

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (THERMAL ENGINEERING) (21)

ADVANCED REFRIGERATION ENGINEERING

SUBJECT CODE: 2722109

SEMESTER: II

Type of course: Applied Engineering (Advanced)

Prerequisite: Fundamental knowledge of refrigeration

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
L	T	P		Theory Marks		Tutorial/Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
ESE	OEP	PA			RP					
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	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	15
2	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	5	12
3	Vapour 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	12	26
4	Vapour Absorption refrigeration: h-x charts of LiBr-H ₂ O and NH ₃ -H ₂ O solutions, analysis of vapour absorption refrigeration system on h-x chart, heat balance, COP comparison with vapour compression refrigeration systems, two stage vapour absorption refrigeration system	9	16
5	Steam Jet Refrigeration - Introduction, analysis, relative merits and demerits, performance applications	4	8
6	Load estimation & Refrigeration Applications: Sources of heat generation, insulating materials, design principles of cold storage, milk tankers, blood plasma storage. Refrigeration Applications: Refrigeration for preservation of Food, refrigerating systems for transport by trucks and containers, Refrigerated Railway cars, Marine Refrigeration.	6	15

7	Control Devices: Thermostatic and automatic expansion valve, side glass, filter dryer etc. Refrigeration Tubing: Cutting, flaring, pinching, savaging, soldering etc.	6*	8
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* To be covered during practical study

Reference 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. Thermal Environmental Engineering, Threlked J L, Prentice Hall, N. Y.
7. Industrial refrigeration handbook, Stoecker, McGraw Hill

Course Outcome:

After learning the course the students should be able to:

- Acquire an overview of various common refrigeration systems
- Estimate the refrigeration load & design the system components
- Able to understand simple refrigeration system
- Develop the skills to analyze the multi pressure refrigeration systems

List of Experiments:

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 steam jet refrigeration system for particular application.
5. Design of cascade refrigeration system for 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.

Design based Problems (DP)/Open Ended Problem:

- Prepare charts for various refrigeration systems.
- Preparation of chart to identify refrigerants.
- Retrofitting of refrigeration system.
- Study of recent refrigerants used in refrigeration systems.
- Study of various components of the refrigeration systems i.e compressors, evaporator etc.

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

List of Open Source Software/learning website:

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

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.