



S. No	Topic	No. of Practicals
5.	Determination of flow properties using Shear apparatus	1
6.	Determination of Yield locus, Time yield locus and effective yield locus from Mohr's circle	1
7.	Flow through hoppers, openings and ducts	1
8.	Design of belt conveyors	1
9.	Design of chain conveyors	1
10.	Design of screw conveyors	1
11.	Design of bucket elevators	1
12.	Design of roller conveyors	1
13.	Design of pneumatic conveyors	1
14.	Principles of fluidization	1
15.	Recent advances in handling of food materials	2
	Total	16

X. Suggested Reading

- Boumans. 1985. *Grain Handling and Storage*. Elsevier.
- FAO. 1984. *Design and Operation of Cold Stores in Developing Countries*. FAO.
- Golob. 2002. *Crop Post-Harvest: Science and Technology*. Vol 1 Wiley-blackwell.
- Hall CW. 1970. *Handling and Storage of Food Grains in Tropical and Sub-Tropical Areas*. FAO Publisher Oxford & IBH.
- Henderson S and Perry SM. 1976. *Agricultural Process Engineering*. 5th Ed. AVI Publisher.
- Hodges 2004. *Crop Post-Harvest: Science and Technology*. Vol 2, Wiley-blackwell.
- Ripp BE. 1984. *Controlled Atmosphere and Fumigation in Grain Storage*. Elsevier.
- Shefelt RL and Prussi SE. 1992. *Post Harvest Handling – A System Approach*. Academic Press.
- Vijayaraghavan S 1993. *Grain Storage Engineering and Technology*. Batra Book Service.

I. Course Title : Food Package Engineering

II. Course Code : PFE 506

III. Credit Hours : 1+1

IV. Aim of the course

To acquaint and equip the students with packaging methods, packaging materials, packaging machineries, modern packaging techniques etc.

V. Theory

Unit I

Introduction of packaging: Package, functions and design. Principle in the development of protective packaging. Deteriorative changes in foodstuff and packaging methods of prevention.

Unit II

Food containers: Rigid containers, glass, wooden boxes, crates, plywood and wire bound boxes, corrugated and fibre board boxes, textile and paper sacks, corrosion of containers (tin plate). Flexible packaging materials and their properties. Aluminum as packaging material. Evaluation of packaging material and package performance.

Unit III

Packaging equipment: Food packages, bags, types of pouches, wrappers, carton and other traditional package. Retortable pouches: Shelf life of packaged foodstuff.



Unit IV

Methods to extend shelf life. Packaging of perishables and processed foods. Special problems in packaging of food stuff.

Unit V

Package standards and regulation: Shrink packaging, aseptic packaging, CA and MAP. Biodegradable packaging: Recent advances in packaging, active packaging, smart packaging, antioxidant and antimicrobial packaging, edible films and biodegradable packaging, microencapsulation and nano encapsulation.

VI. Practical

Thickness, substance weight, water absorption capability of flexible packaging materials, strength properties of packaging materials, water vapour and gas transmission rate of flexible packaging materials, identification and chemical resistance of plastic films. Packaging of fruits/vegetables: Estimation of shelf-life of packaged food stuff, familiarization of types of packaging material.

VII. Learning outcome

Student's capability to develop packages for all kinds of food products as per requirement of food industries and thereby adding value to the food products.

VIII. Lectures Schedule

S.No.	Topic	No. of Lectures
1.	Introduction to food packaging, Definition, importance, package, functions of packaging, design.	1
2.	Principle in the development of protective packaging	1
3.	Deteriorative changes in foodstuff, Factors affecting shelf life of foods during storage, interactions of spoilage agents with environmental factors (water, oxygen, light and pH), packaging methods of prevention	1
4.	Food containers: Rigid containers, glass, wooden boxes, crates, plywood and wire bound boxes, corrugated and fibre board boxes, textile and paper sacks, corrosion of containers (tin plate).	1
5.	Flexible packaging materials and their properties. Aluminum as packaging material.	1
6.	Evaluation of packaging material and package performance: Testing methods for flexible, rigid and semi rigid materials. Paper and paper board: thickness, bursting strength, breaking length, stiffness, tear resistance, folding endurance, ply bond and surface oil absorption, Plastic film and laminates: thickness, tensile strength, gloss, haze and burning test to identify polymer, aluminium foil: thickness and pin holes, Glass containers: visual defects, colour, dimensions and impact strength and metal containers: pressure test and product compatibility	3
7.	Packaging equipment for food packages, bags, types of pouches, wrappers, carton and other traditional packages	1
8.	Retortable pouches: Shelf life of packaged foodstuff.	1
9.	Methods to extend shelf life. Packaging of perishables and processed foods	1
10.	Special problems in packaging of food stuff	1
11.	Package standards and regulation: Shrink packaging, aseptic packaging, CA and MAP	2



S.No.	Topic	No. of Lectures
12.	Recent advances in packaging, active packaging, smart packaging, antioxidant and antimicrobial packaging, edible films and biodegradable packaging, microencapsulation and nano encapsulation	2
	Total	16

IX. List of Practicals

S.No.	Topic	No. of Practicals
1.	Familiarization of types of packaging material	1
2.	Determination of thickness of different types of packaging materials	1
3.	To determinewater absorption capability of flexible packaging materials	1
4.	Determination of tensile strength of packaging material	1
5.	Determination of compressive strength of packaging material	1
6.	Determination of water vapour transmission rate of packaging material	1
7.	Determination of gas transmission rate of packaging material	1
8.	Identification of different types of plastic films	1
9.	Testing of chemical and grease resistance of packaging materials	1
10.	Determination of bursting strength of packages	1
11.	Drop test for food package strength	1
12.	Vacuum packaging of various food products	1
13.	Nitrogen packaging of food products	1
14.	To study the effect of shrink wrapping onshelf life of fruits and vegetables	1
15.	To study the effect of active modified atmosphere packaging onshelf life of fruits and vegetables	1
16.	Visit to relevant industries	1
	Total	16

X. Suggested Reading

- Crosby NT. 1981. *Food Packaging Materials*. Applied Science Publisher.
- Frank A. 1992. *A Handbook of Food Packaging*. Springer.
- Mahadeviah M and Gowramma RV. 1996. *Food Packaging Materials*. Tata McGraw
- Hill.Palling SJ. 1980. *Developments in Food Packaging*. Applied Science Publisher.
- Robertson GL. 2013. *Food Packaging - Principles and Practice*. 3rd Ed Taylor & Francis.
- Sacharow S and Grittin RC. 1980. *Principles of Food Packaging*. AVI Publisher.

I. Course Title : Instrumentation and Sensors in Food Processing

II. Course Code : PFE 507

III. Credit Hours : 2+1

IV. Aim of the course

To acquaint and equip the students with instrumentation and use of sensors in food processing operations.

V. Theory

Unit I

Basic instrumentation systems and transducer principles. Displacement transducers, Potential meters, LDVT, Piezoelectric and capacitive transducers, Digital transducers, velocity transducers.