

Heat Transfer

Code: 102440
ECTS Credits: 4

Degree	Type	Year	Semester
2500897 Chemical Engineering	OB	3	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Prerequisites

It is recommended to have passed the following subjects:

- Basic Operations of Chemical Engineering
- Applied thermodynamics

Objectives and Contextualisation

The objective of the subject is the study of the principles of heat transmission and its application to the calculation and design of heat exchangers and evaporators.

Competences

- Demonstrate knowledge of the different reaction, separation and processing operations for materials, and transport and circulation of fluids involved in the industrial processes of chemical engineering.
- Develop personal attitude.
- Develop thinking habits.
- Objectively compare and select different technical options for chemical processes.
- Work in a team.

Learning Outcomes

1. Develop a capacity for analysis, synthesis and prospection.
2. Develop curiosity and creativity.
3. Develop scientific thinking.
4. Identify the fluid circulation operations involved in the design of heat transmission systems.
5. Objectively compare and select the different technical options for heat transmission systems.
6. Work cooperatively.

Content

THEME 1: Introduction to Heat Transfer

Energy of a system: total energy, heat energy and mechanical energy.

Transmission mechanisms: conduction, convection and radiation

Heat energy transmission and Chemical Engineering

THEME 2: Heat transfer by conduction in solids

Steady state conduction

Estimation of properties: thermal conductivity and diffusivity

Resistances in series

Radial conduction

THEME 3: Convection heat transfer

Individual heat transfer coefficient and dimensionless modules

Determination of individual coefficients

Heat transfer in a fluid without phase change

Heat transfer in a fluid with phase change: condensation of vapors, boiling of liquids.

THEME 4: Fundamentals of heat exchangers

Fluid-fluid heat transfer through a wall

Overall heat transfer coefficient

Fouling factors

Design equations of concentric tube heat exchangers

THEME 5: Description and design of heat exchangers

Classification and description of heat exchanger configurations

General methods of heat exchanger calculations

Design by the Kern method

THEME 6: Description and design of evaporators

Classification, description and operation of evaporators

Single effect evaporators

Multiple effect evaporators

Methodology

THEORY CLASSES:

There will be master classes virtually, preferably streaming sessions through the Teams platform, in which the basic concepts of the syllabus will be introduced. The supporting audiovisual material will be available on Moodle before the theoretical sessions

PROBLEM SEMINARS:

The teacher and students will solve problems related to the subject exposed in the theory classes. The problems will be proposed by the teacher either from problems proposed "ad hoc" or from those available in a collection of problems of the subject, also available in Moodle. The latter will allow at the same time the autonomous learning of the student by means of the resolution of the same out of the sessions of seminars of problems of classroom. Problem sessions will be conducted virtually in streaming through the Teams platform.

TUTORIALS:

Individual or small group virtual sessions for the resolution of doubts related to the subject.

HOMEWORK:

The knowledge will be achieved through autonomous learning by students from the realization of a group work that will consist of the design of a team of heat transmission type exchanger of housing and tubes

The teacher will provide a work guide document with the specific considerations of the work (index, objectives, extension, bibliography, number of students per group etc ...).

The works will have to deliver following the term that will indicate during the courses and according to the instructions of the professor. Regarding the evaluation of the works, the evaluation section specifies how it will be carried out and the weight of this evaluation on the total of the subject.

CLASS SCHEDULE:

The schedule of all virtual sessions and face-to-face exams of the subject will be posted on Moodle at the beginning of the semester. Any changes to the sessions will be communicated to students well in advance through the Moodle "News" tool.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Practical exercises seminars	13	0.52	5, 3, 4, 6
Theoretical lectures	20	0.8	5, 3, 4
Type: Supervised			
Tutorials	4	0.16	5, 3, 6
Type: Autonomous			
Homeworks	20	0.8	5, 3, 4
Literature search	4	0.16	5, 3, 4
Solving practical exercises	24	0.96	5, 3, 4, 6

Assessment

Please refer to the Catalan or Spanish version of the Heat Trasnfer syllabus for further details

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Heat Exchanger design Homework	15	0	0	5, 1, 2, 4, 6
Theoretical exam 3	15	1	0.04	5, 3, 4
Theoretical-practical exam 1	35	2	0.08	5, 3, 4
Theoretical-practical exam 2	35	2	0.08	5, 3, 4

Bibliography

Procesos de transferencia de calor

D. Q. Kern, Compañía Editorial Continental.

Chemical Engineering. Volume 6. Design.

J. M. Coulson. J.F. Richardson. Editorial Pergamon Press.

Flujo de fluidos. Intercambio de calor.

O. Levenspiel. Editorial Reverté.

A Heat Transfer textbook

John H. Lienhard IV; John H. Lienhard V. Editorial PHLogiston Press.

The properties of gases and liquids

R.C. Reid, J.M. Prausnitz, B.C. Polling, 4th Edition. McGraw-Hill.

Modelling in Transport Phenomena

I.Tosun, Editorial Elsevier, 2002

Transport Processes and Separation Process Principles

C.J. Geankoplis, Editorial Prentice Hall.

The Chemical Engineering Guide to Heat Transfer

Volume I: Plant Principles.

Volume 2: Equipment.

Editorial McGraw-Hill.

Perry's Chemical Engineering Handbook

Perry, R. H. Editorial McGraw-Hill.

Software

The software used will be:

- Browsers: Any is valid and will be used mainly for querying property data
- MS Excel: for the use of the exchanger design spreadsheet