



IX. List of Practicals

S.No.	Topic	No. of Practicals
1.	Conducting experiments and solving problems on mixing and mixing indices.	2
2.	To conduct the experiment on homogenization.	2
3.	To study the process of crystallization.	1
4.	To conduct the experiment on extraction.	2
5.	Experimentation on leaching process.	1
6.	To study the membrane separation process.	1
7.	To conduct the experiment on reverse osmosis technique.	1
8.	To conduct the experiment on ultrafilteraion process.	1
9.	Design of plate and packed tower.	2
10.	Visit to related food industry.	2
	Total	15

X. Suggested Reading

- Brennan JG, Butters JR, Cowell ND and Lilly AEI 1990. *Food Engineering Operations*. Elsevier.
- Earle RL. 1985. *Unit Operations in Food Processing*. Pergamon Press.
- Fellows P. 1988. *Food Processing Technology: Principle and Practice*. VCH Publisher.
- Geankoplis JC. 1999. *Transport Process and Unit Operations*. Allyn & Bacon.
- Gould GW. 1996. *New Methods of Food Preservation*. Blackie Academic & Professional.
- Heldman DR and Lund BD. 1992. *Hand Book of Food Engineering*. Marcel Dekker.
- McCabe WL and Smith JC. 1999. *Unit Operations of Chemical Engineering*. McGraw Hill.
- Sahay KM and Singh KK. 1994. *Unit Operation of Agricultural Processing*. Vikas Publ. House.
- Singh RP 1991. *Fundamentals of Food Process Engineering*. AVI Publisher.
- Singh RP and Heldman DR 1993. *Introduction to Food Engineering*. Academic Press.

I. Course Title : Food Processing Equipment and Plant Design

II. Course Code : PFE 511

III. Credit Hours : 1+1

IV. Aim of the course

To acquaint and equip the students with the design features of different food processing equipment being used in the industries along with the layout, planning of different food processing plants.

V. Theory

Unit I

Design considerations of processing agricultural and food products.

Unit II

Design of machinery for drying, milling, separation, grinding, mixing, evaporation, condensation, membrane separation.

Unit III

Human factors in design, selection of materials of construction and standard component, design standards and testing standards. Plant design concepts and general design considerations: Plant location, location factors and their interaction with plant location, location theory models, and computer aided selection of the location.

Unit IV

Feasibility analysis and preparation of feasibility report; Plant size, factors affecting plant size and their interactions, estimation of break-even and economic plant size. Product and process design, process selection, process flow charts, computer aided development of flow charts.

Unit V

Hygienic design aspects and worker's safety, functional design of plant building and selection of building materials, estimation of capital investment, analysis of plant costs and profitability's, management techniques in plant design including applications of network analysis, preparation of project report and its appraisal.

VI. Practical

Detailed design and drawing of mechanical dryers, milling equipment, separators, evaporators, mixers and separators. Each individual student will be asked to select a food processing plant system and develop a plant design report which shall include product identification and selection, site selection, estimation of plant size, process and equipment selection, process flow-sheeting, plant layout, and its evaluation and profitability analysis.

VII. Learning outcome

Student's capability to deal with food processing equipment and plant, techno-economic feasibility analysis of the project as needed in food industries.

VIII. Lecture Schedule

S.No.	Toic	No. of Lectures
1.	Design considerations of processing agricultural and food products.	
	Plant design concepts - situations giving rise to plant design problems.	2
2.	General design considerations, Food Processing Unit Operations,	
	Design of machinery for drying, milling and grinding	2
3.	Design principles of separation, mixing machines	1
4.	Design of evaporation, condensation, membrane separation machines	2
5.	Human factors in design, selection of materials of construction and standard component	1
6.	Design standards and testing standards	1
7.	Plant location, location factors and their interaction with plant location, location theory models, and computer aided selection of the location.	2
8.	Pre Selection/ Pre feasibility stage, Analysis Stage: Market Analysis, Situational analysis related to market	1
9.	Technical analysis, Financial Analysis, Sensitivity and risk analysis, Feasibility cost estimates	1
10.	Break Even Analysis: Introduction, Break-Even Chart, Fixed Costs, Variable costs, Breakeven point calculation	1
11.	Product and process design, process selection, process flow charts, computer aided development of flow charts.	1
12.	Hygienic design aspects and worker's safety, functional design of plant building and selection of building materials	1
13.	Estimation of capital investment, analysis of plant costs and profitability's. Management techniques in plant design including applications of network analysis. Project report and its appraisal.	2
	Total	18



IX. List of Practicals

S.No.	Topic	No. of Practicals
1.	Detailed design and drawing of mechanical dryers	2
2.	Detailed design and drawing of milling equipment	2
3.	Design of separators	2
4.	Design of evaporators	2
5.	Design of mixers and separators	2
6.	Project report preparation by students. (Individual student will select a processing plant, develop design report include product identification, site selection, estimation of plant size, process and equipment, process flow-sheeting, plant layout, its evaluation and profitability analysis)	5
	Total	15

X. Suggested Reading

- Antonio LG and Gustavo VBC. 2005. *Food Plant Design*. CRC Press.
- Couper. 2012. *Chemical Process Equipment*. Selection and Design Elsevier.
- George S and Athanasios EK. 2015. *Handbook of Food Processing Equipment*. Springer.
- Lloyd EB and Edwin HY. 1959. *Process Equipment Design*. Wiley-Interscience.
- Michael MC. 2013. *Food Plant Sanitation: Design, Maintenance, and Good Manufacturing Practices*. CRC Press.

I. Course Title : Seed Process Engineering

II. Course Code : PFE 512

III. Credit Hours : 1+1

IV. Aim of the course

To acquaint and equip the students with seed processing along with the design features of the equipment used in their processing.

V. Theory

Unit I

Processing of different seeds and their engineering properties, principles and importance of seed processing.

Unit II

Performance characteristics of different unit operations such as precleaning, grading, conveying, elevating, drying, treating, blending, packaging and storage, seed processing machines like scalper, debreader, huller, velvet separator, spiral separator, cleaner-cum-grader, specific gravity separator, indent cylinder, disc separator, and colour sorter, seed treater, weighing and bagging machines, their operation and maintenance, installation and determination of their capacity, seed quality maintenance during processing, plant design and layout, economy and safety consideration in plant design.

Unit III

Seed drying principles and methods, theory of seed drying, introduction to different types of heated air dryers, significance of moisture equilibrium, method of maintaining safe seed moisture, thumb rule and its relevance.