



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Subject Code : ME02000601

Subject Name : Advanced Refrigeration Engineering

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Course

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

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Appraise refrigerants, their properties and applications.	Create
2	Analyze different air and vapor compression refrigeration systems	Analyze
3	Analyze vapor absorption cycles.	Analyze
4	Estimate the refrigeration load and appraise applications of refrigeration.	Evaluate
5	Utilize various control devices and tubing operation used in refrigeration.	Apply

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Refrigerants: Alternate eco-friendly refrigerants and their properties, secondary refrigerants, mixture of refrigerants, azeotropic mixtures, CFC/HCFC phase-out regulations, Montreal and Kyoto Protocols, synthetic lubricating oil and their properties	05	11
2.	Air Refrigeration: Analysis and applications of simple, Bootstrap, regenerative and reduced ambient aircraft refrigeration systems	06	14



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3.	Vapor Compression Refrigeration: Balancing of vapor compression refrigeration system, dual pressure vapor 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	13	30
4.	Vapor Absorption refrigeration: properties of LiBr-H ₂ O and NH ₃ -H ₂ O solutions, analysis of vapor absorption refrigeration systems, heat balance, comparison with vapor compression refrigeration systems, two stage vapor absorption refrigeration system, solar driven sorption systems, heat sources for absorption systems	12	26
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.	05	11
6.	Control Devices: Thermostatic and automatic expansion valve, side glass, filter dryer etc. Refrigeration Tubing: Cutting, flaring, pinching, swaging, soldering etc.	04	08
Total		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
-	20	30	20	20	10

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

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

(b) Open-source software and website:

1. https://onlinecourses.nptel.ac.in/noc22_me135
2. <https://www.danfoss.com/en-in/service-and-support/learning/cooling-learning/>



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Suggested Course Practical List:

1. To compare and analyze advanced refrigeration cycles for different refrigerants.
2. Performance and analysis on heat pump system with different working conditions.
3. Performance analysis of VCR system using capillary tube as a throttling device.
4. Performance analysis of VCR system using thermostatic expansion valve as a throttling device.
5. Performance evaluation of cascade refrigeration system.
6. Design of a $\text{NH}_3\text{-H}_2\text{O}$ vapor absorption refrigeration system for a particular application.
7. Design of a $\text{LiBr-H}_2\text{O}$ vapor absorption refrigeration system for a particular application.
8. To estimate the cooling load of a cold storage.
9. To estimate cooling load and star rating (energy efficiency rating) for any refrigeration application like, domestic refrigerator, deep freezer, water cooler etc.
10. To understand various tools used for refrigeration tubing and to perform various operations like flaring, swaging, bending, brazing etc.

List of Laboratory/Learning Resources Required: Vapor compression refrigeration system with different expansion devices, cascade refrigeration systems, domestic refrigerator, water cooler, Vapor absorption refrigeration system, Mechanical heat pump, expansion valves, refrigeration tool kit, etc.

Suggested Project List:

Suggested Activities for Students: Students are required to download 3-5 research papers from reputed international journals on the recent advancement in the areas of refrigeration. They need to go through the same and prepare a review for the research papers. The review should have three parts: Summary, Critical Evaluation and Creative synthesise

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