



Code: ING-IND/25

Credits: 9

Course: Unit Operation in Food Industry

Main language of instruction: Italian

Other language of instruction: English

Teaching Staff

Head instructor

Prof. Marianna GALLO- marianna.gallo@unicusano.it

Introduction

1. Objective of the course :

The Unit Operations of the Food Industry course aims to give the student a good understanding of some of the Unit Operations that can be applied in the Food Industry. The course aims to provide the basic knowledge to be able to deal with the problems related to the main unitary operations in food processes and to introduce the basic concepts and some elements of calculation related to food processing and preservation. Hints of food chemistry and physics will be given, the different unit operations will be described giving hints of plant design and material and energy balances related to process flows.

Activity associated with the course develop the skills necessary to formulate food industry problems through the use of computational systems.

Objectives

2. Course Structure:

The Food Industry Unit Operations course has the following educational objectives:

1. To know the basics of Unit Operations;
2. To explain process analysis: Balances of Matter and Energy;
3. Illustrate, in particular, stabilization treatments (high T, low T, partial/total removal of water in food);
4. Illustrate the processes of mixing, transformation and separation;
5. Illustrate the conditioning process and the different types of Packaging.

Competencies:

A. Knowledge and understanding:

The student at the end of the Course will have demonstrated knowledge of the topics of food chemistry and physics, unit operations of size reduction, high-temperature stabilization, low-temperature stabilization and stabilization with water removal, mixing, processing and conditioning. In addition, the student will gain knowledge of the main design criteria of agri-food plants, application of design equations and sensitivity to the main control parameters. Finally, the student will acquire methods for the analysis of heat and matter balance processes. In addition, through E-tivity students will acquire the ability to apply theoretical concepts in practice with particular reference to process analysis and plant design of stabilization, mixing, processing and separation plants.

B. Applying knowledge and understanding:

The student will be able to use knowledge of Unit Operations to analyze them and to make a rough choice of suitable reactors for the purpose; students will also be able to implement simple design exercises. E-tivity involve the application of theoretical knowledge to practical problems to be solved.

C. Making judgements:

The student will be able to identify the most appropriate models for describing individual functional blocks of a food process, interpret plant specifications, and choose processes and act on key parameters most appropriate to the application.

D. Communication skills:

The student will be able to describe and sustain conversations about problems typical of the food industry and food systems plant engineering, correctly identifying relevant physical quantities, and using appropriate terminology.

E. Learning skills:

The student at the end of the Course will have knowledge of the fundamentals necessary for the analysis of food systems. All this will enable the student to pursue engineering studies with greater maturity and will provide the basis for learning what will be offered in specialized agribusiness courses, with particular reference to "plant" issues.



Syllabus

3. Programme of the course:

Subject 1 – Unit Operations and Food Properties

- Unit Operations
- Food chemistry
- Food physics
- Balances of matter and energy

Subject 2 – Unit Size Reduction Operation

- Unit Size Reduction Operation
- The Crushers
- The Mills
- The Cutting
- Rolling

Subject 3 - Unit Stabilization Operation

- Unit Stabilization Operation
- The High Temperature Stabilization
- Thermal Deactivation of Microorganisms
- The Low Temperature Stabilization [Refrigeration, Freezing and Deep Freezing]
- The Stabilization with Water Removal [Psychometry, Spray Dryer, Drum Dryer, Tunnel Dryer, Lyophilization, Concentration, Cryoconcentration, Membrane Concentration]

Subject 4 – Unit Mixing Operation

- Unit Mixing Operation
- Homogenization
- Kneading

Subject 5 – Unit Transformation Operation

- Unit Transformation Operation
- Gelatinization
- Fermentation

Subject 6 – Unit Separation Operation

- Unit Separation Operation
- Sedimentation
- Centrifugation



- Filtration
- Screening
- Distillation
- Extraction
- Crystallization

Subject 7 – Unit Conditioning Operation

- Unit Conditioning Operation
- Food Packaging

Evaluation system and criteria

The examination consists of a written test. This includes:

- 3 open-ended questions (1 numerical or theoretical exercise).

In addition, 4 E-tivities, consisting of numerical problems. These need to be sent to the instructor in advance of the examination. E-tivity counts a total of 4 marks.

Bibliography and resources

4. Materials to consult

Notes written by the instructor are available in Italian.

5. Recommended bibliography

Suggested readings are:

- R.P. Singh and D.R. Heldman *Introduction to Food Engineering, 3rd Edition*.Academy Press, 2001
- D. R. Heldman, D. B. Lund, C. Sabliov *Handbook of Food Engineering, Second Edition*. CRC Press, 2006
- L. Piergiovanni, S. Limbo, *“Food packaging”*, Springer-Verlag Italia, 2010.
- Cappelli P, Vannucchi V., *“Chimica degli alimenti – Conservazione e trasformazione”*. Zanichelli, 2016