Refrigeration and Air Conditioning

Programme : B.Tech. (MME) Year: Semester : VII
Course : Elective Credits : 3 Hours : 3 hours per week

Course Context and Overview (100 words):

The objective of the course is to provide the knowledge on the fundamental concepts and processes of refrigeration and air cooling. The further detailed objectives are as following:

1. Learning the fundamental principles and different methods of refrigeration and air conditioning.
2. Study of various refrigeration cycles and evaluate performance using Mollier charts and/ or refrigerant property tables.
3. Comparative study of different refrigerants with respect to properties, applications and environmental issues.
4. Understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.
5. Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems

Prerequisite : Basic Thermodynamics- Laws of thermodynamics, Ideal gas processes, Thermodynamic cycles, Properties of pure substance, Mollier Charts, Fluid properties, Fluid dynamics, Modes of heat transfer, Governing Equations in Heat Transfer, Extended Surfaces, Condensation and Boiling, Heat Exchangers**.**

Course outcomes (COs):

On completion of this course, the students will have the ability to:	
CO1 Illustrate the fundamental principles and applications of refrigeration and air conditioning system	Unit – I, II
C02 Obtain cooling capacity and coefficient of performance by conducting test on vapor compression refrigeration systems	Unit – II, IV
C03 Present the properties, applications and environmental issues of different refrigerants	Unit – III

C04 Calculate cooling load for air conditioning systems used for various applications	Unit – II, IV, V
C05 Operate and analyze the refrigeration and air conditioning systems.	Unit – IV, V, VI

Course Topics:

Topics		**Student development**
UNIT - I **Fundamentals and Applications of Refrigeration and Air Conditioning** History of Refrigeration, Review of Fundamentals Principles (Thermodynamics, Fluid Flow and Heat Transfer). Methods of Producing Low Temperatures Air Refrigeration System: Fundamentals of Reverse Carnot cycle, Block diagram of Refrigerator & Heat pump (numerical), Modified reverse Carnot cycle (Bell Coleman cycle), Necessity of Cooling the Aeroplane and different methods (Simple, Simple Evaporative, Boot-Strap, Boot-Strap Evaporative, Regenerative etc.)	8	Employability
Unit - II **Refrigeration Systems** *Vapour Compression Cycle:* Working of simple vapour compression system, Representation of vapour compression cycle (VCC) on T-s and P-h diagram, COP, Comparison of VCC with Reverse Carnot cycle, Effect of operating parameters on performance of VCC, actual VCC, Methods of improving COP using flash chamber, sub-cooling, liquid vapour heat exchanger, Cascade VCC systems using single and multi evaporators. Liquefactions of Hydrogen, Helium, Applications of Low Temperature *Vapour absorption systems:* Introduction, Working of simple vapour absorption system (VAS), Desirable properties of binary mixture (aqua-ammonia), Performance evaluation of simple VAS (simple numerical treatment), Actual VAS, LiBr absorption system, Three fluid system (Electrolux refrigeration), Applications of VAS, Comparison between VCC and VAC.	8	Employability and Skill Development
Unit – III **Refrigerants**		Employability and Skill Development

Classification of refrigerants, Refrigerants Nomenclature, Desirable properties of refrigerants, Environmental issues (Green House Effect), Ozone depletion and global warming, ODP, GWP, Selection of environment friendly refrigerants, secondary refrigerants, anti-freeze solutions,		
Unit - IV **Psychometric and Air conditioning:** Introduction to air conditioning, Psychometric, Psychometric properties and terms, Psychometric relations, Psychometric processes and its representation on psychometric chart, BPF of coil, ADP, Adiabatic mixing of two air streams, SHF, RSHF, GSHF, ESHF. Thermodynamics of human body, Comfort and comfort chart, Factors affecting human comfort, Cooling Load Calculations: Different Heat Sources, Equipment Load, Concept of infiltration and ventilation, Indoor air quality requirements, Factors contributing to cooling load.	8	Employability and Skill Development
UNIT – V **Air Conditioning Systems** Working of summer, Winter and all year round AC systems, All air system, All water system, Air water system, Variable refrigerant flow and variable air volume systems, Unitary and central air conditioning.	8	Employability and Skill Development
UNIT – VI **Special Topics:** Domestic Refrigerator, Domestic Air Conditioners, Automotive Air Conditioners, Evaporative coolers, Water coolers, Commercial Refrigeration- Dairy, Cold storage, Ice plant, Commercial Air Conditioning (Multiplex, Hospitals, Departmental Stores, Theaters, Auditorium, Restaurants), Industrial Applications (Textile Industry, Heat Treatment), Medical, Transport Air Conditioning (Automobile, Railway, Marine, Aircraft) Installation, Charging, Testing and Maintenance of Refrigeration and Air Conditioning Solar Refrigeration, Air Conditioning and Dehumidification Methods of Defrosting Refrigeration Equipments: Compressor, Condensers, Evaporators, Expansion Devices, Piping and Pumps, Electric Motors, Various Electric Controls Air Conditioning Equipments: Air Filters, Humidifiers, Dehumidifiers, Fans, Blowers, Grill and Registers Duct Design, Air Conditioning and Noise Control	8	Employability and Skill Development

Textbook references (IEEE format):

1. Arora C. P., Refrigeration and Air Conditioning, Tata McGraw-Hill
2. Manohar Prasad, Refrigeration and Air Conditioning, Willey Eastern Ltd, 1983
3. McQuiston, — Heating Ventilating and air Conditioning: Analysis and Design‖ 6th Edition, Wiley India
4. Arora and Domkundwar, Refrigeration & Air Conditioning, Dhanpat rai & Company, New Delhi
5. Ballaney P.L., Refrigeration and Air conditioning, Khanna Publishers, New Delhi, 1992

Additional Resources (NPTEL, MIT Video Lectures, Web resources etc.):

Evaluation Methods:

Item	Weightage
Assignments/Oral/Quiz	50
Viva/Project/Presentation	
Midterm (1.5 hr)	20
Final Examination (2.5 hr)	30

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