UNICUSANO
ROME

Code: ING-IND/25 **Credits: 9**
Course: Food Industry Plants design
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 course in Food Industry Plant Design aims to provide the student with a good knowledge of the basic principles of plant design applied to the Agrifood Industry. The course aims to provide the basic knowledge to be able to deal with the problems related to the main problems of plant design found in the food industry and to introduce the basic concepts and some elements of calculation related to the design itself. Hints of matter, energy and momentum transport, necessary for the understanding of processes, will be given, design criteria will be deepened leading the student to acquire skills as a designer and verifier of new or existing plants.
Eactivities 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 Industries Plant Design course has the following educational objectives:

1. To know the basics of Design starting from CASE-STUDY
2. Illustrate process analysis: Transport of matter, heat and momentum
3. Illustrate, in particular, food stabilization systems (high T, low T, partial/total removal of contained water)
4. Illustrate the plants of mixing, processing and separation processes.

Competencies:

A. Knowledge and understanding:

The student at the end of the Course will have demonstrated knowledge of the topics of matter transport, energy and momentum, basic design principles of High Temperature Stabilization Plants, Low Temperature Stabilization and Stabilization with Water Removal, Mixing and Processing. In addition, the student will gain knowledge of the main design criteria of agri-food plants, the application of design equations and sensitivity to the main control parameters. Finally, the student will acquire methods for the analysis of thermal and matter transport processes. In addition, through Etivity students will acquire the ability to apply theoretical concepts in practice with particular reference to process analysis and plant design of stabilization, mixing and processing plants.

B. Applying knowledge and understanding:

The student will be able to use process knowledge for process analysis and for the rough selection of suitable reactors for the purpose; the student will also be able to implement simple design exercises. Etivity 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 to pursue engineering studies with greater maturity and will provide with the basis for being able to learn what will be offered in specialized agribusiness courses, with particular reference to the topics of "plant engineering".

Syllabus

3. *Programme of the course:*

Subject 1 – Plant Design and Process Analysis
- Plant Design
- Matter Transport Problems
- Energy Transport Problems
- Momentum Transport Problems

Subject 2 – The Pumps
- Pumps: Characteristics and Requirements
- The Centrifugal Pump
- The Volumetric Pumps

Subject 3 - Flow in Pipes
- Analysis of Flow: Laminar or Turbulent Flow
- Concentrated and Distributed Pressure Losses
- Valves

Subject 4 – Heat Exchangers
- Tube to Tube Exchangers
- Scraped Wall Exchangers
- Plate Exchangers
- Steam Injection

Subject 5 – Concentrators
- Single Effect Concentrators
- Double Effect Concentrators
- Multiple Effect Concentrators
- Membrane Concentration

Subject 6 – Mixing of Fluids
- Agitated Reactors
- Mixing Power
- Food Mixers

Subject 7 – Drying: Spray-dryer
- Spray-dryer design
- The Cyclones

- The Bag Filters

Subject 8 – Solid-Liquid Extraction

- Solid-Liquid Extraction
- Countercurrent Extraction
- Extraction with Supercritical Fluids
- Single-Stage Extraction
- Multiple-Stage Extraction

Evaluation system and criteria

The examination consists of a written test. This includes:

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

In addition, the E-tivity, 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:

- D. R. Heldman, D. B. Lund, C. Sabliov Handbook of Food Engineering, Second Edition. CRC Press, 2006
- George Saravacos, Athanasios E.Kostaropoulos Handbook of Food Processing Equipment, 2nd Edition. Springer.