PVP 20

Code: 20ME4501E

III B.Tech - I Semester – Regular / Supplementary Examinations
NOVEMBER 2023

REFRIGERATION AND AIR CONDITIONING
(MECHANICAL ENGINEERING)

Duration: 3 hours Max. Marks: 70

Note: 1. This paper contains questions from 5 units of Syllabus. Each unit carries 14 marks and have an internal choice of Questions.
2. All parts of Question must be answered in one place.

BL – Blooms Level CO – Course Outcome

			BL	CO	Max. Marks
		UNIT-I			
1	a)	Discuss the working of a Carnot refrigerator with working substance as air as well as vapor. Derive an expression for its COP.	L2	CO1	5 M
	b)	300kg of atmospheric air is circulated per hour in a Bell Coleman refrigerator. The air is drawn from the evaporator at temperature 8^0 C and 1 bar and then compressed isentropically to 5 bar. It is cooled at this pressure to 28^0 C and then led to the expander where it expands isentropically down to atmospheric pressure and is discharged to evaporator. Determine the COP of the system. For air take $\gamma = 1.4$ and $C_p = 1.003$ kJ/KgK.	L3	CO1	9 M
		OR			
2	a)	Discuss the advantages and disadvantages of the Bell-Coleman air cycle.	L2	CO1	5 M
	b)	Describe with a schematic diagram and draw T-s representation of the processes of Simple air - Evaporative type air craft refrigeration system.	L2	CO1	9 M

UNIT-II					
3	a)	Explain the differences between flooded type shell-and-tube evaporator & dry type shell-and-tube evaporator.	L2	CO2	7 M
	b)	An NH_3 refrigeration plant has a capacity of 20 TR. The condensation and evaporation temperatures are 35°C and -20°C, respectively. Refrigerant is dry and saturated at the entry to the compressor. There is no undercooling of the liquid refrigerant. If the actual COP is 0.7 times the theoretical COP, determine the following: (i) Mass flow rate of refrigerant. (ii) Power required to drive the compressor. (iii) Diameter and stroke of the compressor running at 4 rev/s and L = D. Its volumetric efficiency is 80% and is single-acting.	L3	CO2	7 M
OR					
4	a)	Describe with the help of a neat sketch the working of the Vapour Compression Refrigeration System. Show the various state points and processes on the T–s diagram.	L2	CO2	7 M
	b)	Discuss the desirable properties of a good refrigerant.	L2	CO2	7 M
UNIT-III					
5	a)	Describe the working of Simple Vapour Absorption Refrigeration System.	L2	CO2	7 M
	b)	Discuss the working principle of Vortex tube refrigeration system with advantages and disadvantages.	L2	CO2	7 M
OR					
6	a)	Explain the working principle of the thermoelectric refrigeration system.	L2	CO2	7 M

	b)	Define the Seebeck effect, Peltier Effect and Thomson effect, prove their relation between them.	L3	CO2	7 M
		UNIT-IV			
7	a)	Explain in detail about specific humidity and establish the following expression for air vapour mixture $W = 0.622 \frac{P_v}{Pb \ -P_v}$ where W=specific humidity, P_v=Partial pressure of water Vapour, P_b=partial barometric pressure or total pressure.	L3	CO3	6 M
	b)	A sling psychrometer reads 40^0C DBT and 28^0C WBT evaluate the following, (i) Specific Humidity (ii) Relative Humidity (iii) vapour density of air (iv) Dew point temperature (v) Enthalpy of the mixture per kg of dry air either using steam tables or psychrometric chart.	L3	CO3	8 M
		OR			
8	a)	Establish the expression for by pass factor of heating coil or cooling coil and also establish the relation between the by pass factor and efficiency of the coil.	L3	CO3	6 M
	b)	The atmospheric air at 760mm of Hg, dry bulb temperature 15^0C and wet bulb temperature 11^0C entering a heating coil whose temperature is 41^0C. Assuming by pass factor of heating coil as 0.5, Evaluate the dry bulb temperature, wet bulb temperature and relative humidity of the air leaving the coil. Also determine the sensible heat added to the air per kg of dry air.	L3	CO3	8 M

		UNIT-V			
9	a)	Discuss the factors effecting on human comfort in air conditioning processes.	L2	CO3	7 M
	b)	The following data refer to the summer air conditioning of a building Outside design conditions=43^0C DBT, 27^0C WBT Inside design conditions=25^0C DBT, 50% of RH Room sensible heat gain = 84000 kJ/h Room latent heat gain = 21000 kJ/h By-pass factor of the cooling coil = 0.2 The return air from the room is mixed with the outside air before entry to cooling coil in the ratio of 4:1 by mass. Determine (i) Apparatus dew point of the cooling coil, (ii) entry and exit conditions of air for cooling coil, (iii) fresh air mass flow rate and (iv) refrigeration load on the cooling coil.	L4	CO3	7 M
		OR			
10	a)	Discuss the following process on the skeleton psychrometric chart i) Heating and Humidification by steam injection ii) Heating and Dehumidification by adiabatic chemical dehumidification.	L2	CO3	9 M
	b)	Describe a centrifugal fan with a neat sketch.	L1	CO3	3 M
	c)	What you understand by the geometrically similar fan? Discuss the various fan similarity laws.	L2	CO3	2 M