Universidad Zaragoza

Year : 2019/20

60827 - HVAC Heating Ventilating and Air Conditioning

Syllabus Information

Academic Year: 2019/20
Subject: 60827 - HVAC Heating Ventilating and Air Conditioning
Faculty / School: 110 -

Degree: 532 - Master's in Industrial Engineering

ECTS: 6.0
Year: 2
Semester: First semester
Subject Type: Optional
Module: ---

1.General information

1.1.Aims of the course

The subject and its expected results meet the following approaches and objectives:

By raising the educational objectives of the course HVAC is necessary to consider a subject that is constantly evolving, therefore student learning should include two complementary aspects. The first one to know the equipment and existing facilities at present, but above this objective acquire the capacity for independent and lifelong learning. With this feature we get to have a good professional at present and in the future, continuing education. So:

- Students will learn descriptive and functional aspects of the various standard equipment in air conditioning compressors, heat exchangers, valves, chillers, boilers, heat pumps, recuperators, pumps, fans, diffusers, regulatory elements, accumulation systems ...
- The student must achieve the necessary knowledge to project air-conditioning.
- The student must achieve the necessary knowledge on energy efficiency taking into account the specific technologies for saving energy and using alternative energy in air conditioning systems.
- The student must achieve the necessary knowledge to certify energy housing.
- The student must acquire the basic knowledge and reasoning schemes that enable and facilitate the autonomous learner.

1.2.Context and importance of this course in the degree

The subject of Climatization and Energy Efficiency Projects belongs to the Optional Training block of the Master's Degree in Industrial Engineering, within the "Energy and Heat and Fluids Technology" Module. In this context, it helps the student to consolidate the basic concepts acquired in the different Engineering Degrees related to HVAC, and enables him / her to understand and project HVAC installations.

1.3.Recommendations to take this course

The student is recommended active class attendance and continuous study of the contents of the subject and lapreparación practical cases that can be resolved in subsequent sessions.
Continued work is essential to overcome with the maximum use of this subject, since each party estudiagra dually with a progressive procedure. So when doubts arise, it is important to resolve as soon as possible to ensure the smooth progress in this area.

2.Learning goals

2.1.Competences

Generic skills

- CG1 - Have adequate knowledge of scientific and technological aspects of: mathematical, analytical and

numerical methods in engineering, electrical engineering, power engineering, chemical engineering, mechanical engineering, continuum mechanics, industrial electronics, automation, manufacturing, materials, methods quantitative management, industrial computing, urban planning, infrastructure, etc.

- CG2 - Projecting, calculate and design products, processes, facilities and plants.
- CG4 - Conduct research, development and innovation in products, processes and methods.
- CG5 - Conduct strategic planning and apply to both constructive and production, quality and environmental management systems.
- CG8 - Apply the acquired knowledge and solve problems in new or unfamiliar environments within broader and multidisciplinary contexts environments.
- CG9 - Being able to integrate knowledge and handle complexity, and formulate judgments based on information that was incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and judgments.
- CG10 - Knowing how to communicate the conclusions -and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously.
- CG11 - Possess learning skills that will allow further study of a self-directed or autonomous mode.
- CG12 - Knowledge, understanding and ability to implement the necessary legislation in the exercise of the profession of

Transversal skills:

- CB6 - knowledge and understanding that provide a basis or opportunity for originality in developing and / or applying ideas, often in a research context
- CB7 - That the students can apply their knowledge and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study
- CB8 - That students are able to integrate knowledge and handle complexity, and formulate judgments based on information that was incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and judgments
- CB9 - That students can communicate their conclusions and the knowledge and rationale underpinning to specialists and non-specialists in a clear and unambiguous
- CB10 - Students must possess the learning skills that enable them to continue studying in a way that will be largely self-directed or autonomous

Specific skills

- C. M. 5 Knowledge and skills for the design and analysis of machines and internal combustion engines, hydraulic machines and systems and industrial cooling heat
- C. M. 6 Knowledge and capacities to understand, analyze, operate and manage the different sources of energy.
- C.M.20 Knowledge and skills for the project and design intelligent electrical and fluid, lighting, air conditioning and ventilation, saving and energy, acoustic efficiency installations, communications, automation and security buildings and facilitiesIndustrial Engineer.

2.2.Learning goals

The student, for passing this subject, should demonstrate the following results ...

- Knowledge of the specific regulations on air conditioning systems and their application.
- Knowledge of the specific regulations on energy certification and enforcement.
- Computing capacity of the heat demand of a building.
- Knowledge of the basics, equipment and air conditioning systems installations.
- Knowledge of the fundamentals of energy efficiency and certification of buildings.
- Ability to choose the installation type most suitable climate and integrate properly in the building.
- Being able to design, calculate predimensionar and air conditioning systems and perform their respective measurements and project plans.
- Aptitude for placing and maintenance of air conditioning systems.
- Ability to write weatherization projects.
- Ability to certify energy buildings.

2.3.Importance of learning goals

The successful completion of the course aims to complete the technical training of the student, and set specific knowledge of Industrial Engineering in the field of Climate and Energy Efficiency. A basic aspect of their professional skills.

3.Assessment (1st and 2nd call)

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

The student is evaluated through a theoretical and practical exam at the end of the semester, practices and assessment of a proposed facility made throughout the course. The valuation of each party in the final grade will be:

- Theoretical and practical written exam: 40%
- Practice: 15%
- Project: 45%

The requirements for passing the course are:

- Present practices
- Deliver and defense of the project in the announced dates.
- Get at least 5 in the project.
- Get at least 5 in the examination.
- Get at least 5 overall grade in the subject.

