

B. E. MECHANICAL ENGINEERING Choice Based Credit System (CBCS) and Outcome Based Education (OBE) SEMESTER – VI Professional Elective- 1			
REFRIGERATION AND AIR CONDITIONING			
Course Code	18ME642	CIE Marks	40
Teaching Hours /Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03
Course Learning Objectives: <ul style="list-style-type: none"> • Study the basic definition, ASHRAE Nomenclature for refrigerating systems. • Understand the working principles and applications of different types of refrigeration systems. • Study the working of air conditioning systems and their applications. • Identify the performance parameters and their relations of an air conditioning system. 			
Module-1			
Introduction to Refrigeration –Basic Definitions, ASHRAE Nomenclature, Air Refrigeration Cycles-reversed Carnot cycle, Bell-Coleman cycle analysis, Air Refrigeration systems-merits and demerits and applications: Aircraft refrigeration cycles, Joule Thompson coefficient and Inversion Temperature, Linde, Claude and Stirling cycles for liquefaction of air. Industrial Refrigeration -Chemical and process industries, Dairy plants , Petroleum refineries, Food processing and food chain, Miscellaneous			
Module-2			
Vapour Compression Refrigeration System(VCRS): Comparison of Vapour Compression Cycle and Gas cycle, Vapour Compression Refrigeration system Working and analysis, Limitations, Superheat horn and throttling loss for various refrigerants, efficiency, Modifications to standard cycle – liquid-suction heat exchangers, Grindlay cycle and Lorenz cycle, Optimum suction condition for optimum COP Actual cycles with pressure drops, Complete Vapour Compression Refrigeration System, Multi-Pressure, Multi-evaporator systems or Compound Vapour Compression Refrigeration Systems – Methods like Flash Gas removal, Flash inter cooling and water Inter cooling.			
Module-3			
Vapour Absorption Refrigeration Systems: Absorbent – Refrigerant combinations, Water-Ammonia Systems, Practical problems, Lithium- Bromide System, Contrast between the two systems, Modified Version of Aqua-Ammonia System with Rectifier and Analyzer Assembly. Practical problems – crystallization and air leakage, Commercial systems Other types of Refrigeration systems: Brief Discussion on (i) Steam-Jet refrigeration system and (ii) Thermoelectric refrigeration, pulse tube refrigeration, thermoacoustic refrigeration systems			
Module-4			
Refrigerants: Primary and secondary refrigerants, Designation of Refrigerants, Desirable properties of refrigerants including solubility in water and lubricating oil, material compatibility, toxicity, flammability, leak detection, cost, environment and performance issues Thermodynamic properties of refrigerants, Synthetic and natural refrigerants, Comparison between different refrigerants vis a vis applications, Special issues and practical implications Refrigerant mixtures – zeotropic and azeotropic mixtures Refrigeration systems Equipment: Compressors, Condensers, Expansion Devices and Evaporators, A brief look at other components of the system.			
Module-5			
Air-Conditioning: Introduction to Air-Conditioning, Basic Definition, Classification, power rating, Mathematical Analysis of Air-Conditioning Loads, Related Aspects, Different Air-Conditioning Systems-Central – Station Air-Conditioning System, Unitary Air-Conditioning System, Window Air-Conditioner and Packaged Air-Conditioner, Components related to Air-Conditioning Systems. Transport air conditioning Systems: Air conditioning systems for automobiles (cars, buses etc.), Air conditioning systems for trains, Air conditioning systems for ships			

Course Outcomes: At the end of the course, the student will be able to:

CO1: Illustrate the principles, nomenclature and applications of refrigeration systems.

CO2: Explain vapour compression refrigeration system and identify methods for performance improvement

CO3: Study the working principles of air, vapour absorption, thermoelectric and steam-jet and thermoacoustic refrigeration systems.

CO4: Estimate the performance of air-conditioning systems using the principles of psychrometry.

CO5: Compute and Interpret cooling and heating loads in an air-conditioning system.

CO6: Identify suitable refrigerant for various refrigerating systems.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
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Textbook/s

1	Refrigeration and Air-conditioning	Arora C.P	Tata Mc Graw –Hill, New Delhi	2 nd Edition, 2001
2	Principles of Refrigeration	Roy J. Dossat	Wiley Limited	
3	Refrigeration and Air-conditioning	Stoecker W.F., and Jones J.W.,	Mc Graw - Hill, New Delhi	2nd edition, 1982.

Reference Books

1	Heating, Ventilation and Air Conditioning	McQuiston	Wiley Students edition	5 th edition 2000.
2	Air conditioning	PITA	Pearson	4th edition 2005
3	Refrigeration and Air-Conditioning	S C Arora & S Domkundwar	Dhanpat Rai Publication	
4	Principles of Refrigeration	Dossat	Pearson	2006
5	Refrigeration and Air-Conditioning	Manohar prasad		
6	Handbook of Air Conditioning and Refrigeration	Shan K. Wang	McGraw-Hill Education	2/e, 2001

Data Book:

1. Mathur M.L. & Mehta, Refrigerant and Psychrometric Properties (Tables & Charts) SI Units, F.S., Jain Brothers, 2008

E- Learning

- <http://nptel.ac.in/courses/112105128/#>

E-Resources

- VTU, E- learning, MOOCS, Open courseware