



# GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3161403

## FOOD ENGINEERING OPERATIONS - II

### VI<sup>th</sup> SEMESTER

**Type of course:** Professional Elective Course

**Prerequisite:** Nil

**Rationale:**

Food engineering operations-II is a multidisciplinary field of applied physical sciences, which combines science, microbiology, and engineering education for food and related industries. This subject presents a comprehensive treatise of all normally used food engineering operations that are employed or applied for separation (Distillation, Leaching, Extraction and Filtration), preservation (Pasteurization, Sterilization) or conversion (Drying, Crystallization) purposes in the Food industry.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

S.No	Topics	Teaching Hrs	Module Weightage
1.	<b>Pasteurization and Sterilization:</b> Introduction, Holding Method, High Temperature Short Time Pasteurization, Bottle Sterilization, UHT Processing, Direct Heating (Injection System Type), Fouling of Heat Exchanger and De-scaling.	9	23
2.	<b>Centrifugation and Homogenization:</b> Homogenization, Technical Execution, Efficiency of Homogenization, Operation and Maintenance, Centrifugation, Stokes Law Clarifiers and Separators, Centrifugal Separators, Efficiency of Separation, Flow Rate, Power Requirement, Construction of Separator, Bactofuge Treatment	6	16
3.	<b>Distillation:</b> Introduction, Flash distillation, Batch distillation Continuous distillation with reflux.	8	21
4.	<b>Leaching and Extraction:</b> Principle of leaching and its equipment, Principle of extraction and its equipment	6	16
5.	<b>Crystallization:</b> Equilibria and yields, Nucleation, Crystal growth, Crystallization equipments	3	8
6.	<b>Filtration:</b> Centrifugal filters, Filter media, Filter aids, Principle of cake filtration	3	8
7.	<b>Freezers And Freeze Drying:</b> Ice Cream Freezer, batch freezer and continuous Freezer, Ammonia and Freon Freezers, operation and trouble shooting, Material of construction, Booster pumps.	3	8

**Suggested Specification table with Marks (Theory):**



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Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
19	18	20	21	22	0

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

## Reference Books:

1. Unit operations of chemical engineering by McCabe and Smith. McGraw-Hill
2. Chemical engineering handbook by Perry RH. McGraw-Hill
3. Dairy plant engineering and management by Tufail Ahmad, Kitab Mahal Publications
4. Engineering for dairy and food product by Farrall AW. John Wiley and Sons
5. Milk Pasteurization by Hall CW. The AVI Publication
6. Introduction to Chemical Engineering By Salil K Ghosal, Shyamal K Sanyal, Siddhartha Datta, Tata Mcgraw Hill

## Course Outcome:

At the end of this module, the student will be able to:

Sr. No.	CO statement	Weightage (%)
CO-1	Understand the concept of thermal processing such as pasteurization and sterilization	10
CO-2	Understand the centrifugation and homogenization and apply in relevant food industry.	10
CO-3	Conceptualize the distillation and the calculation related to design of distillation unit.	20
CO-4	Understand the unit operations such as extraction, leaching, extraction, filtration and its application in food industry.	25
CO-5	Understand the concepts of freezing and different freezing equipments used in food industry.	20
CO-6	Comprehend the engineering principles and operations used in food processing industry.	15

## List of Experiments:

1. To determine the adequacy of pasteurization.
2. To determine the adequacy of sterilization.
3. To study the process of gravitational sedimentation and to determine rate of sedimentation of suspended solids.
4. To study constructional details of a centrifugal disc type cream separator.
5. To study leaching process in beetroot.
6. Predicting freezing times in foods by using Planck's equation.
7. To determine the influence of changing the transport and distribution time on the quality of food.
8. To study and perform the crystallization process.
9. To study about energy of activation of vitamin degradation during food storage.



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10. To study about constructional details of cyclone centrifugal separator. To calculate limiting diameter of particle.

## Major Equipments & Instruments

- a. Agitated vessel
- b. Shell & tube heat exchanger
- c. Single effect vertical tube evaporator
- d. Sieve shaker
- e. Fresh fruit & vegetable handling plant
- f. Weighing balance
- g. Digital calliper

## List of Open Source Software/learning website:

1. <http://foodscience.uark.edu/>
2. <http://rpaulsingh.com/lectures/lecturelist.html>
3. [http://rpaulsingh.com/animations/animations\\_master.html](http://rpaulsingh.com/animations/animations_master.html)
4. [http://rpaulsingh.com/learning/videos/video\\_top.html](http://rpaulsingh.com/learning/videos/video_top.html)
5. [http://www.bbc.co.uk/bitesize/ks3/science/chemical\\_material\\_behaviour/compounds\\_mixtures/revision/9/](http://www.bbc.co.uk/bitesize/ks3/science/chemical_material_behaviour/compounds_mixtures/revision/9/)
6. <http://www.britannica.com/EBchecked/topic/108875/separation-and-purification>