POSTHARVEST ENGINEERING

ENAE 305

Lecture : 3 **Year : III**
Tutorial : 1 **Part : I**
Practical : 2

Course Objectives:
The objective of this course is to familiarize students with the principles of processing and handling of cereals, pulses, oilseeds, fruits, vegetables, and animal products. It also aims to equip students to apply appropriate unit operations, equipment, and design considerations for efficient and sustainable processing in food industries.

1 Food Processing (4 hours)

1.1 Scope and importance of food processing
1.2 Principles and methods of food processing
1.3 Processing of farm crops: Cereals, pulses, oil seeds
1.4 Fruits and vegetables processing and their products for food and feed
1.5 Processing of meat, poultry, eggs, fish, and their products

2 Cleaning and Grading (4 hours)

2.1 Principles of cleaning, sorting and grading
2.2 Screens, different types of screen separators
2.3 Capacity and effectiveness of screens
2.4 Sieve analysis, fineness modulus

3 Size Reduction (6 hours)

3.1 Principle of size reduction
3.2 Grain shape
3.3 Size reduction machines
3.4 Crushers, grinders and cutting machines
3.5 Milling: Modern rice milling; Huller, sheller, polisher
3.6 Flour milling: Steam conditioning
3.7 Operation, efficiency and power requirement for size reduction
3.8 Rittinger's, Kick's and Bond's equation of size reduction

4 Mixing (4 hours)

4.1 Principle of Theory of mixing (Solid and liquid)
4.2 Types of mixtures for dry and paste materials
4.3 Rate of mixing and power requirement
4.4 Mixing indices, its importance and applications

5 Separation (4 hours)

5.1 Theory of separation
5.2 Mechanical, electrostatic and pneumatic separation
5.3 Types of separators: Specific gravity, magnetic, disc, spiral, pneumatic, inclined belt draper, velvet roll, color sorter, cyclone

6 Filtration (4 hours)

6.1 Theory of filtration
6.2 Types of filters (Batch and continuous)
6.3 Rate of filtration; Constant pressure and constant rate filtration
6.4 Pressure drops during filtration

7 Material Handling (7 hours)

7.1 Scope and importance of material handling devices
7.2 Types of material handling systems
7.3 Belt, chain and screw conveyor
7.4 Bucket elevator, trajectory of particles
7.5 Pneumatic conveying mechanism
7.6 Design considerations of various material handling devices
7.7 Capacity and power requirement

8 Moisture Content (4 hours)

8.1 Importance and applications moisture in processing
8.2 Types of moistures in food
8.3 Methods for determination
8.4 Importance and applications of equilibrium moisture content (EMC)
8.5 Methods of its determination
8.6 EMC curve and EMC model; Water activity

9 Drying (4 hours)

9.1 Theory of drying
9.2 Mechanism of thin layer drying
9.3 Critical moisture contents, falling rate and constant rate periods
9.4 Deep bed drying and their analysis
9.5 Shred's and Hukill's curve, drying models
9.6 Methods of grain drying
9.7 Types of dryers, performance and energy utilization pattern

10 Storage (4 hours)

10.1 Types and causes of spoilage in storage
10.2 Control of temperature and RH inside storage
10.3 Modified and controlled atmospheric storage and control of its environment

10.4 Moisture and temperature changes in stored grains
10.5 Grain storage structures: Bukhari; Morai; Kothar; Silo; Bins; Warehouses
10.6 Design of bulk and baggage storage structures
10.7 Economic aspects of storage

Tutorial **(15 hours)**

1. Equipment operation for meat, poultry, egg, and fish processing
2. Calculation of operation efficiency and power requirements for size reduction processes
3. Application of Rittinger's, Kick's, and Bond's equations to predict energy consumption in size reduction
4. Determination of the rate of mixing and power requirement for solid and liquid mixtures
5. Analysis of types of separators and their performance in food processing
6. Operation, capacity, and design of belt, chain, and screw conveyors
7. Calculation of particle trajectory of bucket elevators
8. Calculation of capacity and power requirements of material handling devices
9. Determination of moisture content in food materials using standard methods
10. Evaluation of types of dryers, their performance, and energy utilization
11. Study of grain storage structures and methods for environmental control
12. Design of bulk and baggage storage structures with economic and structural considerations

Practical **(30 hours)**

1. Preparation of flow and layout charts of a food processing plant
2. Determination of fineness modulus and uniformity index
3. Performance evaluation of hammer mill
4. Performance evaluation of attrition mill
5. Study of cleaning equipment's
6. Separation behavior in pneumatic separation
7. Mixing index and study of mixers
8. Study of conveying equipment's
9. Performance evaluation of bucket elevator
10. Drying characteristic and determination of drying constant
11. Determination of moisture content, EMC and ERH
12. Visual presentation and observation of a modern rice mill/food process industry and submission of a detailed report with working principle, equipment drawing, procedure and efficiency of the equipment

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks distribution*
1	4	4
2	4	4
3	6	10
4	4	5
5	4	4
6	4	4
7	7	10
8	4	6
9	4	7
10	4	6
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Fellows, P. (2016). Food processing technology: Principles and practice. Woodhead Publishing
2. Sahay, K.M., Singh, K.K. (2004). Unit operations of agricultural processing (Latest Edition). Vikas Publishing House.
3. Brennan, J.G., Butters, J.R., Cowell, N.D., Lilly, A.E.V. (1990). Food engineering operations (Latest Edition). Elsevier Applied Science.
4. Earle, R.L. (1983). Unit operations in food processing (Latest Edition). Pergamon Press..
5. McCabe, W.L., Smith, J.C. (2004). Unit operations of chemical engineering (Latest Edition). McGraw-Hill.
6. Geankoplis, C. J. (1993). Transport processes and unit operations (Latest Edition). Allyn and Bacon.