FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **Bachelor of Technology (Food Processing Technology)**

Semester: **V**

Course Code: **202070504**

Course Title: **Food Refrigeration and Air Conditioning**

Course Group: **Professional Core Course**

Course Objectives: Food refrigeration, air conditioning and ventilation systems provide artificial cooling for the environment and the processing and preservation of food stuffs. Refrigeration is required for the food chain (producers, processors, warehouses, transport, and retailing). A thorough understanding of refrigeration, cooling and freezing processes, air properties, refrigerants, equipment and instrumentation and control etc. would be highly desirable for a graduating food engineer and technologists. The course is required lead to a learner into acquiring all the skills required to work in the industry with an understanding of types of refrigeration components their repair, safety maintenance, installation, manufacture and selection of the mechanical and electrical systems which provide temperature control for food process needs.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	2	4	50/18	50/17	25/9	25/9	150/53

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

Detailed Syllabus:

Sr.	Contents	Hours
1	**Refrigerants:** Classification & designation of refrigerants. Desirable properties of an ideal refrigerant. Properties & uses of common refrigerants, R22, R 134-A, NH_3 etc. Non CFC refrigerants for food applications, Green House effect	06
2	**Vapour Compression Systems for Food and Agro-produce:** Simple Vapour compression cycle. Functions of parts of vapour compression system. Representation of vapour compression cycle on (T-S) and (P-h) diagram. Factors affecting the performance of vapour compression system. Mathematical analysis of vapour compression refrigeration.	09

3	**Vapour Absorption System:** Simple vapour absorption cycle. Functions of parts of vapour absorption system. Electrolux refrigerator construction and working. Cascade system of refrigeration: Introduction and working for food and allied products.	**06**
4	**Refrigeration Components: Compressor:** Hermetic sealed compressor, open type compressor, screw compressor centrifugal compressor. Condensers: Air-cooled, water-cooled, evaporative, cooling tower and spray pond. Evaporators: Flooded type, dry expansion, bare tube, plate surface, finned tube. Thermostatic expansion valve, capillary tube, solenoid valves.	**06**
5	**Refrigeration System Controls:** Air-conditioning components: Filters, fans, air washer, radiator and convector. Manual, automatic and semiautomatic control system, automatic humidity control, automatic temperature control, limit switches, time switches.	**07**
6	**Cold Air Distribution for Food Storage and Preservation:** Air handling unit, Cold Room air distribution, Requirements of good cold room air distribution, draft, types of supply air outlets, Duct system, and design.	**06**
7	**Cold Storage and Freezing of Foods:** Design of cold storage, distinction between refrigeration, chilling and freezing, Special storage requirements (CA and MA), Quick Instant Freezing.	**05**
	Total	**45**

List of Practicals / Tutorials:

1	Study principle of Vapor Compression Refrigeration System and parts of domestic refrigerator.
2	Study of Toolkit used in maintenance and repairing of refrigeration and air conditioning system.
3	Study of different components of air conditioning system.
4	Performance of vapor compression refrigeration tutor and calculation of different parameters.
5	Performance test on air conditioning tutor for studying the sensible heat process.
6	Performance test on air conditioning tutor for studying the heating and humidification process.
7	Performance test on air conditioning tutor for studying the cooling and dehumidification process.
8	Study of ammonia-water based Vapor Absorption Refrigeration system
9	Performance of Mechanical heat pump find actual and theoretical COP
10	Industrial visit to study working of industrial refrigeration system

Reference Books:

1	Refrigeration and Air-conditioning by CP Arora. TMH
2	Suvendu Bhattacharya, Chapter 13, Refrigeration in Food Production and Processing
3	Frozen Food Science and Technology, Judith A. Evans Food Refrigeration and Process Engineering Research Centre (FRPERC) University of Bristol, UK.
4	Refrigeration and Air-conditioning by Manohar Prasad. New Age pub.
5	Air-conditioning Engineering by Jone WP and Arnold E.
6	Principles of Refrigeration by Dossat RJ. John Wiely

7	Fundamentals of Food Process Engg by Romeo T. Toledo. CBS Publishers.
	Commercial Cooling of Fruits and Vegetables by Thompson Univ. of California ASHRAE Fundamentals, 1997, 2001

Supplementary learning Material:	
1	https://www.ashrae.org/
2	http://www.arpec.org/
3	http://www.irhace.org.nz: Institute of Refrigeration, Heating & Air Conditioning Engineers (IRHACE)
4	www.achrnews.com
5	Refrigeration and Air-Conditioning - ScienceDirect.com f. www.ishrae.in (ISHRAE)

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Industrial/ Field visits
- Course Projects

Internal Evaluation:

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

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

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
20%	30%	20%	10%	10%	10%	

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.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Demonstrate an understanding of procedures within food industry and the ability to service, repair and start-up air conditioning, refrigeration and ventilation systems including the use and maintenance of equipment and tooling to meet food quality and output requirements, working safety and in an environmentally aware manner.	**21**
CO-2	Demonstrate an understanding of the need for control of food quality in the manufacturing, installation, maintenance and repair processes relating to air conditioning, refrigeration and ventilation.	**19**

CO-3	Demonstration an understanding of the application and procedures relating to the operation of various control devices, control systems and programmable logic systems used in food air conditioning, refrigeration and ventilation plants.	**22**
CO-4	Demonstrate an understanding and application of all the various types of systems used and related to the food air conditioning, refrigeration and ventilation industry.	**19**
CO-5	Critical Cross-Field Outcomes include Diagnosing operational faults in refrigeration systems, conducting quality checks and explaining the operation of different systems and refrigerants in the air-conditioning, refrigeration and ventilation industry related to food industry	**19**

Curriculum Revision:	
Version:	2
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	
Next Review on (Month-Year):	June-2025