



## FACULTY OF ENGINEERING & TECHNOLOGY

### First Year Master of Technology

#### Semester I

**Course Code:** 102380103

**Course Title:** Advanced Food Refrigeration System

**Type of Course:** Program Elective I

**Course Objectives:** Develop competence in technology and operation of VCERS and VARS for food applications. Understand and develop ability to select non-conventional food refrigeration systems. Acquaint with practical design considerations of key refrigeration controls and components. To gain knowledge of food freezing systems and applications. To obtain knowledge of cold storage and transport technology for foods

#### Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Internal		External		Total
				Theory	J/V/P*	Theory	J/V/P*	
3	0	2	4	30 / 15	20 / 10	70 / 35	30 / 15	150 / 75

\* J: Jury; V: Viva; P: Practical

#### Detailed Syllabus:

Sr.	Contents	Hours
1	Performance aspects and cycle modifications in actual vapour compression refrigeration systems for food applications. Multi-Stage vapour compression refrigeration systems for food products, Methods for improving COP.	5
2	Steady flow analysis of vapour absorption refrigeration system (Ammonia-Water). Pumpless absorption refrigeration systems-Triple Fluid Vapour Absorption Refrigeration System (TFVARS) or Platen-Munter's system, Solar energy based sorption refrigeration systems for food and allied materials.	5
3	Heat Pumps: different 'heat pump circuits', analysis of heat pump cycle, Applications of heat pumps for food and agro products.	4
4	Non-conventional food refrigeration systems: Steam jet refrigeration, Thermo electric refrigeration, vortex tube, cooling by adiabatic demagnetization, air refrigeration cycles.	4
5	Practical design considerations of key refrigeration components for agro-produce: Compressor, Expansion valves, Analysis of condensers ~ Optimum condenser pressure for lowest running cost. Thermal design of evaporators ~ Enhancement of heat transfer coefficients	4
6	Food Freezing System: Effect of temperature on food spoilage, Freezing equipment, Freezing kinetics, Freezing time and its effect of texture and quality of foods, Freezer types, Blast freezers, Contact plate freezers, Individual quick freezing. Cryogenic freezing of foods, Freezing practice as applied to marine foods, meat and poultry, fruits and vegetables. Quality and stability of frozen fruits and vegetables.	5



7	Classification of commercial cold storages, practices, stacking & handling of food & agro-products in cold rooms, types of cooling loads and their calculation, design and construction of cold storage for perishable food products.	5
8	Fundamentals of control and maintenance of commercial food refrigeration systems: Pressure regulating valves, Thermostatic valves, LP/ HP cut outs, high to low side bypass valve, condenser water regulating valve, capacity control devices, defrosting methods, liquid charging.	4
9	Refrigerated food transport systems: Introduction, cold chain, principles and practice.	3

### Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks						R: Remembering; U: Understanding; A: Application, N: Analyze; E: Evaluate; C: Create
R	U	A	N	E	C	
10	20	20	15	20	15	

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	Suwendu Bhattacharya, Chapter 13, Refrigeration in Food Production and Processing
2	Singh RP and Heldman DR.1993, 2003, 2009. Introduction to food engineering. Academic press 2nd, 3rd and 4th edition
3	Tressler , D.K. , Van Arsdel , W.B. , Copley , M.J. and Woolrich , W.R. ( 1968 ). The Freezing Preservation of Foods. The Avi Publishing Co. , Westport
4	Van Arsdel , W.B. , Copley , M.J. and Olson , R.L. ( 1969 ). Quality and Stability of Frozen Foods. Wiley Interscience , New York
5	Frozen Food Science and Technology, Judith A. Evans Food Refrigeration and Process Engineering Research Centre (FRPERC) University of Bristol, UK
6	Gunther Raymond C. 1957. Refrigeration and Air-conditioning and Cold Storage. Chilton Co
7	Andrew D Althouse & Carl H. Turnquist 1958. Modern Refrigeration and Air-conditioning. Good Heart Wilcox Co

### Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Develop competence in technology and operation of VCRS and VARS for foods.	25
CO-2	Understand and develop ability to select non-conventional food refrigeration systems	15
CO-3	Acquaint with practical design considerations of key refrigeration controls and components	20
CO-4	To gain knowledge of food freezing systems and applications	25
CO-5	To obtain knowledge of cold storage and transport technology for foods.	15



## List of Practicals / Tutorials: [Click or tap here to enter text.](#)

1	To determine the COP of VAR system ( Elertolux Refrigeration System)
2	To acquaint with Refrigerated food transport systems: Introduction, cold chain, principles and practice.
3	To find out cooling and humidification process parameters for green and leafy vegetables and plot the same on psychrometric chart.
4	To find and compare the theoretical and actual COP of a small refrigeration unit on Refrigeration Tutor.
5	Visit to a commercial refrigeration plant for cold storage/ ice bank unit and calculation of its theoretical COP by making cycle on P-h chart.
6	Calculation of theoretical work and comparing it with actual work for some specified cooling job in a commercial plant.
7	Study of various control and safety devices in a commercial refrigeration plant.
8	Design problems on cold storage for different food/ dairy products.
9	Use of Computer software specific to cold store AC design
10	Study the working of an actual heat pump system.

## Supplementary learning Material:

1	Holdsworth , D.S. ( 1987 ). Physical and engineering aspects of food freezing. In Developments in Food Preservation – 4 (Thorne, S. , ed. ) . Elsevier Applied Science, London
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## Curriculum Revision:

Version:	1
Drafted on (Month-Year):	Apr-20
Last Reviewed on (Month-Year):	Jul-20
Next Review on (Month-Year):	Apr-22