


	<b>PROCESO PARA EL DESARROLLO DE LAS ENSEÑANZAS DE LA ESCUELA DE INGENIERÍAS AGRARIAS</b>		 Escuela de Ingenierías Agrarias
		<b>CÓDIGO:</b> <b>P/CL009_D002</b>	

## PROGRAMME IN UNIT OPERATION IN FOOD INDUSTRY

**Academic course: 2023-2024**

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
<b>María Luisa Timón Andrada</b>	D 708 Valle del Jerte	mltimon@unex.es	
Field of knowledge	Food Technology		
Department	Animal Production and Food Science		
Coordinator (if there is more than one professor)			
Lessons and contents			
Syllabus			
<b>SECTION 1. INTRODUCTION</b>			
<b>Lesson 1. Basic Principles</b> 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			
<b>SECTION II. FLUID FLOW (MOMENTUM TRANSFER). UNIT OPERATIONS BASED ON MOMENTUM TRANSFER</b>			
<b>Lesson 2. Fluid: Basic Principles</b> Fluid statics and fluid dynamics. Continuous equation and Bernoulli equation.			
<b>Lesson 3. Fluid flow</b> Type of flow. Flow measurement and instrumentation			
<b>Lesson 4. Centrifugation</b> Centrifugal force. Separation of solid-liquid and immiscible liquids. Types of centrifuge. Applications in food industry			

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**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 stability 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**

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Practical lesson 6: **Distillation**

Monographic 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
<b>Assessment **</b>	9	2						7
<b>TOTAL</b>	150	37,5		20		2,5	7,5	82,5

L: Lectures (100 students)

HI: Hospital internships (7 students)

LAB: Laboratory or field practices (15 students)

COM: Computer room or language laboratory practices (30 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 \***

\*\* Indicate the total number of evaluation hours of this subject.

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### 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%).

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

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.

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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/>