Course guide
220281 - 220281 - Refrigeration and Air Conditioning

Last modified: 13/07/2023

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 724 - MMT - Department of Heat Engines.

Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2013). (Optional subject).

Academic year: 2023 **ECTS Credits:** 5.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: ÒSCAR RIBÉ TORIJANO

Others:

PRIOR SKILLS

Thermodynamics, Heat transfer, Fluid mechanics.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Knowledge and ability to analyze the processes of heat transfer that allows the design and calculation of equipment and thermal applications.
2. Knowledge and capability to design and calculate equipment and refrigeration facilities (refrigeration and air conditioning).
3. Knowledge and ability to analyze, design, calculation and application of power cycles and alternative heat engines.
4. Knowledge about technology and applications of unconventional alternatives energy (geothermal energy, solar energy and fuel cells).

TEACHING METHODOLOGY

The teaching methodology is divided into three parts:
- Face-to-face sessions of exposition of the contents.
- Face-to-face sessions of practical work (exercises, problems and laboratory practices).
- Autonomous work of study and realization of exercises and activities.

In the sessions of exposition of the contents, the teacher will introduce the theoretical bases of the subject, concepts, methods and results, illustrating them with examples,
methods and results illustrating them with convenient examples to facilitate their understanding.
In the practical work sessions in the classroom , the teacher will guide the student in the application of theoretical concepts for problem solving , basing at all times the critical reasoning . Exercises will be proposed for students to
solve in the classroom and outside the classroom, to favor the contact and use of the basic tools necessary for problem solving.
problem solving.
The student, in an autonomous way, has to work the material provided by the teacher and the result of the sessions of
work-problems sessions to assimilate and fix the concepts. The teacher will provide a plan of study and follow-up activities (ATENEA).
of activities (ATENEA).

LEARNING OBJECTIVES OF THE SUBJECT

Study of refrigeration and air conditioning technology for the design and calculation of equipment and installations related to these fields.
It is intended to develop the subject progressively, from its basic principles to the most recent technologies, according to the following teaching scheme: theoretical bases, technology of equipment and installations, calculation methodology, applications, calculation examples, industrial information, regulations.
The course is structured in two parts or thematic modules:
1) Refrigeration (2,5 ECTS)
2) Air conditioning (2,5 ETCS)

Module 1 : Refrigeration
Study of refrigeration technology, mainly focused on the vapor compression system, as the most widely used system at present.
The treatment of the subject is carried out in two phases:
1) Theoretical bases (refrigeration thermodynamics, refrigerants).
2) Equipment technology and methodology of design and calculation (general description of installations, compressors, evaporators, condensers, expansion valves).
Special emphasis is given to the problem of refrigerants and the environment (ozone layer), a situation that is currently conditioning, significantly, the development of new equipment in the refrigeration sector.

Module 2 : Air conditioning
Study of air conditioning technology for the design and calculation of this type of installations.
The treatment of the subject is carried out in four parts:
1) Psychrometrics
2) General aspects (design conditions, types of air-conditioning systems).
3) Technology of cooling and heating equipment (mainly focused on heating equipment, since the cooling equipment part has been previously dealt with in the Refrigeration module).
4) Calculation methodology (calculation of heating and cooling loads).
The thematic is complemented with the development of an example of calculation of an air conditioning installation.

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	24.00
Self study	80,0	64.00
Hours small group	15,0	12.00

Total learning time: 125 h

CONTENTS

Item 1: Refrigeration

Description:
1.- Introduction to refrigerating machines
2.- Inverse Rankine Cycle
3.- Refrigerants
4.- Refrigeration installations with HFCs
5.- Refrigeration installations with NH3
6.- Refrigeration installations with CO2

Related activities:
Laboratory practice 1 (Refrigeration)
Laboratory practice 2 (Air conditioning)
Refrigeration problems
Air conditioning problems

Full-or-part-time: 62h 30m
Theory classes: 15h
Laboratory classes: 7h 30m
Self study : 40h

Item 2: Air Conditioning

Description:
1.- Basic concepts. Design conditions
2 .- Psychrometry
3.- Types of air conditioning installations.
4.- Cooling and heating production equipment.
Heating thermal load
6.- Cooling thermal load
7.- Calculation example

Related activities:
Laboratory practice 2 (Air conditioning)
Air conditioning problems

Full-or-part-time: 62h 30m
Theory classes: 15h
Laboratory classes: 7h 30m
Self study : 40h

GRADING SYSTEM

The final mark for the course will be the weighted mark for the following activities:
- 1st Evaluation: 35 %.
- 2nd Evaluation: 35 %.
- Laboratory practicals: 10 %.
- Refrigeration problems: 10 %.
- Air conditioning problems: 10 %.

For students who do not pass the 1st Evaluation, a recovery exam will be held during the class timetable of the course.
Rules for the make-up exam:
-Only students who have failed the 1st evaluation can sit the exam.
-Maximum mark limited to 6.0 out of 10.0.
The final mark of the 1st Evaluation will be the highest mark obtained by the student between the two exams (ordinary exam and make-up exam).
For those students who fulfil the requirements and sit the re-evaluation exam, the grade of the re-evaluation exam will replace the grades of all the evaluation acts that are face-to-face written tests (controls, mid-term and final exams) and the grades of practicals, assignments, projects and presentations obtained during the course will be maintained.
If the final mark after the re-evaluation is lower than 5.0, it will replace the initial mark only if it is higher. If the final mark after the re-evaluation is higher or equal to 5.0, the final mark for the course will be a pass mark of 5.0.

BIBLIOGRAPHY

Basic:

- Stoecker, Wilbert F. Industrial refrigeration handbook. New York [etc.]: McGraw-Hill, cop. 1998. ISBN 007061623X.
- Çencel, Yunus A.; Boles, Michael A. Termodinámica [on line]. 9ª ed. México: McGraw-Hill, 2019 [Consultation: 03/10/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5808940. ISBN 9781456269166.
- ASHRAE handbook: fundamentals. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, 2013. ISBN 9781936504473.
- ASHRAE handbook: refrigeration. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, 2010. ISBN 9781936504732.
- Wang, Shan K. Handbook of air conditioning and refrigeration. New York: McGraw-Hill, cop. 1993. ISBN 0070681384.
- ASHRAE handbook: HVAC systems and equipment. Atlanta: American Society of Heating, Ventilating and Air-Conditioning Engineers, 1992-. ISBN 1078-6066.
- ASHRAE handbook: HVAC applications. Atlanta: American Society of Heating, Ventialting and Air-Conditioning Engineers, 2011. ISBN 9781936504084.