

## UNIT OPERATIONS IN FOOD INDUSTRY

MODULE	CONTENT	YEAR	TERM	CREDITS	TYPE
Food Technology	Basics of Food Technology	2º	1º	6	Compulsory
LECTURER(S)			Postal address, telephone nº, e-mail address		
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DEGREE WITHIN WHICH THE SUBJECT IS TAUGHT					
Degree in Food Science and Technology					
PREREQUISITES and/or RECOMMENDATIONS (if necessary)					
Students should have passed the following subject: Basics of Food Engineering					
BRIEF ACCOUNT OF THE SUBJECT PROGRAMME (ACCORDING TO THE DEGREE ¿??)					
Rheology. Fluid mechanics. Heat transfer. Mass transfer.					
GENERAL AND PARTICULAR ABILITIES					
OBJECTIVES (EXPRESSED IN TERMS OF EXPECTED RESULTS OF THE TEACHING PROGRAMME)					
<ul style="list-style-type: none"> <li>Identify types of fluids from a rheological point of view and the rheological measures necessary.</li> <li>Resolve fluid flow systems employing conservation equations in different flow regimes.</li> <li>Calculate heat transfer systems, including heat exchangers, considering the mechanisms involved.</li> <li>Design, from mass transfer mechanisms, distillation and solid-liquid extraction operations.</li> </ul>					



## DETAILED SUBJECT SYLLABUS

### THEORETICAL TOPICS:

#### 1. Rheology

Rheological classification of fluids: newtonian fluids, non-newtonian fluids. Variables which influence on the rheological parameters. Rheological measures: rotational viscometers, tube viscometers.

#### 2. Fluids flow

Internal flow. Flow regimes. Velocity profiles. Conservation equations. Mechanical energy losses. Pumps. Flow rate measurement.

#### 3. Heat transfer

Heat transfer mechanisms: conduction, convection, radiation, combined mechanisms. Heat exchangers: overall heat transfer coefficient, types of heat exchangers, heat exchangers design.

#### 4. Mass transfer

Mass transfer mechanisms: diffusion, convection. Distillation: liquid-vapor equilibrium, simple distillation, rectification. Solid-liquid extraction: extraction equilibrium, single-stage extraction, multistage extraction.

### LABORATORY PRACTICES:

1. Tube and shell heat exchangers.
2. Friction losses through pipes and fittings.
3. Pump characteristic curve.
4. Viscosity measurement using Cannon-Fenske viscosimeter.

### READING

- Aguado J. y cols. Ingeniería de la Industria Alimentaria. Vol. I. Conceptos básicos. Ed. Síntesis, 1999.
- Rodríguez F. y cols. Ingeniería de la Industria Alimentaria. Vol. II. Operaciones de procesado de alimentos. Ed. Síntesis, 2002.
- Ibarz A. y Barbosa-Canovas G. Unit Operations in Food Engineering. Ed. CRC, 2002.
- Singh R.P. y Heldman R. Introduction to Food Engineering. Ed. Academic Press, 2009.

### RECOMMENDED INTERNET LINKS

- **Conversion units:** [http://www.thermexcel.com/english/tables/unit\\_con.htm](http://www.thermexcel.com/english/tables/unit_con.htm)
- **Properties of water and other fluids:** [http://www.engineersedge.com/fluid\\_flow/fluid\\_data.htm](http://www.engineersedge.com/fluid_flow/fluid_data.htm)
- **Tools for pump selection and performance**  
<http://www.pumpschool.com/intro/pd%20vs%20centrif.pdf>  
<http://impeller.net/spaix.asp?LGG=en>

