COURSE DATA

DATA SUBJECT

Code: 33997
Name: Basic Operations
Cycle: Undergraduate Studies
ECTS Credits: 9
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1103 - Degree in Food Science and Technology	Facultat de Farmácia i Ciències de L'alimentació	2	Annual

SUBJECT-MATTER

Degree	Subject-matter	Character
1103 - Degree in Food Science and Technology	Chemical engineering	COMPULSORY

COORDINATION

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SUMMARY

Unit Operations is a compulsory subject that is taught annually in the second year of the Degree in Science and Food Technology. In the curriculum of the University of Valencia has a total of 9 ECTS credits. This subject aims students to apply the basic principles of chemical engineering, previously seen in the course Foundations of Chemical Engineering, to design and performance analysis of the unit operations commonly used in the food industry.

The study of the unit operations classification begins with attending to the physical phenomenon that are based predominantly in: unit operations of momentum transport, unit operations of mass transfer and unit operations of heat transfer.

The first group will deal the study of the circulation of liquids by pipeline, filtration and membrane separation operations. Later, the solid-liquid extraction will be studied in detail as an example of unit operation controlled by the mass transfer, present in the food industry. The design and operation of heat exchangers and evaporators for industrial use will be also examine, both controlled by heat transfer. Finally, we will study the processes of dehydration of solids (drying and lyophilization) that in addition to the mass transfer, also takes into account the heat transport.

The subject is eminently applied, so that the theoretical components must be added the practical, both resolution of numerical questions and problems that simulate real situations as well as experimentation in the laboratory. In these practical components the theoretical concepts introduced will be applied, and the student will become familiar with the operation mode of the processes in the food industry.

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 pass the course is essential that students have the following background:
Energy and Mass balances
Rate equations of property transport. Transport coefficients
Basics of Chemistry and Thermodynamics
Math Basics

COMPETENCES / LEARNING OUTCOMES

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Asesorar científica y técnicamente a la industria alimentaria y a los consumidores en el marco de la normativa legal vigente.

Be able to select, size and analyse the operation of processing equipment based on energy transfer.

Be able to select, size and analyse the operation of processing equipment based on mass transfer.

Be able to select, size and analyse the operation of processing equipment based on momentum transfer.

Be able to select, size and analyse the operation of processing equipment based on simultaneous mass and energy transfer.

Capacidad de interpretar datos relevantes.

Control and optimise processes and products in the food industry.

Develop new processes and products in the food industry.

Develop skills to undertake further study.

Interpret information regarding a problem and translate it into process variables or variables of operation of equipment.

Know the modes of operation of the food industry.

Manufacture and preserve food.

Poseer y comprender los conocimientos en el área de Ciencia y Tecnología de los Alimentos.

Saber aplicar esos conocimientos al mundo profesional, contribuyendo al desarrollo de los Derechos Humanos, de los principios democráticos, de los principios de igualdad entre mujeres y hombres, de solidaridad, de protección del medio ambiente y de fomento de la cultura de la paz.

Understand and classify unit operations.

Use laboratory or pilot plant equipment similar to that used in the food industry.

DESCRIPTION OF CONTENTS

1. Introduction

Unit operation. Classification .- Unit Operations controlled by the mass transfer.- Unit operations controlled by heat transfer.- Unit operations of simultaneous heat and mass transfer by direct contact between phases .- Operations unit controlled by the momentum transport.- Complementary Operations

2. LIQUID FLOW IN PIPES

The nature of fluids. Rheological behavior: Newtonian and non-Newtonian fluids.- Liquid flow in pipes. Mechanical energy balance. Mechanical energy loss.- Pumps. Characteristics. Types. Installation point of a pump. Discharge and head supplied by a pump. Pump selection.

3. FILTRATION

Basis of filtration. Constant pressure drop filtration in a filter press. Filter cake washing. Filtration capacity. Optimum filtration

4. MEMBRANE SEPARATION OPERATIONS

Membrane separation processes: Definition. Advantages and disadvantages. Characteristic parameters of operation. -Types of membranes. Configuring modules .- Mechanisms of transport. Friction model. Solution-diffusion model. Concentration polarization .- Reverse Osmosis. Design equations. Applications of reverse osmosis .- Ultrafiltration. Design equations. Applications of ultrafiltration

5. SOLID-LIQUID EXTRACTION

Introduction: solvent extraction .- Equilibrium in SLE. Retention of dissolution for solid .- Modes of operation in SLE .- Design of extractors. Calculating the number of ideal stages .- Concept of stage efficiency .- Industrial equipment for SLE.

6. HEAT EXCHANGE

Introduction.- Double pipe heat exchangers. Effectiveness. Performance analysis. Heat exchangers for industrial applications. Description. Design and performance analysis: method of correction factor for the logarithmic mean temperature difference, method of the number of transfer units, and generalized graphical method. Comparative analysis of heat exchangers. Practical considerations for design

7. EVAPORATION

Introduction to evaporation.- Basic equations in an evaporator. Material balances. Energy balance. Design equation.- Design and performance analysis of a single effect evaporator. Multiple effect evaporator.

