

**Dec. 2025**

**B.Tech. (ME) (Fifth Semester)**  
**Refrigeration and Air-Conditioning**  
**(PCC-ME-504/21)**

*Time : 3 Hours*

*[Maximum Marks : 75]*

**Note :** It is compulsory to answer all the questions (1.5 marks each) of Part A in short. Answer any *four* questions from Part B in detail. Different sub-parts of a question are to be attempted adjacent to each other. Psychrometry chart may be used.

**Part A**

1. (a) What are the different types of air filter used in HVAC systems ? 1.5
- (b) What is Thermistor ? 1.5
- (c) Difference between Infiltration and Ventilation. 1.5
- (d) What are the Internal and External sources of Heat Gain ? 1.5

(e) What is Cooling Load Temperature Difference (CLTD) ? 1.5

(f) Define Dry Air, Water Vapor, and Moist air. 1.5

(g) What is Bypass Factor of a Coil ? 1.5

(h) Define Specific Humidity and Absolute Humidity. 1.5

(i) Differentiate between Analyzer and Rectifier in an Ammonia Absorption system. 1.5

(j) Differentiate between COP of Refrigeration and COP of Heat Pump. 1.5

### Part B

2. (a) Describe the primary and secondary refrigerants with suitable examples and applications. 5

(b) Explain the need for air refrigeration systems in aircraft. 10

In a reduced ambient refrigeration system :  
Ambient pressure 0.8 bar, Pressure of ram air = 1.2 bar, Temperature of ram air =  $21^{\circ}\text{C}$ , Pressure at the end of main compressor = 3.5 bar, Efficiency of main compressor = 84%, Heat exchanger

effectiveness = 78%, Pressure at the exit of the aux. turbine = 0.8 bar, Efficiency of auxiliary turbine = 80%, Temperature of air leaving the cabin = 24°C, Pressure in the cabin = 1.013 bar, Flow rate of air through cabin = 62 kg/min. Find : (I) capacity of the cooling system required (II) Power required; and (III) C.O.P. of the system.

3. (a) Define superheating and sub-cooling in a vapour compression cycle. Why are they desirable in practice ? 5

(b) A vapour compression refrigeration plant works between pressure limits of 5.3 bar and 2.1 bar. The vapour is super-heated at the end of compression, its temperature being 37°C. The vapour is super-heated by 5°C before entering the compressor. If the specific heat of super-heated vapour is 0.63 kJ/kgk, find the coefficient of performance of the plant. Use the data given below : 10

Pressure (bar)	Temp. °C	$h_f$ (kJ/kg)	$h_{fg}$ (kJ/kg)
5.3	15.5	56.15	144.9
2.1	-14	25.12	158.7

4. (a) Draw and explain the layout of a practical Ammonia-Water Absorption system. 5

(b) Describe in detail the construction and working of a LiBr-H<sub>2</sub>O Absorption system with a neat diagram. Explain why Lithium Bromide is used as Absorbent and Water as refrigerant in this system. 10

5. (a) Define Overall Heat Transfer Coefficient (U-value) and its role in HVAC load calculations. 5

(b) For an office space, outside air = 35°C DBT, 25°C WBT; inside = 25 °C DBT, 50% RH. Determine the total heat load due to ventilation air at 500 m<sup>3</sup>/h. 10

6. (a) Compare Reciprocating, Rotary, Screw, and Centrifugal Compressors in terms of Application and Efficiency. 5

(b) What are the main objectives of an Air Distribution system in HVAC design ? Describe Thermostatic Expansion Valve with neat sketch. 10

7.

7. Distinguish between saturated air and unsaturated air. The total sensible and latent heat loads in a theatre are 6,00,000 kJ/hr and 2,50,000 kJ/hr respectively. Outdoor conditions are 35°C DBT and 29°C WBT. Indoor required conditions are 26°C DBT and 50% R.H. The ventilation requirements are 170 m<sup>3</sup>/min. The temperature of air entering the registers should not exceed 14.5°C. Calculate the following : 15

- (a) Condition of air leaving the conditioner
- (b) The flow rate of air passing through conditioner in kg/hr.
- (c) The tons of refrigeration required by the conditioner.

