

MEPE3004 REFRIGERATION AND AIR CONDITIONING (3-0-0)

Course Objectives:

This course provides fundamental knowledge of refrigeration and air conditioning systems, covering vapor compression/absorption cycles, psychrometrics, and comfort air conditioning. Students will analyze system performance (COP, cooling load), compare refrigerants, and design HVAC solutions for diverse applications, including multi-stage systems and thermoelectric refrigeration.

Module-I: (05 Hours)

Air Refrigeration System: Introduction, Unit of refrigeration, Coefficient of performance, Reversed Carnot Cycle, Temperature limitations, maximum COP, Bell Coleman air cycle, Simple Air Cycle System for Aircraft with problems.

Module-II: (06 Hours)

Vapour Compression System: Analysis of theoretical vapour compression cycle, Representation of cycle on T - S and p - h diagram, Simple saturation cycle, subcooled cycle and super-heated cycle, Effect of suction and discharge pressure on performance, Actual vapour compression cycle. Problem illustration and solution.

Multi-stage compression and multi-evaporator systems: Different arrangements of compressors and inter-cooling, Multistage compression with inter-cooling, multi-evaporator system, Dual compression system. Simple problems

Module-III: (8 Hours)

Vapour Absorption System: Simple Ammonia - absorption system, Improved absorption system, Analysis of vapour absorption system (Specifically of analyzing column and rectifier), Electrolux / Three fluid system, Lithium bromide-water vapour absorption system, comparison of absorption system with vapour compression system. Simple Problems and solutions.

Thermoelectric Refrigeration:

Basics and Principle. Defining the figure of Merit. (No Problem)

Refrigerants: Classification of refrigerants and its designation- Halocarbon (compounds, Hydrocarbons, Inorganic compounds, Azeotropes), Properties of refrigerants, comparison of common refrigerants, uses of important refrigerants, Brines. Alternative refrigerants (Organic and inorganic compounds).

Module-IV: (06 Hours)

Psychrometrics: Properties of air-vapour mixture, Law of water vapour-air mixture, Enthalpy of moisture, Psychrometric chart, simple heating and cooling, Humidification, De-humidification, Mixture of air streams. Review question and discussions

Requirements of comfort air conditioning: Oxygen supply, Heat removal, moisture removal, air motion, purity of air, Thermodynamics of human body, comfort and comfort chart, effective temperature, factors governing optimum effective temperature

Module-V: (05 Hours)

Air Conditioning System: Process in air conditioning, Summer air conditioning, Winter air conditioning and year-round air conditioning, Cooling load calculations. Review question and discussions.

Course Outcomes:

CO1: Remembering (Knowledge): Define key terms (COP, effective temperature) and classify refrigerants (halocarbons, azeotropes).

- CO2: Understanding (Comprehension): Explain vapor compression/absorption cycles, psychrometric processes, and comfort chart principles.
- CO3: Applying (Application): Calculate cooling loads, system performance (COP), and analyze multi-stage compression/inter-cooling setups.
- CO4: Analyzing (Analysis): Evaluate refrigerant properties and compare system efficiencies (absorption vs. compression, thermoelectric).
- CO5: Creating (Synthesis): Design HVAC systems (summer/winter/year-round) integrating psychrometrics and load calculations for optimal performance.

Textbooks:

1. Refrigeration and Air Conditioning by R.C. Arora, PHI Publication
2. Refrigeration and Air Conditioning by S.C. Arora and S. Domkundwar, Dhanpat Rai & Sons. Chapters; 3,4,5,6,7,11,16,17,19,20
3. Refrigeration and Airconditioning Data book by Manohar Prasad

Reference Books:

1. Refrigeration and Air conditioning by P.L. Balloney, Khanna Publishers.
2. Refrigeration and Air conditioning by Manohar Prasad, New Age international publishers.
3. Refrigeration and Air conditioning by C.P. Arora, Tata McGraw Hill.