8. DEHYDRATION: DRYING AND LYOPHILIZATION

Introduction to dehydration .- Dried-hot air. Properties of moist air and properties of wet solids.- Drying curves and drying rate curves .- Lyophilization

9. LABORATORY + INFORMATICS

Introduction to laboratory. Reynolds experiment. Determination of the characteristics of a centrifugal pump. Study of rheological behavior of fluids. Experimental study of drying. Mass balance in unsteady state. Simple open distillation. Heat exchangers. Circulation of fluids. Experimental study of filtration.-Simulation of fluid flow. Activity related to the food industry. Calculations and reporting.- Management software packages.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	2,00
Theory	52,00
Seminar	2,00
Laboratory	24,00
Computer classroom practice	6,00
Total hours	**86,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	30,00
Independent study and work	20,00
Preparation of lessons	40,00

Preparation for assessment activities	15,00
Resolution of case studies	30,00
Total hours	**135,00**

TEACHING METHODOLOGY

The development of the course is structured around theory and problems classes, seminars, laboratory sessions, the performance of works and tutoring.

In the theory classes the lecture model will be used. The teacher will explain the contents of each issue, focusing on key aspects for comprehension.

Practical classes of problems will be developed following two different models. In some classes the teacher is who solves a series of sample problems for students to learn to identify the essential elements of the approach and solve problems of theme. In the other classes of problems the students will solve, individually or in groups, similar problems under the supervision of the teacher. After the work, the problems will be collected, analyzed and corrected by the teacher or by the students themselves.

In the seminars students will expose to the group a topic proposed by the teachers, consisting in a process description of a process of the food industry, including unit operations of the three properties transport (momentum, mass and heat).

For laboratory practice sessions, activities will be scheduled for the introduction of practice to perform, development activities of experimentation and analysis activities and treatment of results (which will correspond to the computer sessions.) Students will have practical guide and experimentation will be carried out entirely by them under the supervision of the teacher.
The proposed work for the students will be of two types: problems similar in complexity to those of exams, and questionnaires. All of these activities will be done in class or at home, and will have a timetable for completion and delivery.

With respect to the tutorials, students will be attended in groups of 16. In them, the teacher will discuss and clarify general aspects of the subject as individual questions. Also, in these sessions the teacher will return the activities delivered by students, corrections, and resolve questions and errors in its resolution. The attendance to tutorials is mandatory.

EVALUATION

The evaluation of student learning will be carried out following two models:

A) By evaluating the activities (questionnaires and problems) carried out by the students, the grade from the seminar, the grade from the laboratory and the grade from the exam that is carried out.

B) From the note of the seminar, the laboratory and the exam.

To be evaluated by the modality A), the student must have completed at least 60% of the scoring activities proposed. Exceeded this requirement to qualify for this evaluation modality, the final grade will be obtained as the highest of:

- The weight between the average mark of the exam (50%), the mark of the scoring activities delivered (questionnaires 10% and problems 10%), the grade of the seminar (10%) and the mark of the laboratory (20%).

- The weight between the average mark of the exam (70%), the seminar grade (10%) and the laboratory grade (20%).

In modality B) the final grade will be obtained from the weighting between the average grade of the exam (70%), the seminar grade (10%) and the laboratory grade (20%).

The evaluation will be carried out through:

Objective test consisting of an exam with theoretical s and/or practical questions, and problems. The level of understanding and knowledge of the subject will be evaluated by the written exam. The student may consult the supporting material in some part of the examination.

To pass the course the average mark (weighted, if necessary) of the different parts of the exam is not less than 40 (over 100) will be required. This section will contribute to the final grade of the course with a percentage of 50% or 70%, according to the evaluation models. If the mark obtained in the examination is less than 40 points (out of 100), the grade for the course will be this one.

Continuous assessment of each student, based on regular attendance of classroom activities (theory classes, problems classes, seminars and tutorials), delivery of complementary activities (questionnaires and problems), attitude, participation and involvement of the student in the teaching-learning process.

The level of understanding of content and skills to approach and solve problems will be evaluated. The average mark of the questionnaires could contribute to the final mark with a percentage of 10% and the average mark of problems could contribute to the final with a percentage of 10%. Attendance at tutorial sessions is mandatory to take into account these percentages in the final mark of the course. Failure to attend these sessions without justification reduces those two percentages to 5%.

By other hand, the capacity for implementation, presentation, exhibition and discussion of a topic related to the contents of the degree will be evaluated (seminars). This section will contribute to the final of the subject at a rate of 10%. The students who cursed the subject for first time must attend to the coordinated seminars. Failure to attend them without justification involves a zero in the corresponding section of evaluation seminars.

Laboratory evaluation by supervising the knowledge of the guide lab (questionnaires), and the ability to present and discuss well detailed and organized the experimental results (laboratory reports). The laboratory mark is obtained as weighting of the average grade of the questionnaires (10%) and the average grade of the reports (90%). Attendance at all laboratory sessions, as well as computer sessions is mandatory. It is also planned to carry out an activity related to a food industry. Failure to carry out this activity reduces the mark obtained in the laboratory by 10%.

To pass the course the mark of laboratory must be equal or more than 50 (over 100). This part will contribute to the final mark of the course with a percentage of 20%.

To pass the course, the weighted average mark of the different parts (objective test, activities, seminar and laboratory) must be equal or more than 50 (over 100). If the course is not overcome but the laboratory is passed, the mark corresponding to this part remains for future courses.

To request advance date in the convocation of this course, students must have completed the mandatory activities listed in this teaching guide.

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