

December 2024

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.

Part A

1. (a) What is difference between wet bulb temperature and dew point temperature ? 1.5
- (b) What is Gross Sensible heat factor ? 1.5
- (c) Why multistage compression used in vapour compression refrigeration system ? 1.5
- (d) What is Contact factor for cooling coils ? 1.5

- (e) What is the effect of undercooling of refrigerant in vapour Compression refrigeration system ? 1.5
- (f) What is the effect of super heating of refrigerant vapours in VCRS ? 1.5
- (g) What is difference between Sensible Heat and latent heat ? 1.5
- (h) Differentiate between primary refrigerants and secondary refrigerants. 1.5
- (i) Why and where is the motive steam used ? 1.5
- (j) What are the uses of Heat Pump ? 1.5

Part B

2. (a) Discuss different factors affecting the choice of refrigerants used in vapour compression system. 5
- (b) The following data refers to a reduced ambient air refrigeration system used for an aircraft:
Speed of aircraft = 1500 km/h, Ambient pressure = 0.8 bar, Ambient temperature =

0°C , Ram efficiency = 100%, Pressure of cooled air leaving the first cooling turbine = 0.8 bar, Temperature of cooled air leaving the heat exchanger = 100°C , Pressure ratio of the main compressor = 3 Pressure loss between the outlet of second cooling turbine and the cabin = 0.1 bar, Pressure in the cabin = 1 bar, Temperature in the cabin = 22°C , Load in the cabin = 10 TR, Isentropic efficiency of compressor = 85%, Isentropic efficiency of both cooling turbines = 80%. Find : (i) mass flow of the air passing through the second cooling turbine; (ii) quantity of Ram air passing through the heat exchanger, if the rise in temperature is limited to 80 K and (iii) C.O.P. of the system.

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3. (a) Discuss the Effects of subcooling and superheating operating conditions on COP in a vapour compression system.

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- (b) An ammonia refrigeration machine works between the temperatures of -10°C and 30°C . The vapour leaves the compressor in dry and saturated condition and temperature

of the liquid refrigerant leaving the condenser is 30°C . Find the kilograms of ice produced per kW-hour assuming actual COP is 65% of theoretical. The quantity of heat carried per kg of ice is 370 kJ/kg. The properties of Ammonia are given below : 10

Temp $^{\circ}\text{C}$	h_f (kJ/kg)	h_{fg} (kJ/kg)	s_f (kJ/kg-K)	s_g (kJ/kg-K)
30	28.5	290.8	0.099	1.055
-10	-8.84	323	-0.033	1.191

4. (a) Describe the steam jet refrigeration system and thermoelectric refrigeration system and its uses. 5
- (b) Explain the construction and working of Lithium-Bromide water absorption refrigeration system and compare it with Water-Ammonia refrigeration system. 10
5. (a) Explain the Gibbs-Dalton law and how is it uses in air conditioning and also the properties of moist Air ? 5
- (b) The air at 40°C DBT and 35% R.H is passed through adiabatic humidifier and it comes out with 36.4°C DBT and fully saturated. Find the quality of water vapour added per kg of dry air. Assume air pressure to be 1.013 bar. 10

6. (a) Describe the functions of the Temperature sensors, Pressure sensors, and Humidity sensors in vapour compression refrigeration system. 5

(b) Explain the terms static and velocity pressure in a duct system used for air-conditioning. Derive an expression for continuity equation in ducts. 10

7. An air conditioned Room is maintained at 25°C DBT and 55% RH. The outdoor conditions are 40°C DBT and 25°C WBT. The sensible heat load in the space is 24.5 kW. The air supplied to the conditioned space as saturated air at 10°C and the equipment consists of an air washer. The air entering the air washer contains 25% outdoor air and 65% re-circulated air. Determine (i) volume of air supplied to the space per minute, (ii) latent heat load in the space, (iii) cooling load of air washer.

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