C34 Understand applied thermodynamics and heat transmission. Basic principles and their application to engineering problems solving.

2.2. Learning goals

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

1. Describe the thermo physical properties of industrial interest and use and select appropriate procedures and tools for their calculation.

2. Apply the laws of thermodynamics to the energy analysis of equipment and basic engineering processes.

3. Use the basic criteria for the analysis of thermodynamic cycles.

4. Apply the basic mechanisms of heat transfer to the analysis of thermal equipment.

5. Solve, giving reasons, basic problems of technical thermodynamics and heat transfer applied to engineering.

2.3. Importance of learning goals

This subject has a specific engineering nature, that is, it offers training with application content and immediate development in the labor and professional market. Through the achievement of the relevant learning outcomes, the necessary capacity is obtained to understand the operation of power production systems with steam and gas, refrigeration and heat pump systems, cogeneration systems, combined and refrigeration cycles, heat exchangers and thermal insulation cycles, which will be essential for the design and start up of many applications, plants, processes, etc. included within the field of Industrial Management Engineering.

3. Assessment (1st and 2nd call)

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

The assessment of the subject provides for a split assessment system and a global final assessment system.

1. Split assessment system.

The split assessment system will have the following group of grading activities:

- **Individual activities in class**: The solving of theoretical and practical exercises in class will account for 10% of the final grade for the course. The active participation of the student will be taken into account, answering the questions posed by the teacher during the teaching period and the marks of the theoretical-practical exercises posed and handed in on site. All activities will account for the same proportion of the global mark of that block, being graded from 0 to 10 points.

At least 80% of the classroom activities (practice tasks, technical visits, classes, etc.) must be attended.

- **Laboratory practice activities**: Activities corresponding to each of the issues concerned will be developed.

In addition to verifying their correct operation, a report must be produced, in the format provided by the teacher, which must be submitted for correction at the specified time. In each of the practice activities the dynamics followed for their correct execution and operation will be valued, the specific weight of this section being 30% of the total mark of the practice activity. The report produced will account for the remaining 70%. The grading of each practice will go from 0 to 10 points and never less than 5, since, otherwise, it will be considered a fail and will have to be repeated, making changes so as to get things right. The final grade for all the practices will be the average of all of them. Laboratory practice activities will account for 15% of the final grade for the course. The making of the practice activities and their learning are compulsory for all. For this reason, the course cannot be passed without them. If a student is unable to attend the practical classes, they must let the teacher know well in advance (at the beginning of the semester) in order to find a solution.

- Posed work: The teacher will pose the completion of a compulsory work in a group of three students maximum. A part of it will be done, discussed, solved, etc. in the seminars organized for that purpose. The approach and appropriate development, the writing and coherence of what was discussed, as well as the achievement of results and the final conclusions reached, will be valued. This activity will account for 15% of the final grade for the course. In order to take this mark into account, the papers must be handed in on the specified dates and all seminars must be attended.

- Written assessment tests: These tests will include theoretical and / or practical questions from the different issues to be assessed. There will be a maximum of two, distributed throughout the entire semester with a duration of two hours. The final grade of this activity will be calculated with the average of the tests, as long as the minimum in any of them is 3 points. In this case the test will be failed. The two tests will consist of two applied theory questions, each of which will account for 10% of the grade and three problems that will account for 80% of the grade. This activity will account for 60% to the final grade of the course.

As a summary of the aforementioned, the following weight table of the grading process of the different activities, in which the split evaluation process of the course is based on, has been designed

Assessment activity. Weighting

Individual activities in class 10%

Laboratory practice activities 15%

Posed work 15%

Written assessment tests 60%

Prior to the first call, the teacher of the subject will notify each student whether or not they have passed based on the use of the split assessment system, based on the addition of the marks obtained in the different activities carried out, each

accounting for a minimum of 50%. In case of not passing in this way, the student will have two additional calls to do so (global assessment test). On the other hand, the student who has passed the course, may also choose the final assessment, first call, to improve their grade, but never to lower it.

