20/05/2025 TE MECHANICAL SEM-VI C-SCHEME HVACR QP CODE: 10083835

Time: 3Hrs **Marks:80**

NB:
1. **Question No.1** is compulsory
2. Attempt **any three questions from the remaining questions**.
3. **All questions carry equal marks.**
4. **Assume suitable data** if necessary and **state it clearly**.
5. **Use of Refrigerant tables, Friction Charts, Psychrometric Charts, and Steam Tables are permitted.**

1		Answer any four from the following	20
	a.	Explain the classification of refrigerants with an example.	5
	b.	A machine working on a Carnot cycle operates between 305 K and 260 K. Determine the C.O.P. when it is operated as: 1. A refrigerating machine; 2. A Heat Pump, and 3. a heat engine.	5
	c.	Write a note on a Heat Pump.	5
	d.	Define the term 'effective temperature' and explain its significance in the design of air conditioning systems.	5
	e.	State the types of Expansion device and explain the working of any one with neat diagram.	5
	f.	State the various applications of HVACR and explain any one application.	5

2 a. Draw a neat diagram of a three-fluid system of refrigeration (Electrolux refrigeration system) and explain its working. **08**

 b. A Simple evaporative air refrigeration system is used for an aeroplane to take 20 tonnes of refrigeration load. The ambient air conditions are 20°C and 0.9 bar. The ambient air is rammed isentropically to a pressure of 1 bar. The air leaving the main compressor at pressure 3.5 bar is first cooled in the heat exchanger having effectiveness of 0. 6 and then in the evaporator where its temperature is reduced by 5°C. The air from the evaporator is passed through the cooling turbine, and then it is supplied to the cabin, which is to be maintained at a temperature of 25°C and at a pressure of 1.05 bar. If the internal efficiency of the compressor is 80% and that of cooling turbine is 75%, determine: 1. Mass of air bled off the main compressor; 2. Power required for the refrigerating system, and 3. C.O.P. of the refrigerating system. **12**

3 a. A vapour compression refrigerator uses R-12 as refrigerant and the liquid evaporates in the evaporator at - l5°C. The temperature of this refrigerant at the delivery from the compressor is 15°C when the vapour is condensed at 10°C. Find the coefficient performance if (i) there is no undercooling, and (ii) the liquid is cooled by 5°C before expansion by throttling. **10**

Take specific heat at constant pressure for the superheated vapour as 0.64 kJ/kg K, and that for liquid as 0.94 kJ/kg K. The other properties of refrigerant are as follows:

Temperature in °C	Enthalpy in kJ/ kg		Specific entropy in kJ/kg K	
	Liquid	Vapour	Liquid	Vapour
-15	22.3	180.33	0.0904	0.7051
10	45.4	191.76	0.1750	0.6921

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   b. A vapor compression cycle using refrigerant R-22 operates at a condensing temperature   **10**
of 34°C and an evaporative temperature of -10°C. For a mass flow rate of the refrigerant
equal to 0.33 kg/s. **Determine the following: Use p-h chart**: 1. The compressor power;
2. The refrigerating effect; 3. The coefficient of performance.

4 **a.** Explain various psychrometric processes.   **08**

   b. The following data refer to air conditioning of a public hall: **12**
    Outdoor conditions = 40°C DBT, 20°C WBT
    Required comfort conditions = 20°C, DBT, 50% RH
    Seating capacity of hall = 1000
    Amount of outdoor air supplied = 0.3 m^3/min/person
    If the required condition is achieved first by adiabatic humidifying and then cooling, find:
    1. The capacity of the cooling coil and surface temperature of the coil if the by-pass factor
      is 0.25, and 2. The capacity of the humidifier and its efficiency

5 **a** .800 m^3/min of recirculated air at 22°C DBT and 10°C dew point temperature is to be   **10**
mixed with 300 m^3/min of fresh air at 30°C DBT and 50% RH. Determine the enthalpy,
specific volume, humidity ratio, and dew point temperature of the mixture. Determine:
    a. Enthalpy
    b. Humidity Ratio
    c. Specific volume and
    d. DPT of the mixture

   b Draw a neat sketch of Air Handling Unit showing each component. Also, state the   **10**
functions of each component.

6 **a** A duct of 15m length passes air at the rate of 90 m^3/min. Assuming the friction factor as   **10**
0.005, calculate the pressure drop in the duct in mm of water when (a) the duct is circular
of diameter 0.3 m; and (b) the duct is of 0.3 m square cross-section.

   b **Answer Any TWO.**   **10**
   1. Define human comfort. Explain the factors affecting human comfort.   **5**
   2. Define: i) Ton of Refrigeration ii) Bypass Factor iii) Dry bulb temperature iv) Wet bulb   **5**
   temperature v) Humidity ratio
   3. Dairy and food processing plant   **5**

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