The note is calculated from the following equation:
A = 0.4 ? Et + Pra + 0.15 ? 0.45 ? Pro
Where: A is the note in the minutes of 10 (or global note in the subject)
Et is the exam of theoretical and practical out of 10
Pra is the practices of 10
Pro is the project of 10

If the note of A is less than 5, the note Project and practices for the calls of the same academic year will be saved.
If a student does not pass the Project or fails to deliver and / or defense of the project and / or practices on the agreed dates, you must perform a practical exam, in addition to the theoretical and practical at the end of the semester.

In this case the conditions to pass the course are:

- Get at least 5 in the practical test.
- Get at least 5 in the theoretical and practical exam.
- Get at least 5 overall grade in the subject.

The note is calculated from the following equation:
A = Et + 0.5 ? 0.5 ? Ep
Where: A is the note in the minutes of 10 (or global note in the subject)
Et is the exam of theoretical and practical out of 10
Ep is the practical exam of 10

No exam notes or project are saved for subsequent calls

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. It encourages continuous work and active participation, and it focuses on the theoretical and practical aspects to understand, analyze and apply knowledge to solve real problems. A wide range of teaching and learning tasks are implemented, such as lectures, problem-solving, practice sessions, papers, and projects.

4.2.Learning tasks

The course includes the following learning tasks:

- **Lectures** (30 hours). Two weekly hours. In the lectures the theoretical concepts of the course will be explained, supported by some model problem-solving.
- **Practice sessions** (15 hours). One weekly hour. In these classes, students solve problems supervised by the teacher. Problems or cases will be related to the theoretical part explained in lectures.
- **Laboratory sessions** (15 hours). One weekly hour. Students work with short papers, related to the lectures and problems, to verify compression of the matter, acquire a point of view more applied, and solve more complex

problems with the help of appropriate resources. They will be made individually or in groups and will be supervised by the teachers. The evaluation of the these sessions will be a continuous report of the student's level of achievement of the expected learning outcomes.

- **Project** (15 hours). 1 or 2 activities will be proposed during the course (HVAC Projects), which will be done individually and be supervised by the teachers. They consist of the development of a climate project (or a part of it) proposed by the teacher. Students will submit a report and orally present the project to the teacher.
- **Autonomous work** (70 hours). Individual continuous study throughout the semester is recommended.
- **Assessment tests** (5 hours). An examination will be conducted to assess the theoretical and practical knowledge gained by the student.

4.3.Syllabus

The course will address the following topics:

Topic 0.- Normative

Topic 1.- HVAC systems

- 1.1.- Schemes of principle
- 1.2.- Production of cold / heat. Primary
- 1.3.- Cold / heat distribution (secondary). Systems

Topic 2.- Energy demand in the building

- 2.1.- Thermal loads
- 2.2.- Internal conditions
- 2.3.- External conditions
- 2.4.- Estimation of cooling demand
- 2.5.- Estimating demand for heating
- 2.6.- Practical examples

Topic 3.- Projects of air conditioning

- 3.1.- Introduction
- 3.2.- General description of the building
- 3.3.- Calculation of Loads
- 3.4.- Air conditioning systems

Topic 4.- Air conditioners

- 4.1.- Introduction and definitions
- 4.2.- Sections of an air conditioner
- 4.3.- Calculation of air conditioners

Topic 5.- Calculation and selection of terminal elements

- 5.1.- Introduction
- 5.2.- Water heating emitters
- 5.3.- Radiant water floor
- 5.4.- Electric heating
- 5.5.- Fancoils
- 5.6.- Inductors

Topic 6.- ACS

- 6.1.- Introduction
- 6.2.- Systems and components
- 6.3.- Instantaneous Production and Accumulation
- 6.4.- Schemes of facilities
- 6.5.- Calculation examples
- 6.6.- HE4

Topic 7.- Auxiliary systems

- 7.1.- Introduction
- 7.2.- Expansion vessels
- 7.3.- Hydraulic schemes of auxiliary elements

- 7.4.- The collector / bottle breaks presses
- 7.5.- Pipe and conduit networks

Topic 8.- Control systems in air conditioning systems

- 8.1.- Introduction
- 8.2.- Systems for the management of technical installations of buildings
- 8.3.- Evolution of technology
- 8.4.- Control points

Topic 9.- Air diffusion systems

- 9.1.- Mixing diffusion systems
- 9.2.- Displacement diffusion systems

Topic 10.- Boiler rooms

- 10.1.- Introduction
- 10.2.- Elements of boiler rooms
- 10.3.- UNE 60601. Machine rooms
- 10.4.- Examples

Topic 11.- Energy Efficiency

- 11.1.- Current regulatory framework
- 11.2.- Energy certification programs for buildings
- 11.3.- Unified Leader-Calener
- 11.4.- Calener VyP
- 11.5.- CE3X

4.4.Course planning and calendar

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course, will be provided on the first day of class or please refer to the EINA website.

This is a subject of 6 ECTS credits, equivalent to 150 hours of student work, to perform both as classroom contact hours.

The schedule of the course is adapted to the established in the School of Engineering and Architecture (EINA) and their schedules and exam schedule, and all of them can be found on their website: http://eina.unizar.es.
The practice sessions will be scheduled depending on the number of students since the beginning of the semester students will have the detailed schedule of activities (practical and laboratory, ...) that will be provided by the corresponding teacher.

4.5.Bibliography and recommended resources

http://biblos.unizar.es/br/br_citas.php?codigo=60827&year=2019