

**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°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. 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 :

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- (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.

