

GUJARAT TECHNOLOGICAL UNIVERSITY

FOOD PROCESSING & TECHNOLOGY (14) LOW TEMPERATURE PROCESS SYSTEMS FOR FOODS SUBJECT CODE: 2161410 B.E. 6th SEMESTER

Type of course: Food Processing Technology

Prerequisite: Fundamentals of food engineering & laws of thermodynamics

Rationale:

Low Temperature Process Systems for Foods provide external cooling for the environment to facilitate processing and preservation of food products. Low temperature is required for the food chains and is required by producers, processors, warehouses, transport and retailing. An understanding of refrigeration, cooling and air properties, refrigerants, equipments and instrumentation and control etc. is desirable for a graduating food engineer and technologist. The course is designed for a learner for acquiring requisite skills to work in the industry to handle all types of refrigeration components, their repair, safety maintenance, installation, manufacture and selection of the mechanical and electrical systems which provide low temperature for food process needs

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks					Total Marks	
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
PA	ALA	ESE		OEP						
4	0	2	6	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Fundamental Concept of Cooling and refrigerants.: Types of refrigerants. Desirable properties of an ideal refrigerant. Properties & uses of common refrigerants, comparison, Non CFC refrigerants, Global warming and Green House effect, Ozone layer depletion.	5	13
2	Rankine Cycle Compression Systems : Simple refrigeration cycle. Functions of different components. Graphical representation of cycle. Factors affecting the performance of cycle. Analysis of refrigeration cycle.	10	20
3	Non-CFC based Absorption Systems : Concept of Vapour absorption cycle and Functions of components. Electrolux refrigerator principle and working. Temperature and enthalpy diagram. Cascade system of refrigeration	9	14
4	Cooling System Components, Instruments and Controls: Hermetic sealed compressor, open type compressor, screw compressor centrifugal compressor. Condensers and their types. Evaporators and their types: Instruments and controls.	9	14
5	Components of artificial climate control: Climate control components. Manual, automatic and semiautomatic control system, automatic humidity control, air movement system, automatic temperature control, limit switches,	6	12

	time switches.		
6	Cooled air Distribution: AHU's, Room air distribution, Requirements of air distribution, types of outlets, Duct systems, and Air-distribution system. Duct design guidelines.	5	13
7	Freezing and Low Temperature Storage of Foods: Chilling and freezing, quality and special storage requirements, IQF. Design of cold storage, Storage requirements of food different stuff's .	5	14

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
19	23	17	20	21	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

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. Principles of Refrigeration by Dossat RJ. John Wiely
2. Fundamentals of Food Process Engg by Romeo T. Toledo. CBS Publishers.
3. Refrigeration and Air-conditioning by CP Arora. TMH
4. Refrigeration and Air-conditioning by Manohar Prasad. New Age pub.
5. Air-conditioning Engineering by Jone WP and Arnold E.
6. Commercial Cooling of Fruits and Vegetables by Thompson Univ. of California

Course Outcome:

At the end of this module, the student will be able to:

1. Understanding of procedures within food industry and the ability to service, repair and start-up air conditioning, refrigeration and ventilation systems.
2. Use and maintenance of equipment and tooling to meet food quality and output requirements, working safety and in an environmentally aware manner.
3. Understanding of the need for control of food quality in the manufacturing, installation, maintenance and repair processes relating to air conditioning, refrigeration and ventilation.
4. 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.
5. Demonstrate an understanding and application of all the various types of systems used and related to the food air conditioning, refrigeration and ventilation industry.
6. Critical Cross-Field Outcomes include Diagnosing operational faults in refrigeration systems.
7. Conducting quality checks and explaining the operation of different systems and refrigerants in the air-conditioning, refrigeration and ventilation industry related to food industry

List of Experiments:

1. Performance evaluation of on IBT tutor.
2. Performance evaluation of VCR tutor.
3. Performance of Mechanical heat pump.

4. Study different types of expansion valves used for refrigeration systems.
5. Test on air conditioning tutor for studying the sensible heat process.
6. Test on air conditioning tutor for studying the cooling and dehumidification process.
7. Test on air conditioning tutor for studying the heating and humidification process.
8. To understand different types of compressors.
9. To study the use of refrigeration tool kit used for maintenance.

Design based Problems (DP)/Open Ended Problem:

1. Design of an Energy-Efficient Food Cooling system for transportation and handling of fresh fruits and vegetables.
2. Modeling and Simulation of humid air heating and cooling processes for long term storage of food grains.

Major Equipments & Instruments:

- a. DX-coil Evaporator
- b. Thermostatic expansion valves
- c. Mechanical VCR Heat Pump Trainer
- d. Vapour Compression Refrigeration System Trainer
- e. DX-coil ice bank tank or Mini Ice plant
- f. Reciprocating and rotary compressors.
- g. Air cooled condenser
- h. Water cooled condenser
- i. Vapour absorption refrigeration system.
- j. Special tool kits

List of Open Source Software/learning website: <http://foodscience.uark.edu/>

- a. <https://www.ashrae.org/>
- b. <http://www.irhace.org.nz>: Institute of Refrigeration, Heating & Air Conditioning Engineers (IRHACE)
- c. <http://www.arpec.org/>
- d. [Refrigeration and Air-Conditioning - ScienceDirect.com](#)

www.ishrae.in (ISHRAE)

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.