



# GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering (Food Processing Technology)

Subject Code: 3141407

Food Drying and Dehydration

4<sup>th</sup> SEMESTER

**Type of course:** Food Processing Technology

**Prerequisite:** Nil

## Rationale

1. Food Drying is study of moisture removal process for food preservation.
2. It includes moisture content in foods, its determination, Equilibrium moisture content and its importance.
3. Various dryers with their basic construction and applications.
4. It also includes quality of dried products classifications and selection of dryers, novel drying technology.

## Teaching and Examination Scheme

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

## Course Content

Sr. No.	Topics	Teaching Hours
1	<b>Introduction:</b> Drying definition, Moisture removal and its need, Dehydration of food, Utilities of drying, Theoretical aspects of drying, Thermal properties related to drying of foods.	5
2	<b>Food Moisture:</b> Moisture content measurement, representation and determination, Equilibrium moisture content (EMC), its determination, methods, models and importance, Moisture sorption curves, Hysteresis phenomenon.	5
3	<b>Drying theory and mechanisms:</b> Drying process and methods, Drying rate periods – constant and falling rate periods and their calculation, Capillary and diffusion theory, Thin layer and deep bed drying, Dryer performance indices – overall thermal efficiency, specific energy consumption, coefficient of performance.	8
4	<b>Classification and selection of dryers:</b> Classification and selection, Quality criteria for dryer selection.	4
5	<b>Types of dryers and their applications:</b> Basic construction and application of the following dryers –Tray dryers, Vacuum dryers, Spray dryers, Fluidized bed dryers, Freeze dryers, Flash Dryers, Super-heated steam drying, Solar energy based dryers, Osmotic Dehydration, Drum dryer.	6



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6	<b>Dryer design:</b> Basic design steps and calculations – Tray dryer	3
7	<b>Properties of dried products:</b> Physical, Chemical and Microbiological characteristics of dehydrated foods, Re-hydration ratio, size and density, shelf-life, water activity.	4
8	<b>Emerging Trends in Drying Technologies:</b> Novel drying techniques, Hybrid dryers, Energy and environment conservation.	4

## Suggested Specification table with Marks (Theory)

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level
26%	25%	21%	15%	13%

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate 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. Drying of Foods, Vegetables and Fruits (Volume 1), Sachin V. Jangam, Chung Lim Law and Arun S. Mujumdar.
3. Drying Technologies for Foods: Fundamentals and Applications, Prabhat K. Nema, Barjinder Pal Kaur, Arun S. Mujumdar, CRC Press, 2018
4. Handbook of Industrial Drying, Edited By Arun S. Mujumda, CRC Press, 2006
5. Hand Book Of Food Dehydration & Drying, by Eiri Board, Published by Engineers India Research Institute (2008)
6. Drying and Dehydration of Foods Paperback by Harry W. Von Loesecke, Delany Pres, 2012

## Course Outcomes and Weightage of Marks

At the end of this syllabus students will be able to:

CO's	CO Statements	% Marks Wightage
CO-1	Understand moisture content, moisture removal and its requirement.	15
CO-2	Understand moisture content measurement and thermal properties related to drying.	15
CO-3	Understand drying mechanism for foods.	20
CO-4	Select suitable dryer meeting requirement.	13
CO-5	Develop functional design of dryers.	15
CO-6	Judge quality of dried product.	10
CO-7	Understand novel and hybrid drying technology.	12

## List of Practicals

1. To measure thermal properties of food product
2. EMC determination of grains
3. Determination of drying rate characteristics
4. Evaluate performance of tray dryer



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5. Evaluate dehydration and rehydration of food product
6. Evaluate spray drying performance
7. Study of solar drying
8. Study of freeze drying process
9. Study of quality changes during drying of food materials
10. Study of LSU type grain dryer
11. Evaluate performance of vacuum dryer

### Major Equipments

1. Tray dryer
2. Vacuum dryer
3. Hot air oven
4. Weighing balance
5. Microwave oven
6. Solar dryer
7. Moisture meters
8. Freeze dryer
9. Infrared dryer

### List of open source software/learning websites

- a. [http://www.aces.uiuc.edu/vista/html\\_pubs/DRYING/dryfood.html](http://www.aces.uiuc.edu/vista/html_pubs/DRYING/dryfood.html)
- b. <http://nchfp.uga.edu/how/dry.html>
- c. <http://www.britannica.com/EBchecked/topic/172410/drying-process>
- d. [http://science.utcc.ac.th/lecturer/muanmai/AITdownload/Ch5\\_moisture&drying.ppt](http://science.utcc.ac.th/lecturer/muanmai/AITdownload/Ch5_moisture&drying.ppt)