PROGRAMME IN UNIT OPERATION IN FOOD INDUSTRY

Academic course: 2024-2025

Identification and characteristics of the subject				
Code	501248		Credits ECTS	6
Name (Spanish)	Operaciones Básicas en la Industria Agroalimentaria			
Name (English)	Unit Operations in Food Industry			
Degree	FOOD SCIENCE AND TECHNOLOGY			
Center	Agricultural Engineering School			
Semester	Third (3º)	Type	Compulsory	
Module	Food Technology			
Subject	Food Technology			
Language	Spanish			
Professor/s				
Name		Room	e-mail	Web link
María Luisa Timón Andrada		D 708 Valle del Jerte	mltimon@unex.es	
Field of knowledge	Food Technology			
Departament	Animal Production and Food Science			
Coordinator (if there is more than one professor)				

Competencies
CB1: Students must have demonstrated knowledge and understanding in a field of study that builds on the foundation of general secondary education and is typically at a level that, while supported by advanced textbooks, also includes some aspects that involve knowledge from the forefront of their field of study.
CB2: Students must be able to apply their knowledge to their work or vocation in a professional manner and possess the competencies that are usually demonstrated through the development and defense of arguments and problem-solving within their area of study.
CB3: Students must have the ability to gather and interpret relevant data (usually within their field of study) to make judgments that include reflection on relevant social, scientific, or ethical issues.
CB4: Students must be able to convey information, ideas, problems, and solutions to both specialized and non-specialized audiences.
CB5: Students must have developed the necessary learning skills to undertake further studies with a high degree of autonomy.
CG3: In the field of process and product development and innovation, the ability to design and develop new processes and products to meet market needs in various aspects

involved; evaluate the market acceptability of these products; establish their production costs; evaluate the environmental risks of new production processes.
CG4: In the field of food processing, be able to identify problems associated with different foods and their processing, which includes in-depth knowledge of raw materials, component interactions, various technological processes (including production, packaging, storage, transportation, and distribution of products), as well as the transformations that products may undergo during these processes; manage processing from an environmental perspective; establish process control tools.
CG8: In the field of legal, scientific, and technical advice, be able to study and interpret reports and administrative records related to a product, in order to respond reasonably to the issue at hand; know the current legislation; advocate for the modification of regulations related to any product before the administration.
CT1: Mastery of ICT (Information and Communication Technologies).
CECTA2: Ability to know, understand, and use the principles of basic fundamentals and appropriate technological processes for the production, packaging, and preservation of food.
CECTA3: Evaluate the impact of processing on the properties of food.
CECTA4: Determine the suitability of technological advances for food and process innovation in the food industry.
CECTA5: Ability to know, understand, and use the facilities of the agri-food industries, their equipment, and auxiliary machinery of the agri-food industry.
CECTA6: Ability to know, understand, and control processes in the agri-food industry. Modeling and optimization of food processes.
Contents
Course outline
Theoretical foundations of basic operations. Application of the equations that define basic operations. Mechanisms of mass, energy, and momentum transfer. Heat transfer in food processing. Movement of food fluids. Steam production. Calculations in evaporation facilities. Technology of raw material transformation processes: emulsification, mixing, filtration, centrifugation, membrane separation, pressing, distillation. SDGs and basic operations.

OBJETIVOS DE DESARROLLO SOSTENIBLE CONTEMPLADOS

☐	☐	☐	☐	☐	☒
☒	☐	☒	☐	☐	☒
☒	☐	☐	☐	☐	☐

Course syllabus

SECTION 1. INTRODUCTION

Lesson 1. Basic Principles
Basic principles of Unit Operations. Fluid flow (momentum transfer), heat transfer and mass transfer. Material and Energy balances: Problems and resolution methods. Process definition. Continuous processes. Flow Chart. SDG6, SDG7, SDG9, SDG12, SDG13

SECTION II. FLUID FLOW (MOMENTUM TRANSFER). UNIT OPERATIONS BASED ON MOMENTUM TRANSFER

Lesson 2. Fluid: Basic Principles
Fluid statics and fluid dynamics. Continuous equation and Bernoulli equation.

