

GUJARAT TECHNOLOGICAL UNIVERSITY

FOOD PROCESSING & TECHNOLOGY (14)

FOOD DRYING & DEHYDRATION

SUBJECT CODE: 2141407

B.E. 4th 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			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
PA	ALA	ESE		OEP						
3	0	2	6	70	20	10	20	10	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Introduction: Drying definition, Moisture removal and its need, Dehydration of food, Evaporation of water below its boiling point, Utilities of drying, Theoretical aspects of drying, Thermal properties related to drying of foods.	7	15
2	Food Moisture: Moisture content measurement, representation and determination, Equilibrium moisture content (EMC), its determination, methods, models and importance, and importance, Moisture sorption curves, Hysteresis phenomenon.	7	15
3	Drying theory and mechanisms: Drying process and methods, Drying rate periods – constant and falling rate periods and their calculation, Heat and mass transfer coefficient calculations, Capillary and diffusion theory, Thin layer and deep bed drying, Dryer performance indices – overall thermal efficiency, specific energy consumption, coefficient of performance.	10	12
4	Classification and selection of dryers: Classification and selection, Quality criteria for dryer selection.	4	12
5	Types of dryers and their applications: Basic construction and application of the following dryers – Grain 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.	10	14

6	Dryer design: Basic design steps and calculations – Tray dryer, Vacuum dryer, Freeze dryer, fluidized bed dryer.	6	10
7	Properties of dried products: Physical, Chemical and Microbiological characteristics of dehydrated foods, Re-hydration ratio, size and density, shelf-life, water activity, Microbial stability of selected foods.	5	12
8	Emerging Trends in Drying Technologies: Novel drying techniques, Hybrid dryers, Energy and environment conservation.	4	10

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. 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 Outcomes:

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

- a. Understand moisture content, moisture removal and its requirement.
- b. Understand moisture content measurement and thermal properties related to drying.
- c. Understand drying mechanism.
- d. Can select suitable dryer meeting requirement.
- e. Can develop functional design of dryers.
- f. Can judge quality of dried product.
- g. Understand novel and hybrid drying technology

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
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

Open Ended Problems:

The topics taught in this subject would be useful to develop insight and application based knowledge among students.

Design of dryer to meet the requirement of drying of a given product with required drying qualities.

Collection of drying requirement and select drying method. What are the components of a selected dryer?

Design various components considering capacity and size of dryer. Design component like heating system, blower size, conveyor capacity, air flow rate, temperature of hot air, etc

Major Equipments

1. Tray dryer
2. Vacuum dryer
3. Hot air oven
4. Weighing balance
5. Microwave oven
6. Solar dryer

List of open source software/learning websites:

- a. 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

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.