GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3151404

Food Engineering Operations – I

5thSEMESTER

Type of course: Food Processing Technology

Prerequisite: Nil

Rationale: This subject includes broad categories of unit operation like drying, particle size reduction/separation, Study properties of Grains, Storage and material handling Equipments.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction:** Structure and composition of food grains, Engineering properties of agricultural materials, Physical properties, Mechanical properties, Thermal properties, Rheological properties.	6	17
2	**Cleaning, Grading and Separation:** Screening, Types of screens, Grizzly, Revolving screen, Shaking screen, Rotary screen, Vibratory screen, Horizontal screen, Perforated metal screen, Wire-mesh screen, Ideal and actual screen, Effectiveness of screen, Airscreen cleaners, Screen analysis, Fineness modules, Crushing efficiency, Size reduction procedures, Grading- Size grading, Colour grading, Specific gravity grading, Magnetic separation, Energy requirements in size reduction.	14	23
3	**Heat and Mass Transfer:** Heat Transfer: Law of conduction, Steady and unsteady state conduction, Natural convection, Forced convection in laminar and turbulent flow, Emission of radiation, Combined heat transfer by conduction, Convection and radiation, Mass transfer: Theory of diffusion, Prediction of diffusivities, Mass transfer theories- Film theory, Boundary layer theory, Two film theory, Mass transfer coefficients, Transport phenomena, Finite element techniques and molecular transport in gas, Solids and liquid.	15	25
4	**Storage:** Direct damages, Indirect damages, Sources of infestation, Traditional storage structures, Improved storage structures, Modern storage structures, Storage of agricultural perishables, Controlled and modified atmospheric storage, Sources of infestation and control.	9	22
5	**Material Handling:** Belt conveyors, Belt tension, Bucket Elevator, Screw conveyor, Drive mechanism, Pneumatic and hydraulic conveying systems.	5	13

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
19	**16**	**22**	**23**	**20**	**-**

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 Agricultural Processing by Sahay K.M. and Singh K.K., Vikas PublishingHouse.
2. Physical Properties of Plant and Animal Products by Mohsenin N.N., Gordon andBreach.
3. Unit operations of chemical engineering by McCabe and Smith,McGraw-Hill.
4. Introduction to Food Engineering, 3rd Edition, R Paul Singh, Dennis R Heldman, Academic Press,USA.
5. Food Processing Technology: Principles and Practice, by P J Fellows, Woodhead Publishing Limited, CambridgeEngland

Course Outcome:

After learning the course the students should be able to:

1. Understanding of the engineering properties of food materials
2. Ability to understand different types of cleaning, grading, separation and size reduction equipment.
3. Understand heat and mass transfer in food.
4. Understand different storage structure for food grains
5. Understand the material handling equipments for food.
6. Ability to identify, formulate, and solve engineeringproblems

List of Experiments:

1. Determination of size and sphericity of agricultural materialsgiven
2. Determination of bulk density of differentmaterials
3. Determination of dynamic angle of repose of givengrains
4. Determination of the rate of drying for given foodproduct
5. To find the fineness modulus and average particle size in groundproduct
6. To study the rate of drying for given food material using vacuumdryer
7. To study the specific gravity separator as separationmachinery
8. To study the clean-O-grader as separationmachinery
9. To study different types of size reduction equipments.
10. Study of different conveying equipments used in food materialhandling

Design based Problems (DP)/Open Ended Problems:

Characterization of size distribution of contaminant of waste stream like wastewater or any effluent from the plant, Energy consumption for size reduction and desired yield for any given product.

Major Equipments:

1. Vacuumdryer
2. Axial flow traydryer

3. Gravityseparator
4. Clean – O –grader
5. Angle of repose setup
6. Sieve shaker
7. Hammer mill
8. Ball mill