

DISCIPLINE SPECIFIC CORE COURSE

DSC FT12: Food Engineering- I

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITE OF THE COURSE

Course title & code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Theory	Tutorial	Practical/Practice		
Food Engineering- I	4	3	0	1	XII Pass with PCM/PCB	Nil

Learning Objectives

- To understand the concept of unit operation, units and dimensions.
- To comprehend the different Heat and mass transfer, refrigeration and Freezing operations.
- To understand the fundamentals of food engineering systems and its process.

Learning Outcomes

After completing this course, students will be able to:

- Understand the principle of unit operation.
- Apprehend the different methods of separation in the food industry.
- Acquire the basic knowledge of thermal properties, methods of heat transfer and mass transfer, principles of refrigeration and freezing.
- Apply these principles for solving numerical problems.

SYLLABUS OF DSC FT12

THEORY

Credits: 3; Hours: 45

UNIT I: Introduction

6 Hours

Unit Description: The unit will provide information on the concept of unit operation, mass balance and energy balance system.

Subtopics:

- Concept of Unit operation
- Units and dimensions, Unit conversions, dimensional analysis
- Mass and Energy Balance

UNIT II: Separation Processes

12 Hours

Unit Description: The unit will provide an insight into the principle and equipment design of various separation processes like distillation, extraction, centrifugation, filtration and sedimentation.

Subtopics:

- Distillation principles and methods: steam, batch, continuous distillation with rectification and stripping.
- Extraction : Hildebrandt, Bollman, SCF extraction
- Filtration : Plate and frame, pressure leaf, continuous rotary vacuum, batch and continuous filtration
- Centrifugation: Tubular, disc bowl and basket centrifuge
- Sedimentation : continuous thickener

UNIT III: Heat and Mass Transfer

15 Hours

Unit Description: The unit will provide knowledge of thermal properties of food, design and derivation of heat and mass transfer systems and applications.

Subtopics:

- Systems for heating and cooling food products
- Thermal Properties of Food
- Modes of heat transfer- Conduction, Convection and Radiation
- Applications of steady state heat transfer, estimation of conductive heat transfer coefficient, convective heat transfer coefficient, overall heat transfer coefficient and design of tubular heat exchanger
- Fick's Law of Diffusion
- Related basic numerical
- Membrane separation systems-Electrodialysis system , Reverse Osmosis, Ultra filtration, Microfiltration
- Membrane devices used for RO and UF: Plate and Frame, Tubular, Spiral wound and hollow fiber devices

UNIT IV: Refrigeration and Freezing

12 Hours

Unit Description: The unit will provide concept of refrigerants, VCR cycle, components of Refrigeration system and freezing time calculations

Subtopics:

- Concept, properties and selection of refrigerants
- Description of Vapor compression refrigeration (VCR) cycle
- Pressure Enthalpy charts and Tables
- Mathematical expressions useful in analysis of VCR cycle
- Numerical on VCR system using R -134a, R-717, R-12; Saturated cycle and deviations from the standard
- Freezing time calculation using Plank equation
- Frozen food storage

PRACTICAL
Credit : 1, Hours: 30

1. Mass and Energy Balance Calculations
2. Determination of alcohol insoluble solids using extraction process
3. Determination of the osmotic pressure of the given sample
4. Estimation of sedimentation rate
5. Determination of thermal properties of the given samples
6. Mathematical Design of Heat exchanger
7. Cooling refrigeration load calculations.
8. Determination of Convective heat transfer coefficient and freezing time
9. Determination of freezing point depression in given solution

Essential Readings

- Rao, D.G. (2010). *Fundamentals of food engineering*. PHI learning private ltd.
- Singh, R.P. and Heldman, D.R. (2009) *Introduction to food engineering* 2nd edition. 4th edition Academic press.
- Singh, R.P. and Heldman, D.R. (2014) *Introduction to food engineering* 5th edition. Academic press

Suggested Readings

- Earle, R.L. (1983). *Unit Operations in Food Processing*, 2nd edition. Pergamon press.
- Fellows, P. (2009). *Food processing technology*. Woodhead publication, 3rd edition
- Garg, M., Chaturvedi, S., Sadhu, S.D. and Barwa, M. and Pani. B ., (2020) *Practical Handbook of Food Engineering* Aryush Education, ISBN NO. 978-81-930437-5-2

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.