

## 30818 - Basic operations in the food industry

### Información del Plan Docente

Academic Year	2016/17
Academic center	105 - Facultad de Veterinaria
Degree	568 - Degree in Food Science and Technology
ECTS	6.0
Course	2
Period	Second semester
Subject Type	Compulsory
Module	---

### 1. Basic info

#### 1.1. Recommendations to take this course

#### 1.2. Activities and key dates for the course

### 2. Initiation

#### 2.1. Learning outcomes that define the subject

#### 2.2. Introduction

### 3. Context and competences

#### 3.1. Goals

#### 3.2. Context and meaning of the subject in the degree

#### 3.3. Competences

#### 3.4. Importance of learning outcomes

### 4. Evaluation

### 5. Activities and resources

#### 5.1. General methodological presentation

The learning process that is designed for this subject is based on ....

The course is divided into 44 lecture sessions of one hour each, 6 hours of seminars, and 10 hours of practices in laboratory and pilot plant, conducting individual practical work.

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Two-thirds of the lectures will be devoted to the exhibition of the most important theoretical aspects of each topic, and one-third to the resolution of questions and problems. Students will have beforehand the documentation about the theoretical aspects as well as the questions and problems that must be afforded in each topic. In addition, after an issue has been worked in class, new questions and problems will be proposed to the students as personal work. Solutions will be provided by the lecturer allowing the self-evaluation of the students.

Seminars will be organized with all the students attending the course divided in groups. They will consist of two sessions of three-hours each in which the resolution of practical questions and problems previously proposed to students will be discussed and rebutted in common.

The practices will consist of five sessions of 2 hours each in which students, distributed in groups, will put into operation, collect data and analyze the performance of different equipment. Prior to the implementation of practices, students will have information about the flowsheet of the installation to use, description of the data acquired during the development of practices and questions to answer after performing the practice.

### 5.2.Learning activities

- Lectures: 26 h to discuss the theoretical content
- Sessions of issues and problems: 18 h for the resolution of the exercises.
- Seminars: 6 h for the resolution, comment and sharing of case studies.
- Lab: 10 h distributed in five sessions of 2 hours each.
- Mentored practical work: 15 hours of autonomous work in which the student will work personally in the resolution of problems proposed by the lecturer which will guide the learning.
- Study: 71 h of autonomous work, not supervised by the lecturer.
- Exams: 4 h for the realization of two assessment tests (theoretical and practical).

### 5.3.Program

#### I. INTRODUCTION

##### *Item 1. Fundamental concepts.*

Food processing. Basic operations in the food processing industry. Principles on which basic operations are based. Transport phenomena in basic operations. Classification of basic operations: according to property being transported, according to the phases involved, according to their application. Types of contact between streams in a basic operations:

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simple, multiple, continuous, discontinuous, counter-current and co-current. Process flowsheets.

### II. UNIT OPERATIONS BASED ON MOMENTUM TRANSPORT

#### *Item 2. Characterization of solid particles. Fluidization and pneumatic transport.*

Particle shape. Particle size. Sieve analysis of granular or powdered food. Specific surface area, average size and number of particles of a heterogeneous mixture of particles. Fluidized beds. Minimum fluidization velocity. Terminal velocity. Fluidization applications in the food industry. Pneumatic transport.

#### *Item 3. Sedimentation and centrifugation.*

Gravitational sedimentation: free settling velocity. Hindered settling. Sedimentation equipment: discontinuous and continuous. Centrifugation: separation of immiscible liquids and solid-liquid separation. Types of centrifuges. Applications of sedimentation and centrifugation in the food industry.

#### *Item 4. Filtration.*

Theoretical principles. Filtration at constant pressure and at constant rate. Centrifugal filtration. Practical development of filtration: filter aids. Optimal capacity. Equipment for filtration. Applications in the food industry.

#### *Item 5. Operations with membranes.*

Definition of membrane and retention capacity of a membrane. Membrane types. Nature of the flow through membranes. Concentration polarization and strategies for its reduction. Cleaning. Design modules. Configuration process. Diafiltration. Applications in the food industry.

### III. UNIT OPERATIONS BASED ON HEAT TRANSFER

#### *Item 6. Heating and cooling.*

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Types of heat exchangers: double pipe, shell and tube, plate, and expanded scraped wall surface. Calculus of the heat transfer and efficiency.

### *Item 7. Evaporation.*

Introduction. Heat transfer in the evaporators: energy balance, boiling point rise, heat transfer coefficient. Methods of operation: single and multiple-effect evaporator (parallel and counter current). Other alternatives for greater energy efficiency.

### *Item 8. Refrigeration and freezing.*

Calculation of the cooling load. Calculation of freezing time: Planck equation and its limits.

## IV. UNIT OPERATIONS BASED ON MASS TRANSFER

### *Item 9. Distillation.*

Introduction. Vapor-liquid equilibrium of binary mixtures. Simple distillation of binary mixtures: batch distillation, flash distillation. Rectification of binary mixtures.

### *Item 10. Lixiviation.*

Extraction equilibrium. Extraction kinetics. Factors influencing extraction. Extraction stage and in several stages: simple contact, multiple contact direct current and counter current. Leaching equipment. Supercritical fluid extraction. Applications of leaching in the food industry.

## V. UNIT OPERATIONS BASED ON SIMULTANEOUS HEAT AND MASS TRANSFER

### *Item 11. Drying.*

Basic principles. Methods for drying food. Drying with hot air: psychrometric diagram and drying curves of a food. Material

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and energy balances in ideal drying.

### 5.4.Planning and scheduling

#### Schedule sessions and presentation of works

The dates and key milestones of the subject are described in detail, along with the other subjects in the second year in CTA Degree, on the website of the Faculty of Veterinary (link: <http://veterinaria.unizar.es/gradocta/>). This link will be updated at the beginning of every academic year.

### 5.5.Bibliography and recommended resources

Brennan, J.G.; Butters, J.R.; Cowell, N.D. y Lilly, A.E., "Las Operaciones en la Ingeniería de los Alimentos", 3ª ed. Acribia, Zaragoza, 1998.

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Coulson, J.M.; Richardson, J.F., y cols., "Ingeniería Química. Operaciones Básicas". Tomo II. 3ª ed. Reverté, Barcelona, 1981.

Coulson, J.M.; Richardson, J.F., y cols., "Ingeniería Química. Soluciones a los problemas del tomo II. Tomo V. 3ª ed. Reverté, Barcelona, 1982.

Fellows, P. "Tecnología del procesado de alimentos. Principios y prácticas". Acribia, 2ª ed, Zaragoza, 2007.

Ibarz, A.; Barbosa, G., "Operaciones Unitarias en la Ingeniería de Alimentos". Mundi-Prensa, Madrid. 2005.

Lewis, M.J., "Propiedades físicas de los alimentos y de los sistemas de procesado". Acribia, Zaragoza, 1993.

Rodríguez, F.(Ed.), Aguado, J., Calles, J.A., Cañizares, P., López, B., Santos, A., Serrano, D., "Ingeniería de la Industria Alimentaria". Vol II."Operaciones de procesado de alimentos" Vol. III. "Operaciones de conservación de alimentos". Editorial Síntesis, Madrid, 2002.

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Toledo, R.T., "Fundamentals of Food Process Engineering". Chapman and Hall, 2<sup>a</sup> ed., reimp., Nueva York, 1994.