GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3722109
Semester – II
Subject Name: Advanced Refrigeration Engineering

Type of course: Program Elective

Prerequisite: Nil

Rationale: The course is designed to give knowledge of various refrigeration systems, properties of refrigerants and its behavior under various conditions

Teaching and Examination Scheme:

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

Content:

Sr. No.	Content	Total Hrs
1	**Refrigerants:** Alternate eco-friendly refrigerants and their properties, secondary refrigerants, mixture of refrigerants, azeotropics, and salient characteristics of various refrigerants, CFC/HCFC phase-out regulations, Montreal and Kyoto Protocols, synthetic lubricating oil and their properties	4
2	**Air Refrigeration:** Aircraft refrigeration systems – simple, Boot strap, regenerative and reduced ambient, analysis of an aircraft refrigeration cycles and their applications, calculations of COP of the systems	6
3	**Vapour Compression Refrigeration:** Balancing of vapour compression refrigeration system, dual pressure vapour compression system and its analysis, compound compression with flash cooler and flash intercooler, multiple expansions, parallel operation, sectionalizing, booster operations, various types of cascade systems and their analysis	12
4	**Vapour Absorption refrigeration**: properties of LiBr-H_2O and NH_3-H_2O solutions, analysis of vapour absorption refrigeration systems, heat balance, COP comparison with vapour compression refrigeration systems, two stage vapour absorption refrigeration system, solar driven sorption systems, heat sources for absorption systems	12
5	**Load estimation:** Sources of heat generation, insulating materials, design principles of cold storage, milk tankers and blood plasma storage. **Refrigeration Applications:** Refrigeration for preservation of food, refrigerating systems for transport by trucks and containers, Refrigerated railway cars, Marine refrigeration.	4
6	**Control Devices:** Thermostatic and automatic expansion valve, side glass, filter dryer etc. **Refrigeration Tubing:** Cutting, flaring, pinching, savaging, soldering etc.	4

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Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**20**	**20**	**20**	**20**	**10**

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, C. P. Arora, McGraw Hill
2. ASHRAE Hand Book, (1) Fundamentals (2) Refrigeration
3. 40 Lessons on Refrigeration and Air Conditioning IIT KGP
4. Principles of Refrigeration, R J Dossat, Pearson Education Asia
5. Refrigeration and air conditioning, Stocker, McGraw Hill
6. Refrigeration and air conditioning, Jordan and Priester, McGraw Hill
7. Industrial Refrigeration Handbook, Stoecker, McGraw Hill

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Appraise refrigerants, their properties and applications.	10
CO-2	Discuss different air and vapour compression refrigeration systems and analyze them.	42
CO-3	Analyze vapour absorption cycles.	28
CO-4	Estimate the refrigeration load and appraise applications of refrigeration.	10
CO-5	Discuss various control devices and tubing operation used in refrigeration.	10

List of Experiments: (any ten)

1. To compare and analyze advance refrigeration cycle for different refrigerants.
2. Performance analysis of VCR system using capillary tube as a throttling device.
3. Performance analysis of VCR system using thermostatic expansion valve as a throttling device.
4. Design of a vapour absorption refrigeration ($LiBr-H_2O$ or NH_3-H_2O) system for a particular application.
5. Design of cascade refrigeration system for a particular application.
6. Performance analysis of "Electrolux" refrigerator.
7. Performance and analysis on heat pump system with different working conditions.
8. To estimate cooling load and star rating (energy efficiency rating) for any refrigeration application like, domestic refrigerator, deep freezer, water cooler etc.
9. To understand percentage running time of domestic refrigerator on a particular thermostat setting.
10. To understand construction and working of Ice Plant and determine COP of it.

Equipment / Computational facility:

Vapor Compression Refrigeration System, Vapor Absorption Refrigeration Trainer-Electrolux, Mechanical Heat Pump, Ice Plant Tutor etc.

List of Open Source Software/learning website:

1. Students can refer to video lectures available on the websites including NPTEL.
2. Students can refer the CDs which are available with some reference books for the solution of problems using software/spreadsheets. Students can develop their own programs/ spreadsheets for the solutions of problems.