Lesson 3. Fluid flow
Type of flow. Flow measurement and instrumentation

Lesson 4. Centrifugation
Centrifugal force. Separation of solid-liquid and immiscible liquids. Types of centrifuge. Applications in food industry

Lesson 5. Filtration
Filtration at constant pressure and constant flow. Filtration equipment. Applications in food industry

Lesson 6. Pressing.
Principles and applications. Equipment and efficiency

Lesson 7. Stirring, mixing and emulsifying.
Introduction. Classification of mixtures. Stirring: definition, power, similarity criteria and stirring mechanisms. Mixing: definition, high viscosity material mixing, solid material mixing and mixers. Emulsifying: definition, interfacial properties, emulsion stabitlity and equipment. Food industry applications.

SECTION 3. HEAT TRANSFER. UNIT OPERATIONS BASED ON HEAT TRANSFER

Lesson 8. Heat transfer
Conduction heat transfer. Convection heat transfer. Radiation heat transfer

Lesson 9. Heat exchanger
Heat transfer mechanism in heat exchanger. Type of equipment

Lesson 10. Evaporation
Heat transfer mechanism in evaporation. Heat transfer coefficients and factors that affect these coefficients. Factors affecting boiling liquid point. Boiling liquid characteristics. Calculations: one effect and multiple effect evaporation. Evaporators. Evaporation applications in Food Industry.

SECTION 4. MASS TRANSFER. UNIT OPERATIONS BASED ON MASS TRANSFER

Lesson 11. Mass transfer
Heat transfer by diffusion: Fick law

Lesson 12. Distillation and rectification
Theory, equipments and applications in food industry

Lesson 13. Solid liquid extraction
Introduction. Mass transfer in the extraction. Extraction efficiency and parameters. Calculations. Equipments. Applications in Food Industry

Lesson 14. Clarification of gases
Principles, equipments and applications

Lesson 15. Membrane separation: Ultrafiltration and reverse osmosis
Theory. Types of membranes. Equipment and applications.

PRACTICAL SYLLABUS

Practical lesson 1: **Solution preparation**
Practical lesson 2: **Centrifugation**
Practical lesson 3: **Filtration**
Practical lesson 4: **Meat emulsion preparation**
Practical lesson 5: **Heat transfer by conduction and convection**
Practical lesson 6: **Distillation**

Monografic work: **Flow chart preparation and oral presentation**

Educational activities *

Student workload in hours by lesson		Lectures	Practical activities				Monitoring activity	Homework
Lesson	**Total**	**L**	**HI**	**LAB**	**COM**	**SEM**	**SGT**	**PS**
1	13	4		3				6
2	11,5	3,5				1		7
3	9,5	2				1,5		6
4	14	2		3			2	7
5	13,5	2		3			2	6,5
6	8,5	2					1,5	5
7	12	2		3				7
8	12	4		2				6
9	9	4						5
10	12	3					2	7
11	5	2						3
12	6	1		3				2
13	3	1						2
14	6	1		3				2
15	6	2						4
Assessment 1**	9	2						7
TOTAL	150	37,5		20		2,5	7,5	82,5

L: Lectures (85 students)

[1]** Indicate the total number of evaluation hours of this subject.

HI: Hospital internships (7 students)
LAB: Laboratory or field practices (15 students)
COM: Computer room or language laboratory practices (20 students)
SEM: Problem classes or seminars or case studies (40 students)
SGT: Scheduled group tutorials (educational monitoring, ECTS type tutorials)
PS: Personal study, individual or group work and reading of bibliography

Teaching Methodologies*

The expository and cognitive method is used, which is developed using the following activities:
1. Lectures and discussion of theoretical content
2. Problem development
3. Laboratory practices, pilot plants and field
4. Practical cases
6. Development and presentation of works
7. Use of the virtual classroom
9. Study of matter
10. Search and management of scientific bibliography
11. Evaluation of activities

Assessment systems *

Continuous evaluation system

1. Final assessment of knowledge (60%): Degree of acquisition of knowledge of the subject during the course by completing a final written exam (45%) and a problem exam (15%). The final exam will consist of multiple choice and short questions related to the subject matter taught. It is necessary to pass both exams (minimum mark of 5 out of 10) to pass the subject.

2. Continuous assessment (30%): Degree of achievement of practical skills and ability to integrate with theoretical knowledge. Use and participation in practical classes through direct questions to the groups of students and discussion of the results (20%). Presentation of a flow chart in relation to the theoretical and practical knowledge acquired (10%, non-recoverable).

