HEATING VENTILATION AND COLD STORAGE

ENME 207

Lecture : 3 **Year : II**
Tutorial : 1 **Part : I**
Practical : 2

Course Objectives:
The objective of this course is to provide students with foundational knowledge of vapor compression systems, including an understanding of its theoretical cycles, components, and their operation. Students will also learn to estimate load, size components for cold storage, and acquire the skills necessary to design, operate, diagnose, and maintain various systems used in cooling and heating applications.

1 Thermodynamic Cycles (2 hours)

1.1 Carnot cycle for refrigeration
1.2 Reverse Carnot cycle
1.3 Conclusion from Carnot cycle
1.4 Refrigerator and heat pump
1.5 Coefficient of performance (COP)

2 Refrigeration System (8 hours)

2.1 Introduction
2.2 Unit of refrigeration
2.3 Simple vapour compression refrigeration system: Ideal and actual vapour compression cycles, T-s and p-h diagrams, effects of dry compression and wet compression, COP
2.4 Refrigerants: Classification, ideal properties, chemical properties, chemical properties, environment friendly refrigerants
2.5 Expansion devices: Types, construction and functions

3 Reciprocating Air Compressor (6 hours)

3.1 Air compressor terminology
3.2 Primary components of a reciprocating air compressor
3.3 Working principle of reciprocating air compressor
3.4 Work done by compressor
3.5 Volumetric and adiabatic efficiencies
3.6 Multi-stage compression
3.7 Intercoolers

3.8 Representation of p-V and T-s diagrams
3.9 Clearance volume effects
3.10 Condition for minimum work
3.11 Power required to drive a compressor

4 Other Compressors (6 hours)

4.1 Rotary compressors
4.2 Hermetic sealed compressors
4.3 Centrifugal compressors
4.4 Axial flow compressors
4.5 Application of compressors

5 Evaporators and Condensers (2 hours)

5.1 Evaporators: Types, function, capacity of an evaporator, factors affecting the heat transfer capacity
5.2 Condensers: Types, function, factors affecting the condenser capacity, heat rejection factor, cooling towers and spray ponds

6 Principle of Psychometrics (5 hours)

6.1 Psychrometric properties
6.2 Psychometric processes
6.2.1 Sensible heating and cooling
6.2.2 Cooling and dehumidification
6.2.3 Heating and humidification
6.2.4 Humidification and dehumidification
6.2.5 Mixing of two streams of air
6.2.6 Evaporative cooling/ adiabatic humidification
6.3 Psychrometric chart and its use

7 Cold Storage (8 hours)

7.1 Introduction
7.2 Functional requirements of cold storage
7.3 Condition of storage for perishable products
7.4 Calculation of cooling and heating load
7.5 Design of cold storage system and construction
7.6 Types of cooling plants for cold storage
7.7 Insulation properties and types of insulation material
7.8 Cold storage for milk, meat, fruits, vegetables, poultry and marine products
7.9 Refrigerated transport, handling and distribution, cold chain, refrigerated product handling, order picking, refrigerated vans, refrigerated display. Air diffusion equipment, doors and other openings.

7.10 Prefabricated systems, walk-in-coolers, and refrigerated container trucks
7.11 Sensors for cold storage management
7.12 Freezer storages, freezer room temperatures, insulation of freezer rooms pre-cooling and pre freezing

8 Different Application of Heating and Cooling Processes (8 hours)

8.1 Air conditioning system: Comfort conditions
  8.1.1 Air conditioning systems-equipment used
8.2 Classification-comfort and Industrial air conditioning system- winter, summer and year- round air conditioning system- unitary and central air conditioning system
  8.2.1 Application of refrigeration and air conditioning
  8.2.2 Domestic refrigerator and freezer- ice manufacture
8.3 Ripening chamber: Components, working, maintenance
8.4 Poultry incubator: Components, working, maintenance
8.5 Curd incubator: Components, working, maintenance
8.6 Milk processing plant: Components, working, maintenance
8.7 Ice-cream manufacturing plant: Components, working, maintenance

Tutorial (15 hours)

1. Calculation of cop for different conditions of vapour compression system, heat absorbed by evaporator, heat rejected by condenser
2. Calculation of power required to drive the compressor, volumetric, mechanical efficiencies of compressors
3. Problem related to different psychrometric processes
4. Heating and cooling load calculation, numerical related to design of cold storage
5. Numerical related to design of poultry incubator, curd incubator, milk processing plant, ripening chamber

Project

Cold store design (Home assignment)

Practical (30 hours)

1. Performance evaluation of reciprocating air compressor
2. Study on components and processes of vapour compression
3. Diagnosis maintenance and testing of vapour compression system (Domestic refrigerator)
4. Determination of coefficient of performance of vapour compression.
5. Experiment on cooling towers to determine the efficiency of cooling towers.
6. Determination of pull-down characteristics of a cold storage.

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks distribution*
1	2	4
2	8	10
3	6	8
4	6	6
5	2	4
6	5	8
7	8	10
8	8	10
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

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2. Prasa, M. (2003). Refrigeration and air-conditioning. New Delhi, India: Wiley Eastern Publishers.
3. Dossat, R. J. (1997). Principles of refrigeration. Wiley Eastern Publishers.
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5. Dellino, C. D. J. (1997). Cold and chilled storage technology. Kluwer Academic Publishers.
6. Domkundwar, S., & Arora, S. (1994). A course in refrigeration and air conditioning. New Delhi: Dhanpat Rai and Sons.
7. Althouse, A. D., Turnquist, C. H., Bracciano, A. F., Bracciano, D. A., & Bracciano, G. F. (2004). Modern refrigeration and air conditioning (18th ed.). Goodheart-Willcox Company.
8. Willcox Company Inc. (1982). E.R. Hollowell: Cold storage and freezer storage manual. AVI Publishing Co.
9. Hollowell, E. R. (1980). Cold storage and freezer storage manual. AVI Publishing Co.
10. Rao, C. G. (2015). Engineering for storage of fruits and vegetables. B S Publications, a unit of BSP Pvt. Ltd