COURSE DATA

Data Subject	
Code	34767
Name	Unit Operations of Chemical Engineering II
Cycle	Grade
ECTS Credits	4.5
Academic year	2020 - 2021

Study (s)

Degree	Center	Acad. year	Period
1401 - Degree in Chemical Engineering	School of Engineering	3	First term

Subject-matter

Degree	Subject-matter	Character
1401 - Degree in Chemical Engineering	15 - Basic operations of chemical engineering	Obligatory

Coordination

Name	Department
LLOPIS ALONSO, FRANCISCO	245 - Chemical Engineering
MIGUEL DOLZ, PABLO JOAQUIN	245 - Chemical Engineering

SUMMARY

The subject Basic Operations of Chemical Engineering-II (OBIQ-II) is part of the matter Unit Operations of Chemical Engineering, whose overall objective is to enable the student to the design and performance analysis of different types of basic operations of the industry process. As regards the subject OBIQ-II, it focuses on the basic operations based on heat transfer. It aims to give students the ability to design and manage the operation of thermal systems own industrial systems.

It is a compulsory subject that is taught in the third year of Degree in Chemical Engineering. The curriculum consists of a total of 4.5 ECTS credits.

This is a subject with a practical component in which, following the introduction of the concepts, students will undertake numerous practical exercises.

The subject **contents** of the course are: heat transport Basic Operations: basic design equations. Design and analysis of heat transfer equipment.

Observations: Theoretical classes will be taught in Spanish and the practical classes as stated in the course sheet available on the degree website.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

To successfully addressing this subject is necessary that the student has previous knowledge required level for the subjects studied in first and second course. Among others include:

Fundamentals of physics, chemistry and mathematics.
Balance of property approach (matter and energy).
Transport phenomena. Determination of transport coefficients.

OUTCOMES

1401 - Degree in Chemical Engineering

- G3 - Knowledge of basic and technological subjects that allows students to learn new methods and theories and provides them with versatility to adapt to new situations.
- G4 - Ability to solve problems with initiative, decision-making skills, creativity and critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of industrial engineering.
- G5 - Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and analogous work.
- G6 - Ability to deal with specifications, regulations and mandatory standards.
- G10 - Ability to work in a multilingual and multidisciplinary environment.
- G11 - Knowledge, understanding and ability to apply the necessary legislation for practising professionally as a qualified industrial technical engineer.
- TE1 - Knowledge of material and energy balances, biotechnology, matter transfer, separation operations, chemical reaction engineering, reactor design, and valorisation and transformation of raw materials and energy resources.
- TE2 - Ability to analyse, design, undertake simulations and optimise processes and products.

LEARNING OUTCOMES

Learning Outcomes:

- Understand the basic principles of the basic operations of heat transport and be able to use them to identify, formulate and solve problems in their area of work (G3, G4, TE1).
- Understand the basic principles of thermodynamic equilibrium and be able to use them to identify, formulate and solve problems (G3, G4, TE1).
- Being able to design equipment and facilities for heat transport in accordance with standards and specifications (G4, G5; G6, G11, TE2).
- Being able to operate equipment heat transport in plants, chemical process industry, in accordance with standards and specifications (G5, G6, G11, TE1).
- Ability to analyze equipment and heat transport processes, to assess their suitability and to propose alternatives (G4, TE2).

- Know how to use specific tools for analysis and design of basic operations (G4, TE2).
- Interpret and extract the information needed to solve the problems (G4, TE2).
- Select and apply appropriate mathematical methods to solve problems (G4, TE2).
- Critically analyze the results obtained by solving the problems (G11, TE2).
- Find, select and understand the information in specialized literature sources (G4, G6, G11).
- Acquire ability to work in groups (G10).

Skills to acquire:

The student should be able to:

- Know the different mechanisms and rate equations of heat transfer.
- Solving equations by conduction heat transfer and apply for determining the temperature distribution in a material and for calculating the thickness of insulation.
- Solve the equations of convective heat transport and apply to the determination of variations in temperature and heat fluxes.
- Determine the heat transfer by radiation in different ways and in combination with other energy transport mechanisms.
- Classify and describe the operation of heat exchangers.
- Determine the effectiveness of a heat exchanger.
- Design concentric tubes heat exchanger.
- Design shell and tubes heat exchanger.
- Solve the energy and material balances of an evaporator.
- Classify and describe the operation of evaporators.
- Design a single-effect evaporator.
- Design a multiple effect evaporator.
- Know heat transfer equipment for radiation.
- Determine the temperature of a gas with combined effects of heat transfer.

