Paper ID : 250542

Roll No:

BTECH
(SEM VI) THEORY EXAMINATION 2024-25
REFRIGERATION AND AIR CONDITIONING

TIME: 3 HRS   **M.MARKS: 70**

Note: Attempt all Sections. In case of any missing data; choose suitably.
Steam Table and psychometric chart is allowed

SECTION A

1.   **Attempt *all* questions in brief.**   **02 x 7 = 14**

Q no.	Question	CO	Level
a.	Define Refrigeration Effect and Ton of Refrigeration (TR).	1	K1
b.	Differentiate between Refrigerator and Heat Pump.	1	K2
c.	Why is subcooling done in a vapour compression cycle?	2	K3
d.	What is the significance of DART (Dry Air Rated Temperature) in aircraft refrigeration?	2	K4
e.	Define term Refrigerant and Absorbent in case of vapour absorption refrigeration system.	3	K2
f.	What are Ozone Depletion Potential (ODP) and Global Warming Potential (GWP)?	4	K1
g.	Define Sensible Heat Factor (SHF) and Apparatus Dew Point (ADP).	5	K2

SECTION B

2.   **Attempt any *three* of the following:**   **07 x 3 = 21**

Q no.	Question	CO	Level
a.	Explain the Reversed Carnot Refrigeration Cycle with a T-S diagram. Why is it not practical for real applications?	1	K4
b.	Compare Boot-Strap and Reduced Ambient aircraft refrigeration systems with neat sketches.	2	K5
c.	Discuss the effect of superheating and subcooling on the performance of a Vapour Compression Refrigeration System (VCRS).	3	K3
d.	Explain the working principle of a vapour absorption refrigeration system with neat sketch. Consider the case of Ammonia -water	4	K3
e.	What are secondary refrigerants? Compare them with primary refrigerants.	5	K4

SECTION C

3.   **Attempt any *one* part of the following:**   **07 x 1 = 07**

Q no.	Question	CO	Level
a.	In a 5-kW refrigeration system working on a simple VCRS cycle, the refrigerant enters the evaporator with an enthalpy of 75 kJ/kg and leaves at 183 kJ/kg. The enthalpy at the compressor discharge is 210 kJ/kg. **Calculate:**(i) COP (ii) Power consumption (kW) (iii) Rate of heat transfer in the condenser (kW) (iv) Mass flow rate of Refrigerant.	1	K3
b.	A VCRS system using R-12 produces 8640 kg of ice/day. The condenser and evaporator temperatures are 48°C and -20°C, respectively. Saturated liquid leaves the condenser, and saturated vapour leaves the evaporator. The compression is isentropic. Water at 35°C is used to form ice at -8°C. Heat leakage into the brine tank is 10% of the total heat removed. Determine the total power required (kW). (Given: Specific heat of ice = 2.26 kJ/kgK, Latent heat of ice = 334.72 kJ/kg, Specific heat of vapour refrigerant = 0.82 kJ/kgK.)	1	K3

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4.	**Attempt any *one* part of the following:**	07 x 1 = 07	
a.	A Bell-Coleman cycle refrigerator operates with air entering the compressor at 1 bar, -3°C, compressed to 5 bar, cooled to 17°C, and expanded polytropically ($PV^{1.25}$ = C) to 1 bar. Determine: (i) Refrigeration effect (kJ/kg) (ii) Work input (kJ/kg)(iii) COP	2	K3
b.	A Joule cycle refrigeration system has an outlet temperature from the cold space at 270 K and turbine inlet at 318 K with a pressure ratio of 4. For 1 TR cooling capacity, determine:(i) Mass flow rate (kg/s) (ii)Heat rejection (kW) (iii) Compressor & Turbine work (kW) (iv) COP (v) Volume flow rates at compressor inlet & turbine outlet. Take Cpair = 1.005 KJ/KgK.	2	K3
5.	**Attempt any *one* part of the following:**	07 x 1 = 07	
a.	The DBT and WBT of atmospheric air are 30°C and 20°C, respectively, at 740 mm Hg**.** Determine: **(**i) Partial pressure of water vapour & dew point temperature (ii) Specific humidity (iii) Relative humidity (iv) Vapour density (Given: Saturated pressure at 30°C is 0.04242 bar and at 20°C = 0.02337 bar.)	3	K3
b.	A geothermal well (130°C) supplies 100,500 kJ/hr to an absorption refrigeration system. The environment is at 30°C, and the refrigerated space is at -22°C. Determine the maximum possible heat removal rate from the refrigerated space.	3	5
6.	**Attempt any *one* part of the following:**	07 x 1 = 07	
a.	Break down the Cooling Load Calculation process by comparing the relative contributions of wall heat gain, infiltration, and internal heat sources. How would you diagnose the dominant factor in a given scenario?	4	K4
b.	Using a psychrometric chart, demonstrate the adiabatic mixing of two air streams with given temperature and humidity conditions. Calculate the resulting DBT, WBT, and Specific Humidity, and justify your findings.	4	K3
7.	**Attempt any *one* part of the following:**	07 x 1 = 07	
a.	Explain the working of a Steam Jet Refrigeration System using a neat diagram and classify the key components based on their functions.	5	K3
b.	Analyze the key distinctions between vapour compression and vapour absorption refrigeration systems by: (i) Evaluating their energy sources in terms of efficiency and practicality (ii) Comparing their theoretical and practical COP under varying conditions (iii) Diagnosing their suitability for specific industrial/commercial applications (iv) Assessing their environmental impact in terms of refrigerant emissions and energy sustainability	5	K3