

## **FST-211, Food Process Engineering 3(2-1)**

### **Educational Objectives:**

The course aims at providing students with the knowledge necessary for the interpretation and measurement of the phenomena on which the fundamental physical operations for the treatment of agricultural and food products are based. The course provides knowledge on the main unitary operations of food technology in terms of phenomenology, material and energy balances, kinetics, functional schemes of the main plants and optimization criteria. The course also aims to provide knowledge on mathematical relationships and models useful for solving numerical design and control problems. At the end of the course the students will know how to assess the suitability of plants and of the operating conditions of the treatments, define the conditions for optimization, and use proper technical language and terminology.

### **Course Outcomes:**

1. Define the basic technological and commercial aspect of the food processing industry.
2. Apply the latest engineering and scientific technology developments in food processing.
3. Critically reflect on the ethical and societal aspects of food processing.
4. Critically reflect the inter-relation between theory and practice in achieving unique innovations for the food industry.
5. Develop an understanding of key unit operations relevant to the food industry.

### **Course contents:**

- Introduction: Agricultural raw materials - physical, mechanical, thermal and rheological properties (stress, deformation, measurement of deformation, shear thickening, shear thinning etc.).
- Engineering approach in materials handling: Designing a material handling system and its analysis,
- equipment used in material handling (conveyers, pumps, their operation and efficiency, pipelines in industry and their construction).
- Mass and energy balances:
  - Basic concepts and calculations related to mass and energy balances.
  - Food processing wastes: Recycling of waste and waste treatment.

- Dough processing systems: Types of dough and dough mixers, sheeting and laminating of dough.
- Food packaging: Importance, environmental aspects, packaging materials and machinery.
- Extraction process of agricultural products:
- Oil seeds, fruits.
- Cost analysis: Engineering processes, finished products.

**Practical:**

- Determination of different type of storage environment conditions for agricultural raw materials.
- Maintenance and operation of the equipment used for engineering processes – refrigerant units, heat exchangers.
- Determination of depression in freezing point, surface tension and absolute viscosity of given fluids.
- Determination of freezing time for food products using Plank's equation. Verification of Stokes law.
- Selection of pumps and fans using characteristic curves.
- Determination of thermal conductivity of food materials.
- Determination of overall heat transfer coefficient of shell and tube heat exchangers.
- Calculation of thermal process time of foods packed in containers.
- Visit to cold stores and freezing units.

**Recommended Books:**

1. Theodoros Varzakas; Constantina Tzia, 2014, Food engineering handbook: food process engineering, CRC, Taylor and Francis.
2. Goyal, Megh Raj; Meghwal, Murlidhar, 2017, Food process engineering: emerging trends in research and applications, Apple academic press.
3. Romeo T. Toledo & Rakesh K. Singh & Fanbin Kong, 2018, Fundamentals of food process engineering, Springer International Publishing.
4. F. Xavier Malcata, 2020, Food process engineering: safety assurance and complements