# Heat exchangers design

**Academic Year: ( 2023 / 2024 )** **Review date: 28-03-2023**

**Department assigned to the subject: Thermal and Fluids Engineering Department**

**Coordinating teacher: SANTANA SANTANA, DOMINGO JOSE**

**Type: Electives ECTS Credits : 6.0**

**Year : 4 Semester :**

## REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

- Thermodynamic
- Heat Transfer
- Fluid Mechamic

## SKILLS AND LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study
CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG1. Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
CG3. Ability to design a system, component or process in the field of Industrial Technologies to meet the required specifications
CG4. Knowledge and ability to apply current legislation as well as the specifications, regulations and mandatory standards in the field of Industrial Engineering.
CG5. Adequate knowledge of the concept of company, institutional and legal framework of the company. Organisation and management of companies.
CG6. Applied knowledge of company organisation.
CG8. Knowledge and ability to apply quality principles and methods.
CG9. Knowledge and ability to apply computational and experimental tools for the analysis and quantification of Industrial Engineering problems.
RA1. Knowledge and understanding: Have basic knowledge and understanding of science, mathematics and engineering within the industrial field, as well as knowledge and understanding of Mechanics, Solid and Structural Mechanics, Thermal Engineering, Fluid Mechanics, Production Systems, Electronics and Automation, Industrial Organisation and Electrical Engineering.
RA2. Engineering Analysis: To be able to identify engineering problems within the industrial field, recognise specifications, establish different resolution methods and select the most appropriate one for their solution
RA5. Engineering Applications: To be able to apply their knowledge and understanding to solve problems and design devices or processes in the field of industrial engineering in accordance with criteria of cost, quality, safety, efficiency and respect for the environment.

## OBJECTIVES

The main objective of this course, from the holistic point of view, the integration, the selection, calculation and design of the different energy systems up to the industry of power, air conditioning and the chemical industry. To achieve this goal, the student must acquire a series of knowledge, skills and attitudes.

With regard to knowledge, at the end of the course the student will be able to:
- Know and determine the operation conditions of boilers, cooling towers, evaporators, condensers and heat exchangers
- Achieve relevant concepts in phase changes, in non-reactive systems and in radiation processes in

participating media
Knowledge about the design of heat exchangers with and without phase change to meet operating conditions.

In terms of capabilities, these can be classified into two groups, one more capabilities and other more generic skills or skills.

As for the specific abilities, at the end of the course the student will be able to:
- Estimation of the functioning of the different calorie exchange systems that make up a process
- Selection and design of equipment for different systems according to function

Regarding the general abilities or skills, during the course they will work:
- The ability to solve problems.
- The ability to search, communicate and discriminate which is the relevant information to characterize a calorie exchange team.
- The ability to apply knowledge of thermodynamics and transfer of calories to solve a problem of interchangers integrated into a system.
- The ability to work as a team and distribute the workload to deal with complex problems, mainly design.

Regarding attitudes, the student after completing the course should have:
- A critical attitude regarding the selection and design of the different teams that make up a process.
- An attitude of collaboration that allows you to obtain other agents.

## DESCRIPTION OF CONTENTS: PROGRAMME

This course is devoted to the design and operation of different heat exchangers . The program is divided into 5 parts mainly of applications:

1- Basic and detail projects (power production plants and HVAC systems)
2- Surface exchangers with phase change (surface condensers, FWH, steam generators)
3- Interchangers in direct contact (cooling towers)
4- Hybrid systems (hybrid towers and evaporative condensers)
5- Radiation in participating media (boilers)

## LEARNING ACTIVITIES AND METHODOLOGY

The methodology will include:
1) Magisterial classes, where the knowledge that students should acquire will be presented. To facilitate their development, students will receive class notes and will have basic reference texts that will allow them to complete and deepen in those topics in which they are most interested.
2) Problem solving, in relation to the knowledge that will be presented and especially in relation to the specific skills that students must develop.
3) Resolution of exercises by the student that will serve to self-assess their knowledge and acquire the necessary skills.
4) Development of basic engineering projects and detail of some equipment and its presentation.
Sharing of the answers to the exercises and joint correction that should serve to strengthen knowledge and develop the ability to analyze and communicate the relevant information for the resolution of problems. In addition, the sharing will favor the exchange of critical opinions both between teacher and students and between students.

## ASSESSMENT SYSTEM

The (continuous) evaluation will be based on the following deliverables:
- Exercises will be done in class for the qualification of the continuous evaluation (these three exercises will suppose 50% of the continuous evaluation). These exercises may be partial deliveries of the project. This note will be the one assigned to the continuous evaluation.

The final exam will consist in the delivery on the day of the exams of a basic project made throughout the course. For this deliverable both in the ordinary and extraordinary call: It will be proposed to carry out a customized basic project of a power production center, HVAC, etc ... (this project will mean the other 50% of the evaluation, in the case of having followed the continuous evaluation). In the case of not having followed the continuous evaluation must be delivered on the day of the examination of the extraordinary call both partial deliveries and the basic project.
* In the basic project will be delivered, at least, the diagrams of the necessary process and in the specification sheets of designed equipment.

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| **% end-of-term-examination:** | 50 |
| **% of continuous assessment (assigments, laboratory, practicals…):** | 50 |