3. Assistance with taking advantage of face-to-face activities (10%, non recoverable):

Attendance, use and participation in theoretical classes, practices and ECTS tutorials

Alternative assessment system with a global final test*

Final written exam that will have two parts: the first part (85%) will consist of multiple choice and short questions related to the syllabus taught. The second part (15%) will consist of solving problems worked on during the course. Both parties must be approved

**According to Resolución de 26 de octubre de 2020, DOE, 212, 3 de noviembre*

Bibliography (basic and complementary)

RECOMMENDED BIBLIOGRAPHY

Brennan, Butters, Cowell y Lilly. "Las Operaciones de la Ingeniería de los Alimentos". 3ª ed., Ed. Acribia 1998.

Earle, R.L. "Ingeniería de los alimentos". Ed. Acribia. 1988.

Fellows, P. "Tecnología del procesado de los alimentos" Ed. Acribia, 2007.

McCabe, W.L.; Smith, J.C. y Harriott, P. "Operaciones Básicas de la Ingeniería Química". McGraw-Hill. 1991.

Hermida Bun, J.R. "Fundamentos de ingeniería de procesos agroalimentarios" Ed. Mundi-Prensa, 2.000.

OTHER BIBLIOGRAPHY

Aguado, J. (Editor) "Ingeniería de la Industria alimentaria" Ed. Síntesis.
Vol I: Conceptos básicos. 1.999.
Vol II: Operaciones de procesado de alimentos. 2.002
Vol. III: Operaciones de conservación de alimentos. 2.002

Calleja Pardo, G. (Editor) "Introducción a la ingeniería Química" Ed. Síntesis, 1.999.

Coulson, J.M. y Richardson, J.F. "Ingeniería Química" Ed. Reverté.
Vol I: Flujo de fluidos, transmisión de calor y transferencia de materia. 1981.
Vol. II: Operaciones Básicas. 1988.
Vol. IV: Solución a los problemas del vol I. 1980.
Vol V: Solución a los problemas del vol. II. 1982.

Geankoplis, C.J. "Procesos de transporte y Operaciones Unitarias". Ed. Continental (Méjico) 1998.

HELDMAN, D.R. y LUND, D.B. (2007). Handbook of food engineering. Ed. Dekker. Nueva York.

LEVENSPIEL, O. (2004). Flujo de Fluidos. Intercambio de Calor. Ed. Reverté, S.A. Barcelona.

MAFART, P. (1993 y 1994). Ingeniería industrial alimentaria. Vol 1. Procesos físicos de conservación. Vol 2. Técnicas de separación. Ed. Acribia, S.A. Zaragoza.

Singh RP y Heldman DR: Introducción a la ingeniería de los alimentos. Acribia S.A. (2009)

Welty, J.R. "Fundamentos de transferencia de momento, calor y masa" 2ª ed., Ed. Limusa Wiley 2.000.

FOR PROBLEMS:

HENLEY, E.J. y ROSEN, E.M. (2002). Cálculo de balances de materia y energía. Ed. Reverté, S.A. Barcelona

Hougen,O.A.; Watson, K.M. y Ragatz, R.A. "Principios de los procesos químicos. I. Balances de materia y energía". Ed. Reverté 1982.

Himmelblau, D.M. "Principios y cálculos básicos de la Ingeniería Química". Ed. Prentice Hall Hispanoamericana S.A., 1997

Valiente Barderas, A. "Problemas de balance de materia y energía en la Industria Alimentaria". Ed. Limusa 1999.

Other resources and complementary educational materials
http://www.agroinformacion.com/ http://www.niroinc.com/ http://www.fiab.es/ http://makbor.com.tr/en/index.asp https://www.foodindustry.es https://www.denismancarella.com https://www.dordal.com/ https://www.calero-group.com/procesos-en-la-industria-alimentaria/ https://www.virtualpro.co/revista/algunas-operaciones-unitarias-aplicadas-a-la-industria-de-alimentos https://industrialimentariafp.com/ https://sefifood.es/blog/ https://www.industriaalimentaria.org/blog https://www.bsigroup.com/es-ES/blog/blog-sector-alimentario/ http://industrias-alimentarias.blogspot.com/ https://revistaalimentaria.es/ https://www.foodbusinessnews.net/ https://www.foodengineeringmag.com/ https://www.foodnavigator.com/ https://www.tecnoalimen.com/