

Course Unit	Unit operations	Field of study	Engineering and engineering trades
Bachelor in	Food Engineering	School	School of Agriculture
Academic Year	2025/2026	Year of study	1
Type	Semestral	Semester	2
Level	1-1	ECTS credits	6.0
Code	9087-641-1205-00-25		
Workload (hours)	162	Contact hours	T - TP - PL - TC - S - E - OT - O -

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) António Manuel Coelho Lino Peres, Elsa Cristina Dantas Ramalhosa

#### Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. Know the principles underlying the unitary operations associated with processes in food industry.
2. Recognize the equipment linked to different unitary operations.
3. Develop the equations for the unitary operation under study and calculate the procedural variables involved.

#### Prerequisites

Before the course unit the learner is expected to be able to:  
Solve problems that involve differential and integral calculus.

#### Course contents

A) Description of the main unitary operations (UOs) used in food processing. B) General principles of each UO. C) Equipment associated to the different UOs. D) Determination of the relevant design variables, of the design equations of the UO under study, and calculus of the procedural variables involved. E) Effects associated with the UO in food processing. F) Application of mathematical models to estimate/predict operating conditions of the most important processes in the food industry.

#### Course contents (extended version)

1. Introduction
  - Equipment's operating procedures.
  - Reaction kinetics: chemical, enzymatic, microbial growth.
  - Residence and mixing time.
  - Ideal mixture.
  - Ideal Reactors: types and mass balances.
  - Real Reactors: distribution of residence times (DTR) and its determination.
2. Mixture
  - Mixing of solids.
  - Mixing of liquids.
  - Equipment and effect on food quality.
3. Thermal processing operations
  - Bleaching.
  - Pasteurization.
  - Sterilization.
  - Refrigeration.
  - Freezing.
4. Drying
  - Relevance of process versus quality.
  - Drying times.
  - Psychrometry.
  - Calculation of rate and drying time.
5. Evaporation
  - Mass and energy balances.
  - Evaporators and operation modes.
6. Filtration
  - Effect of pressure and flow.
  - Equipment and filters.
  - Membrane separation.
7. Reference to centrifugation, sedimentation and decantation.
8. Reference to sieving and pressing.
9. Quick reference to other UOs: extrusion, frying, distillation, crystallization.

#### Recommended reading

1. Fellows, P. 2000. Food Processing Technology – Principles and Practice. Ellis Horwood.
2. Ramaswamy H, and Marcotte M. 2006. Food Processing Principles and Applications. CRC Press.
3. Ibarz A. and Barbosa Cánovas G. V. 2003. Unit Operations in Food Engineering. CRC Press.
4. Irudayaraj, J. 2002. Food Processing Operations Modeling. Design and Analysis. Marcel Dekker.
5. Singh RP, Heldman DR. 2001. Introduction to Food Engineering, . Academic Press.

#### Teaching and learning methods

Theoretical classes of exposition character to allow the acquisition of information about the fundamentals and principles underlying each unitary operation. Theoretical-practical and laboratory classes with consequent acquisition of practical skills in order to perform these operations. Study visit to a food company.

#### Assessment methods

1. Option I - (Regular, Student Worker) (Final, Supplementary, Special)
  - Intermediate Written Test - 60% (Mini-tests that approach the subjects taught. The last mini-test is performed in the Final Call)
  - Practical Work - 40% (Includes the reports of the practical works, exercises, and the report of the study visit)

**Assessment methods**

2. Option II - (Student Worker) (Final, Supplementary, Special)
  - Final Written Exam - 60% (Final exam that covers all the topics of the curricular unit)
  - Practical Work - 40% (Includes the reports of the practical works, exercises, and the report of the study visit)
3. Option III - (Student Worker) (Final, Supplementary, Special)
  - Final Written Exam - 100% (Final exam that covers all the topics of the curricular unit)

**Language of instruction**

1. Portuguese
2. Portuguese, with additional English support for foreign students.

**Electronic validation**

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21-01-2026	22-01-2026	24-01-2026	24-01-2026