GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3161410

STORAGE ENGINEERING
VIth SEMESTER

Type of course: Professional Elective Course

Prerequisite: Nil

Rationale: This course aims to acquaint the learner with fundamentals and types of storage systems for food and agricultural products and design of different food storage structures. This course will enable the student to understand and apply basic concepts of storage in practical situations.

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)	
3	0	2	4	70	30	30	20	150

S.No	Topics	Teaching Hours	Module Weightage %
1.	Need for scientific storage systems for agro-products, Functional requirements of food storage, Requirements of an ideal food grain storage structure. Types and causes of food spoilage during storage (Mechanical damage, Heat, Moisture, Rodents, Birds, Insects, etc.), Sources of infestation and control. Loss in quantity and quality during storage.	8	20
2.	Traditional, Improved and Modern food grain storage structures, Typical godown layout.	5	12
3.	Environment control inside storage systems: Moisture and temperature changes in stored grains, Aeration, Process of aeration and its advantages. Aeration theory and aeration system design.	6	16
4.	Types of Cooling Load, Cooling Load Calculation, Respiration of grains, Moisture and temperature changes in stored grains; Conditioning of environment inside storage through simple ventilation.	6	16
5.	Functional and structural design of grain storage structures, pressure theories, pressure distribution in the bin, grain storage loads, pressure and capacities, warehouse and silos.	7	18
6.	Cold storage, Controlled and modified atmospheric storage systems. Storage conditions for various perishable agro-produce, Storage of cereal grains, Hermetic and Frozen Storage.	7	18

Suggested Specification table with Marks (Theory)

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. A.M. Michael and T.P. Ojha. 2004. Principle of Agricultural Engineering, Vol. I. Jain Brothers, New Delhi
2. Jayas D.S., White N.D.G., Muir, W.E. 1994. Stored Grain Ecosystems. Marcel Dekker, New York
3. J. Whitaker. 2002. Agricultural Buildings and Structures. Reston Publishing Home, Reston, Virgenia, USA.
4. G. Boumans. 1985. Grain Handling and Storage. Elsevier Science Publishers, Amsterdam, The Netherlands.
5. C.W. Hall. 1980. Drying and Storage of Agricultural Crops. The AVI Publishing Company, Inc., Westport, Connecticut, USA
6. K. M. Sahay and K. K. Singh, "Unit Operations of Agricultural Processing", 2nd edition, Vikas Publishing House, New Delhi, 2004.
7. S. Vijayaraghavan, "Grain Storage Engineering and Technology", 1st edition, Batra Book Service, New Delhi, 1993.
8. J. L. Multon, "Preservation and Storage of Grains, Seeds and their By-products: Cereals, Oil Seeds, Pulses and Animal Feed". 1st edition, CBS Publishing and Distributions, Delhi, 1989.
9. Post Harvest Technology of Fruits and Vegetables- A.K. Thomson

Course Outcomes

Sr. No.	CO statement	**Weightage (%)**
CO-1	To acquaint with the need for scientific storage systems for foods, their spoilage during storage and control methods.	15
CO-2	Understand various storage techniques for agricultural products.	25
CO-3	To acquaint with design aspects of food crop storage structures/systems.	20
CO-4	Select storage structures according to the requirements.	15
CO-5	To understand and apply cold storage, controlled and modified atmospheric storage techniques.	25

List of Experiments

1. Layout design, sizing, capacity and drawing of traditional storage structures
2. Design of grain godowns for a specified food grain.
3. Drawing and layout of grain godown for particular commodity and capacity
4. Design of cold storage for particular capacity and commodity
5. Design and layout of commercial bag storage facilities.
6. Study of different domestic storage structures.
7. Drawing and layout of cold storage for particular commodity and capacity
8. Design of CA storage for particular capacity and commodity
9. To study the effect of relative humidity and temperature on grains stored in gunny bags
10. Visits to commercial handling and storage facilities for grains.
11. Design of MA storage system for a specified perishable food

Major Equipments & Instruments

1. CA storage system
2. MA storage system

3. Cold storage system
4. Packaging materials
5. Gunny bags
6. Temperature sensors
7. Hygrometer, RH meter
8. Refrigeration tutor