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Subject Code: BME601

Roll No:

BTECH

(SEM. VI) THEORY EXAMINATION 2025-26

REFRIGERATION AND AIR CONDITIONING

TIME: 3 HRS

M.MARKS: 70

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.**SECTION A**1. Attempt *all* questions in brief.

2x7 = 14

Q.N.	Question	CO	Level
(a)	Define refrigeration and state the unit of refrigeration (Ton of Refrigeration).	CO1	K2
(b)	What is Coefficient of Performance (COP)? Write its expression for a refrigerator and a heat pump.	CO1	K2
(c)	List any four desirable properties of an ideal refrigerant.	CO3	K2
(d)	What is dry air rated temperature (DART) in aircraft refrigeration?	CO1	K2
(e)	Define psychrometric properties: Dry Bulb Temperature and Wet Bulb Temperature.	CO4	K2
(f)	State the effect of sub-cooling of condensate on the COP of a vapour compression refrigeration cycle.	CO6	K4
(g)	What is an Apparatus Dew Point (ADP) and Bypass Factor in air conditioning?	CO4	K2

SECTION B2. Attempt any *three* of the following:

7 x 3 = 21

(a)	Derive the expression for COP of a reversed Carnot refrigeration cycle. Compare it with a practical vapour compression cycle and explain the limitations of the reversed Carnot cycle.	CO2	K2
(b)	With a neat schematic diagram, explain the working of a Bell Coleman (Reversed Joule) air refrigeration cycle. Derive the expression for its COP.	CO2	K2
(c)	Explain the working principle of a vapour absorption refrigeration system. Draw the schematic diagram and compare it with the vapour compression system.	CO2	K2
(d)	Explain the following psychrometric processes with the help of a psychrometric chart: (i) Sensible Cooling, (ii) Sensible Heating, (iii) Cooling and Dehumidification, (iv) Heating and Humidification.	CO4	K2
(e)	What is a multistage vapour compression system? With a diagram, explain a two-stage system with inter-cooling and flash gas removal. State its advantages over single-stage compression.	CO3	K2

SECTION C3. Attempt any *one* part of the following:

7 x 1 = 7

(a)	A reversed Carnot cycle operates between temperature limits of -10°C and 40°C . Calculate: (i) COP of the refrigerator, (ii) COP of the heat pump, and (iii) the refrigerating effect produced per kW of work input. Also draw the cycle on T-S diagram.	CO5	K3
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(b)	In a simple vapour compression refrigeration system using R-134a, the evaporator and condenser pressures are 2.0 bar and 10.0 bar respectively. The vapour entering the compressor is dry and saturated. Determine: (i) Refrigerating effect per kg of refrigerant, (ii) Work done per kg, (iii) COP of the system, (iv) Mass flow rate for 5 TR capacity.	CO5	K3
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4. Attempt any one part of the following:

7 x 1 = 7

(a)	Explain the bootstrap air refrigeration system used in aircraft with a neat diagram. Derive the expression for COP and compare it with the simple air refrigeration cycle. State the advantages of bootstrap system.	CO3	K2
(b)	Explain the Ammonia-Water vapour absorption system with a neat schematic diagram. Discuss the role of the analyser and rectifier. Also draw the Temperature-Concentration diagram for the NH ₃ -H ₂ O mixture.	CO2	K2

5. Attempt any one part of the following:

7 x 1 = 7

(a)	Discuss ozone layer depletion and global warming potential (GWP) of refrigerants. What are Hydrofluoro-Olefins (HFOs) and why are they considered future refrigerants?	CO3	K2
(b)	What is a cascade refrigeration system? With a neat diagram, explain its working principle, advantages, and applications. Derive the expression for overall COP of a two-stage cascade system.	CO3	K3

6. Attempt any one part of the following:

7 x 1 = 7

(a)	For an air-conditioned space, the following data is given: Outdoor conditions 40°C DBT, 27°C WBT; Indoor conditions 25°C DBT, 50% RH; Supply air at ADP. Calculate: (i) Sensible Heat Factor (SHF), (ii) Apparatus Dew Point, (iii) By-pass factor if sensible heat load = 20 kW and latent heat load = 5 kW.	CO5	K3
(b)	Explain the effect of change in suction pressure and discharge pressure on the COP of a vapour compression refrigeration cycle using appropriate graphs. Also explain the effect of superheating of refrigerant vapour on COP.	CO6	K4

7. Attempt any one part of the following:

7 x 1 = 7

(a)	Write short notes on any two of the following: (i) Vortex tube refrigeration system, (ii) Thermoelectric refrigeration system, (iii) Steam jet refrigeration system, (iv) Magnetic refrigeration system.	CO3	K2
(b)	Explain the types of compressors used in refrigeration systems. Discuss the construction and working of a hermetically sealed compressor and a thermostatic expansion valve.	CO2	K2