SEMESTER S4

STORAGE ENGINEERING

Course Code	PEAGT 412	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	0	Exam Hours	2 Hrs 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To understand about the basics of food grain storage and its design
2. To gain insights into CAS & MAS of fruits and vegetables
3. To understand the basics of precooling and cooling load calculations for different commodities

SYLLABUS

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Module No.	Syllabus Description	Contact Hours
1	Grain storage principles- factors- changes during storage. indoor storage system- Bag storage, bulk storage, bunkers, cap storage bags, outdoor storage system – cold storage, hermetic storage, vacuum and gas storage - moisture movement during bulk storage of grains – pressure distribution in storage bins - grain storage structures - location and material selection for storage building - types - traditional, modern, temporary and permanent storage structures, factors affecting qualities of grains during packaging and storage, functional requirements of storage structures - traditional storage structures in India and their improvements.	9

2	Grain storage ecosystem- biotic and abiotic factors- Moisture and temperature migration- Cold spots and hot spots. Aeration – Cooling- dehydration in grain storage, Grain storage in silos, bins and godowns – RCC and steel structures - aeration system for various storage structures, grain pressure theories - design of bulk storage structures, bag storage, godowns, Theory and nature of grain flow, pressure distribution, flow pattern shoppers and ducts – design - Loading and unloading mechanism, management and maintenance of grain storage, code of practices for safe storage of food grains.	**9**
3	Harvest and pre-harvest factors, pre-storage treatments, Controlled and modified atmosphere storage - principles, methods - optimization of storage gas composition, rate of supply, control systems for O2 and CO2, effect of nitrogen, oxygen, and carbon dioxide on durable and perishable commodities, Effect of storage temperature on shelf life in CAS and MAS, Storage of Intermediate moisture Foods -storage of dehydrated fruits and vegetables.	**9**
4	Precooling methods of fruits & vegetables- Ventilation, Forced air cooling, Hydro-cooling, Evaporative cooling, Vacuum cooling, Cold storage of fruits & vegetables – Preliminaries for estimation of cooling load for optimum shelf-life of fruits & vegetables. Design of small capacity cold storage- Dimensions, Layout, stacking methods for cold storage, Transportation of fruits & vegetables – Types, stacking patterns, guidelines for best use of refrigerated transport. Design of cold storage for food products– Meat product, Fishery Product, Dairy Products.	**9**

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Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

\End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Understand the principles of grain storage	**K1**
CO2	Explain the storage system for cereal grains & pulses	**K2**
CO3	Apply the principles of CAS & MAS for extending the shelf-life of foods	**K3**
CO4	Utilize the precooling techniques and estimate cooling load for various commodities	**K3**
CO5	Design cold storage and transportation system for various commodities	**K4**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

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CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	1	1				1	1	2
CO2	3	3	3	1	1					1	1	2
CO3	3	3	3	2	1	2				1	1	2
CO4	3	3	3	2	2					1	1	2
CO5	3	3	3	2	1	1				1	1	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Post-Harvest Technology of Cereals, Pulses and Oilseeds	Chakravarty	IBH Publications	Third Edition, 2005
2	Principles of Agricultural Engineering	Ojha TP and Michael A.M	Jain Brothers	Tenth Edition, 2013
3	Modified and Controlled Atmospheres for the Storage, Transportation, and Packaging of Horticultural Commodities	Elhadi M. Yahia	Taylor & Francis Group	First Edition, 2009

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Cooling Technology in the Food Industry	A. Ciobanu and G. Lasku, V. Bersescu	Abacus Press	First Edition, 1998
2	Preservation and storage of grains, seeds and their by – products	Multon, J.L	CBS Publishers and Distributors	Second Edition, 2000

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