In addition to the specific objectives mentioned above, during the course the development of several **social and technical skills** will be encouraged, among which the following are included:

- Capacity for analysis and synthesis.
- Ability to interpret relevant data.
- Ability to communicate ideas, problems and solutions.
- Ability to argue from rational and logical criteria.
- Ability to communicate in a proper and organized manner.
- Ability to develop a problem in a systematic and organized manner.
- Ability to critically analyze the results of a problem.
- Ability to work autonomously.
- Ability to integrate and participate actively in group tasks.
- Ability to properly distribute the time for development tasks.

DESCRIPTION OF CONTENTS

1. INTRODUCTION TO THE BASIC OPERATIONS OF CHEMICAL ENGINEERING

Heat transfer processes.

2. AN INTRODUCTION TO HEAT TRANSFER

Conduction, convection, radiation. Rate equation in molecular transport: Fourier's law. Rate equation in turbulent transport: individual coefficient. Estimation of individual coefficient of heat transmission. Transfer between phases overall coefficient. Heat transfer fluids. Fundamental equations of radiation.

3. HEAT EXCHANGERS

Classification and description. Concentric tubes heat exchangers. Design equations. Improper operation in concentric tubes heat exchanger. Effectiveness of a heat exchanger. Analysis of the functioning of a heat exchanger.

4. HEAT EXCHANGERS INDUSTRIAL USE

Types of industrial heat exchangers. Shell and tubes heat exchangers. Design of heat exchangers for industrial use. Comparative analysis of different types of heat exchangers. Practical aspects of the design of heat exchangers.

5. EVAPORATORS

Introduction. Fundamental equations in an evaporator. Material balance. Energy balance: dilute solutions, concentrated solutions. Rate equation. Design and operation of an evaporator: simple effect.

6. DESIGN OF MULTIPLE EFFECT EVAPORATORS

Use of the energy of solvent vapour. Multiple effect evaporators. Advantages and disadvantages of different feeds. Design of a triple-effect evaporator fed directly, without boiling point elevation. Design of a triple-effect evaporator with direct feed, with boiling point elevation. Types of evaporators. Anomalies in the operation of an evaporator.

7. RADIATION EQUIPMENT DESIGN

The radiation in the presence of other mechanisms of energy transport. Individual coefficient of heat transmission by radiation. Combination of resistance to heat transport. Thermal insulation of a pipe. Calculating the optimum thickness of the insulating layer. True temperature of a gas flowing through a pipe. Radiation gases. Combustor design. Direct Fired Heaters. Approximate methods. Calculation of furnaces. Calculation of solar heaters.

WORKLOAD

ACTIVITY	Hours	% To be attended
Classroom practices	25,00	100
Theory classes	20,00	100
Development of group work	4,00	0
Study and independent work	19,00	0
Preparation of evaluation activities	11,00	0
Preparing lectures	11,00	0
Preparation of practical classes and problem	15,00	0
Resolution of case studies	7,50	0
TOTAL	**112,50**	

TEACHING METHODOLOGY

The development of the course is structured around theory classes and problems, conducting seminars and work.

In theory classes we will use the lecture model. The teacher will present on presentation and / or explain the contents of each issue impacting on key aspects for understanding (G3, G4, G6, G10, TE1, TE2).

Practical classes of problems will be developed following two models. In some classes the professor will resolve a number of sample problems for students to learn to identify the essential elements of the approach and problem resolution. In other kinds of problems will be the students, individually or arranged in grups, which should solve similar problems under the supervision of the teacher. After the work, the problems will be collected, analyzed and corrected by the teacher or the students themselves (G4, G6, G10, TE2).

In the seminar sessions students, individually or distributed in groups, will be instructed in the use of computer-simulation packages in the area of Unit Operations; they also must solve specific problems using these techniques (G3, G4, G6, G10, TE1, TE2).

The proposed work to the student will be divided into three types: full Problems of similar complexity to those tests, questionnaires aimed at preparing the most important concepts of each topic and self-correcting tests, performed on the Virtual Classroom. Some of these activities will take place in class and the rest will have a timetable for completion and delivery by the students. After correction, students will be informed of their results and a summary of the most consolidated and more frequent failures (G3, G4, G5, G6, G10, TE2).

