



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3171918

Semester –7

Subject Name: Refrigeration and Air-conditioning

Type of course: Professional Elective

Prerequisite: -

Rationale: The course is designed to give fundamental knowledge of types of refrigeration, refrigeration cycles, refrigerants and their behavior under various conditions, air conditioning load calculation and designing of components of air distribution system.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Introduction and Refrigerant: Brief history and need of refrigeration and air conditioning, methods of producing cooling, ton of refrigeration, coefficient of performance, types and application of refrigeration and air conditioning systems, Recapitulation of desirable properties of refrigerants, secondary refrigerants, future industrial refrigerants	4
2	Air refrigeration: Aircraft refrigeration, working and analysis of Simple, Bootstrap, Reduced ambient and Regenerative air refrigeration systems	5
3	Compound Compression VCR system: Multiple evaporators with back pressure valves and with multiple expansion valves without flash inter cooling, analysis of two evaporators with flash intercooler and individual expansion valve and multiple expansion valve, cascade refrigeration system	7
4	Absorption refrigeration system: Practical H ₂ O -NH ₃ cycle, LiBr – H ₂ O system and its working, h-x diagram and simple calculation of various process like adiabatic mixing and mixing with heat transfer, throttling	6
5	Refrigeration system components: Types, construction, working, comparison and selection of compressors, condensers, expansion devices and evaporators; refrigeration piping accessories, evacuation and charging of refrigerant, properties and classification of thermal insulation	4
6	Human comfort and Load analysis: Selection of inside design conditions, thermal comfort, heat balance equation for a human being, factors affecting thermal comfort, Effective temperature, comfort chart and factors governing effective temperature, selection of outside design conditions Site survey, outdoor and indoor design conditions, classification of loads, flywheel effect of	9



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	building material and its use in design, effect of wall construction on cooling load, instantaneous heat gain (IHG) and instantaneous cooling load (ICL) heat transmission through sunlit and shaded glass using tables, method of reduction of solar heat gain through glass, calculations of cooling load TETD due to sunlit and shaded roof and walls using tables, ventilation and air infiltration, load due to outside air, heat gain from occupants; electric lights; product; electric motor and appliances, load calculations for automobiles, use of load estimation sheet	
7	Duct design and air distribution: Function; classification and economic factors influencing duct layout, equal friction, velocity reduction and static regain methods of duct design, use of friction chart, dynamic losses and its determination, Requirements of air distribution system, air distribution, grills, outlets, application, location	6
8	Air-conditioning systems: Classification, system components, all air; all water; and air-water systems, room air conditioners, packaged air conditioning plant, central air conditioning systems, split air conditioning systems	4

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	20	40	20	0	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. Refrigeration and Air Conditioning by C P Arora, McGraw-Hill India Publishing Ltd.
2. Refrigeration and Air-conditioning by Ramesh Arora , Prentice Hall of India
3. Refrigeration and Air Conditioning by Manohar Prasad, New Age International Publisher
4. ASHRAE Handbook – Fundamentals 2017, ASHRAE
5. Automobile Air conditioning by Crouse and Anglin, McGraw Hill Publications

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	To select proper refrigerant for various applications and make basic calculations of aircraft refrigeration.	20
CO-2	To analyze multi-evaporator systems and simple vapor absorption systems.	28
CO-3	To explain construction and working of different refrigeration system components.	09
CO-4	To solve air-conditioning load calculations for buildings and automobiles.	20
CO-5	To select proper air-conditioning system for various applications and construct duct layout for the systems.	23



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List of Experiments:

1. To analyze multi-evaporator systems with different configurations.
2. To analyze cascade refrigeration system.
3. To analyze $\text{NH}_3\text{-H}_2\text{O}$ system for specific application.
4. To analyze $\text{LiBr-H}_2\text{O}$ system for specific application.
5. To understand construction and working of reciprocating, rotary and centrifugal compressor used for R&AC.
6. To understand various tools used for refrigeration tubing and to perform various operations like flaring, swaging, bending, brazing etc.
7. To calculate cooling load of a confined space using table and compare the same with load estimation sheet.
8. To design duct layout of the confined space selected for above.
9. To select and analyze proper air-conditioning system for the confined space selected above.
10. To calculate cooling load of an automobile.

Major Equipment: cut-sectional models of various types of compressors, condensers and evaporators used in R&AC industry, thermostatic expansion valve, automatic expansion valve, capillary tubes, tools for refrigeration tubing

List of open source software/learning website: <https://nptel.ac.in/course.php>