

17FT003 UNIT OPERATIONS IN FOOD PROCESSING ENGINEERING

Hours Per Week :

L	T	P	C
3	-	3	5

Total Hours :

L	T	P	WARA	SSH/HSB	CS	SA	S	BS
45	-	45	15	30	-	5	5	-

Course Description and Objectives:

- To understand the principle involved in food processing engineering
- To the principle and working of various processing equipments
- To know the methods of product recovery

Course Outcomes:

Upon successful completion of this course student should be able to:

- The students understand the operation of equipment
- The students know various factors affecting food processing equipments
- The students learn to select suitable processing equipment

SKILLS:

- ✓ Perform cumulative and differential particle size analysis
- ✓ Identify the suitable mixer required for mixing cohesive and non-cohesive solids
- ✓ Recognize the required specifications of the size reduction equipment for a given feed
- ✓ Identify the filtration equipment required for a specific application.
- ✓ Compare the efficiency of separation, size reduction, mixing and drying equipments

UNIT – I

Principles of fluid flow : Basic engineering mathematics - UNITS and dimension-conservation of mass and energy – principles of fluid flow – properties of liquids, fluid dynamics - mass and energy balance- potential energy, kinetic energy, pressure energy, friction loss, mechanical energy, Newtonian and non – Newtonian fluids-stream line and turbulent flow - flow measurement and measurement of viscosity.

UNIT – II

Evaporation and distillation : Blanching, pasteurization-LTLT, HTST and UHT process- evaporation – definition-single and multiple effect evaporator – mass and enthalpy balance – liquid characteristics – single and multiple effect evaporation-performance of evaporators and boiling point elevation – capacity – economy and heat balance-types of evaporators –short tube evaporators and long tube evaporators– agitated film evaporator- distillation - methods – flash distillation and differential distillation – steam distillation - distillation with Reflux and McCabe – Thiele method- Raleigh equation fractional distillation -steam requirements in food processing industries.

UNIT – III

Separation process : Sedimentation – gravitational sedimentation - Stoke's law - sedimentation of particles in fluids - cyclones – settling under sedimentation and gravitational sedimentation-centrifugal separations – rate of separations – liquid – liquid separation – centrifuge equipment - filtration –filter media – types and requirements-constant rate filtration – constant pressure filtration – filter cake resistance filtration equipment – rotary vacuum filter – filter press - membrane technology- classification – dialysis -gas permeation membrane process – types of membrane – equipments-Reverse osmosis membrane process – flux equation –ultra filtration membrane process – fluid equation – effects of processing variables filtration.

UNIT – IV

Contact equilibrium process : Concentrations - gas/liquid equilibria, solid/ liquid equilibria,- equilibrium concentration relationships - operating conditions- applications - gas absorption- rate of gas absorption- properties of tower packing – types – construction – flow through packed towers - extraction and washing – extraction equipments- washing – equipments and equilibrium diagram - equipment for leaching coarse solids – intermediate solids – crystallization - rate of crystal growth-crystallization equipments.

UNIT – V

Material handling, size reduction and mixing : Material handling equipments screw conveyor, bucket elevator, belt conveyor, chain conveyor, pneumatic conveyor-size reduction process- energy and power requirements in comminuting- Rittinger's, Bond's and Kick's laws of crushing - principles of milling equipments - hammer mill, attrition mill- pin mill, ball mill - homogenization principles - mixing – types of mixers –kneaders and blenders - gas liquid mixing – liquid solid mixing – applications – food plant layout and design - concepts- food plant hygiene - cleaning sterilizing waste disposal methods – food packaging – functions, technique - machinery and equipment.

ACTIVITY:

- Evaluation of efficiency of drying for various fruits and vegetables using different dryers.

FOOD PROCESSING ENGINEERING LAB

List of Experiments

1. Experiment on minimal processing of fruits and vegetables
2. Experiment on microwave heating of food materials
3. Experiments on vacuum dryer
4. Experiments on freeze dryer
5. Experiments on extrusion cooking of foods
6. Experiments on value addition by flaking
7. Experiment on osmotic dehydration of fruits
8. Experiment on canning of fruits and vegetables
9. Experiment on freeze drying of fruits
10. Visit to cold storage
11. Manufacture of fruit squashes, RTS beverages
12. Experiment on irradiation of potatoes
13. Visit to fruit/vegetable processing UNIT
14. Experiment on vacuum packaging of fruits
15. Experiment on vacuum packaging of meat and meat products
16. Experiment on vacuum packaging of vegetables
17. Determination of tensile strength and elongation of packaging materials
18. Determination of water absorption of packaging materials
19. Experiments on modified atmospheric storage of fruits and vegetables
20. Experiment on packaging of powdered materials and oils using FFS machines
21. Visit to food industries and familiarize with packaging operations

TEXT BOOKS:

1. Bird R. Byron, Warren E. Stewart and Edwin N. Lightfoot. 2006. Transport Phenomena. Wiley India Pvt. Ltd., New Delhi
2. Earle, R.L. 1985. UNIT Operations in Food Processing. Pergamon Press. London.
3. Geankoplis J. Christie. 1999. Transport Process and UNIT Operations. Third Edition, Prentice Hall of India, New Delhi.

REFERENCE BOOKS:

1. Albert Ibarz, Gustavo V. Barbosa – Canovas, “UNIT Operations in Food Engineering”. 2nd Edition, Taylor & Francis, 2014.
2. Smith, PG. Introduction to food process engineering, 2nd edition, Springer 2011.
3. Chapman & Hall. USA, CBS publications New Delhi, 2007.