EVALUATION

The assessment of student learning will take place following two ways:

Method A: By assessing the activities of students (questionnaires and problems) and the objective exams.

To be eligible for evaluation with the mode A, the student must have attended 80% of classes and obtained in the proposed activities an average score greater than or equal to 4 (over 10). Once these two requirements have been achieved, the final mark will be obtained as the greater of:

- the weight between the average mark of the objective exams (75%) and the average score of the activities (25%), provided that the average mark of the objective exams is equal to or greater than 4 (over 10).
- the average mark of the objective exams.

Method B: The note with this method is obtained by weighting of the final exam (80%) and the average score of the activities (20%), provided that the mark of the final exam is equal to or greater than 4 (over 10).

The subject is considered overcome when the mark obtained is equal to or greater than 5 (over 10).

In any case, the evaluation system will be governed by the Reglament d'Avaluació i Qualificació de la Universitat de València per a Títols de Grau i Màster (http://links.uv.es/j0Im3ec).

REFERENCES

Basic

- "Transmissió de calor" Sanchotello, Margarita; Orchillés, A. Vicent (PUV, 1997)
- "Transferencia de calor" Holman, Jack P. (McGraw-Hill, 2000)
- "Fundamentos de transferencia de calor" Incropera, Frank P.; de Witt, David P. (Prentice-Hall, 1999)
- "Transferencias de calor y masa" Cengel, Yunus A.; Ghajar, Afshin J. (McGraw-Hill, 2011)

Additional

- "Principios de transferencia de calor" Kreith, Frank; Bohn, Mark S. (International Thomson Editores, 2001)
- "Flujo de fluidos. Intercambio de calor" Levenspiel, Octave (Reverté, 1993)
- "Transferencia de calor aplicada a la ingeniería" Welty, James R. (Limusa, 1978)
- "Transferencia de calor" Özisik, M. Necati (McGraw-Hill, 1979)
- "Ingeniería Química (Vol. 4, Transmisión de calor)" Costa, Enrique y otros (Alhambra, 1986)
- "Termotecnia. Aplicaciones agroindustriales" Amigo, Pablo (Mundi-Prensa, 2000)
- "Radiative transfer" Hottel, Hoyt C.; Sarofim, Adel F. (McGraw-Hill, 1967)

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

Contents

The contents initially collected in the course guide are maintained.

Workload and temporary teaching planning

Regarding the workload:

The different activities described in the Course Guide are maintained with the planned dedication.

Regarding the temporary planning of teaching:

The material for the follow-up of the theory/practical lessons allows to continue the temporary teaching planning both in days and hours, both if the teaching is in the classroom or not.

Teaching methodology

In theory and practical lessons in the classroom, maximum possible attendance will be the rule, always respecting the sanitary restrictions that limit the capacity of the classrooms to 50% of their usual occupation. Depending on the capacity of the classroom and the number of students enrolled, it may be necessary to distribute the students into two groups. If this situation arises, each group will attend theory and practical sessions with physical presence in the classroom by rotating shifts, thus ensuring compliance with the criteria for occupying spaces. The rotation system will be established once the enrolment data is known, guaranteeing, in any case, that the attendance percentage of all the students enrolled in the subject is the same. For classroom sessions and theory sessions that are not face-to-face, there will be a preferably synchronous online teaching model if compatibility with other scheduled activities allows. Online teaching will be carried out by synchronous videoconference respecting the schedule, or, if not possible, asynchronous.

Once the enrolment data is available and the availability of spaces is known, the Academic Committee of the Degree will approve the Teaching Model of the Degree and its adaptation to each subject, establishing the specific conditions in which it will be taught.

If there is a closure of the facilities for sanitary reasons that totally or partially affects the classes of the course, they will be replaced by online sessions following the established schedules.

Evaluation

The evaluation system described in the Course Guide is maintained. In it the various evaluable activities have been specified as well as their contribution to the final grade of the course is maintained.

If there is a closure of the facilities for sanitary reasons that affect the development of any face-to-face evaluable activity of the subject, it will be replaced by a test of a similar nature that will be carried out in virtual mode using the computer tools licensed by the University of Valencia. The contribution of each evaluable activity to the final grade of the subject will remain unchanged, as established in this guide.

References

The literature recommended is the Course Guide is maintained since part of it is accessible and is complemented by notes, slides and problems uploaded to Virtual Classroom as material of the course.