

28936 - Unit operations I

Syllabus Information

Academic year: 2024/25

Subject: 28936 - Unit operations I

Faculty / School: 201 - Escuela Politécnica Superior

Degree: 583 - Degree in Rural and Agri-Food Engineering

ECTS: 6.0

Year:

Semester: First semester

Subject type: Optional

Module:

1. General information

The general objective of this subject is to know, understand and learn to use the principles of food engineering and technology, to apply them in the design of basic operations that constitute the processes in the food industries.

This objective will involve:

1. Solve material and energy balances to calculate flow rates, compositions, temperatures and energy requirements of food industry processes.
2. To know the mechanisms of heat transmission and material transfer in the equipment used in the food industries.

These objectives are aligned with the Sustainable Development Goals (SDG) of the United Nations 2030 Agenda (<https://www.un.org/sustainabledevelopment/es/>), specifically, the learning activities planned in this subject will contribute to the achievement of Goal 4 (Goal 4.3), Goal 7 (goal 7.3) and Goal 9 (goal 9.4).

2. Learning results

At the end of the subject, the student is expected to be able to:

1. To list and describe the forms of operation of the food industry, as well as their advantages and disadvantages.
2. To pose and solve matter and energy balances (without chemical reaction).
3. Estimate the numerical value of the overall heat transfer coefficient and quantify the heat transfer area required to carry out a given heat exchange operation.
4. Determine the capacity and economy of a single acting evaporator.
5. Estimate the time required, and the average heat removed, to refrigerate or freeze a given food.
6. Estimate the number of stages and the amount of solvent required to achieve a given degree of extraction.
7. To obtain the vapor-liquid equilibrium curve of a binary mixture. Calculate the number of plates of a column of distillation. Calculate the efficiency of each stage.
8. Use the EES program for problem solving with ease.
9. Handle with a certain degree of dexterity, and in a responsible manner, the equipment and instruments used during the practical laboratory sessions.
10. Interpret experimental results in the context of the subject and relate them to the theoretical contents.
11. Analyze the most important unit operations in the food industry by using simple physical models that reproduce the action of the operation.
12. Choose the most appropriate basic operation(s) for the preparation, obtaining, preservation and transformation of the following food.

3. Syllabus

Thematic block 1: INTRODUCTION

Topic 1: INTRODUCTION TO CHEMICAL ENGINEERING

Topic 2: TRANSPORT PHENOMENA

Topic 3: BALANCES OF MATTER IN STEADY STATE

Topic 4: ENERGY BALANCES IN STEADY STATE WITHOUT CHEMICAL REACTION

Thematic block 2: BASIC OPERATIONS BASED ON HEAT TRANSFER

Topic 5: HEAT TRANSFER

Topic 6: HEAT EXCHANGERS

Topic 7: EVAPORATION

Topic 8: REFRIGERATION AND FREEZING

Thematic block 3: BASIC OPERATIONS BASED ON THE TRANSFER OF MATTER

Topic 9: FUNDAMENTALS OF DIFFUSION AND INTER-PHASE MATTER TRANSFER

Topic 10: EXTRACTION

Topic 11: DESTILLATION

Practice program

Practice 1: PRINCIPLES OF EES SOFTWARE.

Practice 2: HEAT EXCHANGERS.

Practice 3: DISCONTINUOUS DISTILLATION.

Practice 4: SOLID-LIQUID EXTRACTION.

Practice 5: HEAT TRANSMISSION BY CONDUCTION.

4. Academic activities

Theory and Problems: Attendance to theory classes and problem solving. 50h

Teaching and other activities: *Individual* resolution of a problem (deliverables) and cases (assignments); and elaboration and presentation of a *collaborative work* (group analysis of a basic operation). 24h

Laboratory Practices: 5 in-class sessions of 2 hours. 10h

Study and independent work: During this non-attendance mode, students will dedicate themselves to personal study. 60h.

Assessment: 6h.

5. Assessment system

I Call.

a) Continuous evaluation system

1. Evaluation of the **deliverables/problems** including the public presentation of one of them. (30% of the final grade, minimum of 3.5 out of 10 points). The exact number of deliverable problems will be indicated on the day of the subject's presentation.

2. Evaluation of tasks or **cases**. (25% of the final grade, minimum of 3.5 out of 10 points). The exact number of deliverable tasks will be indicated on the day of the subject's presentation.

3. Evaluation of **work in a cooperative regime** (25% of the final grade, minimum of 3.5 out of 10 points). Group analysis of a basic operation. During the last teaching week of the semester, the teams will be able to submit the work report and make its oral presentation during class time. The grade of the work will be determined based on the quality of the written report and the oral presentation. In justified cases, students may carry out the activity individually.

4. Evaluation of **laboratory practices**. (20% of the final grade, minimum of 3.5 out of 10 points). Students who have attended a minimum of 75% of the practical laboratory sessions will complete an Individual Report on the work carried out in them.

b) Students who do not take the continuous evaluation or want to opt to raise their grade may take a **global test** on the dates established on the EPS website, which will consist of:

1 Theory and problems exam. Individual written test (60% of the final grade; minimum of 4 out of 10 points). It will consist of two parts: theory (40%) and problems (60%). It cannot be less than 4 to compensate with the rest of the activities.

2 Tasks and analysis of a unit operation. (20% of the final grade; minimum of 3.5 out of 10 points). Students who have not completed or passed this activity must submit the resolution of a new collection of tasks and/or a new analysis of a unit operation individually before the start time of the written test of the 1st call.

3 Laboratory practices exam (20% of the final grade; minimum of 3.5 out of 10 points). Students who have not previously completed the laboratory practices will be called to take the practical exam on the same day, but at a different time from the written tests. In this exam you must carry out some of the practices contemplated in the program and answer a questionnaire. To do this, the student will only be able to consult the practice scripts.

II Call. Global evaluation identical to the first call.

The detailed definition of the evaluation system will be presented in class during the presentation of the subject.

The success rates of the subject in the last three years are: 2020/21: No students; 2021/22: 0%*; 2022/23: 100% (*1 student enrolled)

6. Sustainable Development Goals

4 - Quality Education

7 - Affordable and Clean Energy

9 - Industry, Innovation and Infrastructure