20FT019 - ADVANCES IN FOOD ENGINEERING

Hours Per Week : Total Hours :

L	T	P	C
3	-	-	3

L	T	P
45	15	-

WA/RA	SSH/HSH	CS	SA	S	BS
15	**30**	**-**	**5**	**5**	**-**

Course Description and Objectives:

This course deals with technologies related to handling, processing, and storage of 'fruits and vegetables' and 'Cereal and Pulses'. The objective of this course is to impart skill and knowledge required to apply the principles and concepts behind 'fruit and vegetable' and 'cereals and pulses' processing including post-harvest handling, specific processing techniques, quality analysis and stabilizing shelf life of the products.

Course Outcomes:

Upon successful completion of this course student should be able to:

- CO1: Estimate engineering properties of various food and biomaterials.
- CO2: Discuss the significance of water activity in extending the shelf life of foods.
- CO3: Apply the knowledge of properties in the designing of food processing equipments.
- CO4: Gain practical knowledge of food properties.
- CO5: Develop the conceptual knowledge of food properties which can be utilized at industrial level.

SKILLS

- ✓ Identify the suitable mixer required for mixing cohesive and non-cohesive solids.
- ✓ Suggest equipment design based on the properties of food material.
- ✓ Analyze and interpret textural profile of various foods

UNIT - I

Transport phenomena: definitions, and mechanisms. Molecular transport in: mass, energy and momentum transfer. Heat transfer Analysis: Analytical, graphical and numerical solutions to unsteady state conduction; heat transfer analysis in heat exchangers of different types: concentric

tube, shell and tube, plate type, extended surface, scrapped surface etc. Applications of heat transfer theories in thermal process

UNIT - II

Modeling and freezing time calculation. Fluid Flow: transport of fluid foods through pipes, velocity profiles, macroscopic balance, mechanical energy losses, pumps- pump characteristics, pump types and pump selection. Drag and pressure flow mechanisms in screw press and extruder. Fluid flow through porous beds: permeability and Darcy's law, Kozeny-Karman equation, Burke- Plummer equation, Ergun's equation, fluidization. Filtration: fundamentals, filtration resistances – cake resistance and medium resistance, filtration at constant pressure drop, at constant volumetric flow rate, filtration capacity.

UNIT - III

Water relations to foods: Role of water and water activity in foods. Water-activity control: by addition of solute, by moisture removal. Isotherm models, their limitations and applicability. Clapeyron-Clasius equation and Kelvin equation.

UNIT - IV

Internal mass transfer mechanism in foods: vapour transport mechanisms and liquid transport mechanisms. Applications of internal mass transfer models to drying of solid and liquid foods: diffusion model, receding front model, Philip and De Vries model, Luikov model, Krisher Model, Berger and Pei Model and Whitaker's model.

UNIT - V

Lumped parameter approach for modeling of microscopic heat and mass transfer in drying. Analytical and numerical solutions to diffusion equation. Energy and mass balances in air drying calculations: particulate drying, tray drying, through-flow-drying, drum drying, spray drying, and freeze drying. Introduction to: osmotic dehydration, microwave drying and infra-red drying.

TEXT BOOKS:

2. Bird R. Byron, Warren E. Stewart and Edwin N. Lightfoot. 2006. Transport Phenomena. Wiley India Pvt. Ltd., New Delhi
3. Earle, R.L. 1985. UNIT Operations in Food Processing. Pergamon Press. London.
4. Geankoplis J. Christie. 1999. Transport Process and UNIT Operations. Third Edition, Prentice Hall of India, New Delhi.

REFERENCEBOOKS:

1. Albert Ibarz, Gustavo V. Barbosa – Canovas, "UNIT Operations in Food Engineering". 2nd Edition, Taylor & Francis, 2014.
2. Smith, PG. Introduction to food process engineering, 2nd edition, Springer 2011.
3. Chapman & Hall. USA, CBS publications New Delhi, 2007.