2. Global final assessment test.

The student must opt for this modality when, due to their personal situation, they cannot adapt to the rhythm of work required in the split assessment system, have failed or would like to increase their grade having participated in that assessment methodology. The global final assessment test will include a group of grading activities that have already been explained in detail above:

- Laboratory practice activities: They will have to be integrated within the schedule of the split assessment. If this is not possible, they can be carried out during special hours as long as the student informs the teacher of this situation in advance (at the beginning of the semester). They will account for 15% of the final grade of the assessment.

- Posed work: Contribute 15% to the final grade for the evaluation.

- Written exam: Only one test with representative exercises of the issues, accounting for 70% of the final grade for the course.

As a summary of the above mentioned, the following weighting table for the grading process of the different activities has been designed in which the final assessment process of the subject has been based.

Assessment activity Weighting

Laboratory practice activities 15%

Posed works 15%

Written exam 70%

The course will have been passed based on the sum of the marks obtained in the different activities carried out, each accounting a minimum of 50%.

For those students who have failed the split assessment system, but some of their activities, with the exception of written assessment tests, have been carried out, are allowed to validate them for the global final assessment test, and it may be the case that they only have to take the written exam.

All the activities included in the global final evaluation test, with the exception of the written exam, can be valid for the next official call, within the same academic year.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The learning process designed for this subject is based on the following:
The current subject Applied thermodynamics and heat transfer basics is conceived as a stand-alone combination of contents, yet organized into three fundamental and complementary forms, which are: the theoretical concepts of each teaching unit, the solving of problems or the resolution of questions and laboratory work, at the same time supported by other activities.

The approach, methodology and assessment of this guide are intended to be the same for any teaching scenarios. They will be adapted to the social-health situation at any particular time, as well as to the instructions given by the authorities concerned.

4.2. Learning tasks

The course includes the following learning tasks:

- **Face-to-face generic activities:**
    - **Lectures**.
    - **Practice Sessions**.
    - **Laboratory Workshop**.
    - **Seminars.**

- **Generic non-class activities**:
    - Study and understanding of the theory taught in the lectures.
    - Understanding and assimilation of the problems and practical cases solved in the practical classes.
    - Preparation of seminars, solutions to proposed problems, etc.
    - Preparation of laboratory workshops, preparation of summaries and reports.
    - Preparation of the written tests for continuous assessment and final exams.

4.3. Syllabus

The course will address the following topics:

THEORETICAL CONTENTS:

- Topic 1: Introductory concepts and definitions.
- Topic 2: Energy and the first law of Thermodynamics.
- Topic 3: Properties of a pure, simple compressible substance.
- Topic 4: Control volume energy analysis.
- Topic 5: The second law of Thermodynamics and Entropy.
- Topic 6: Vapor power systems.
- Topic 7: Refrigeration and heat pump systems.

PRACTICAL CONTENTS

Some topics discussed in the previous section have associated laboratory practices in this regard. As the topics are developed, these Practices will be presented, both in the classroom and through the Moodle platform.

Following are those practices to be developed in the laboratory that will be carried out by the students in sessions of 2 hours duration.

- Practice 1: Heat pump.
- Practice 2: Thermal insulation.
- Practice 3: Thermohygrometry.

CONTENTS SEMINARS

Heat transfer. Introduction. Driving. Convection. Radiation. Global coefficients of heat transfer. Calculation of thermal loads of cooling and heating.

4.4. Course planning and calendar

The dates of the final exams will be those that are officially published at https://eupla.unizar.es/asuntos-academicos/examenes.
The written assessment tests will be related to the following topics:
- Test 1: Topics 1, 2, 3 & 4.
- Test 2: Topics 5, 6 and 7.

4.5. Bibliography and recommended resources

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=30119