PVP 23

Code: 23ME4602D

III B.Tech - II Semester - Regular Examinations – APRIL 2026

REFRIGERATION & AIR-CONDITIONING

(MECHANICAL ENGINEERING)

Duration: 3 hours Max. Marks: 70

Note: 1. This question paper contains two Parts A and B.
2. Part-A contains 10 short answer questions. Each Question carries 2 Marks.
3. Part-B contains 5 essay questions with an internal choice from each unit. Each Question carries 10 marks.
4. All parts of Question paper must be answered in one place.

BL – Blooms Level CO – Course Outcome

PART – A

		BL	CO
1.a)	A machine working on the Carnot cycle operates between 305K and 260K. Determine the COP when it is operated as a heat engine and heat pump.	L2	CO1
1.b)	What is the term “Ton of refrigeration”.	L2	CO1
1.c)	Mention the chemical formula and the refrigerant number of following refrigerants:(i)Dichloro difluoro methane, (ii) Dichloro tetrafluoro ethane.	L2	CO2
1.d)	What is meant by sub-cooling and superheating of refrigerant in VCR.	L2	CO2
1.e)	State the principle used in thermoelectric refrigerator.	L2	CO3
1.f)	What is meant by three-fluid absorption system and what is the significance of inert gas in three fluid refrigeration system.	L2	CO3
1.g)	What is the need for ventilation in air-onditioned spaces.	L2	CO4
1.h)	Define sensible heat ,latent heat and Sensible Heat Factor.	L2	CO4

1.i)	Define Human comfort. List any four factors affecting human comfort.	L2	CO5
1.j)	What is winter air conditioning and summer air conditioning?	L2	CO5

PART – B

			BL	CO	Max. Marks
		UNIT-I			
2	a)	Plot a neat sketch of the Bell-Coleman cycle on the p-v and T-S diagrams and evaluate the COP of the cycle in terms of pressure ratio.	L2	CO1	5 M
	b)	Distinguish between the Carnot heat engine and the Carnot refrigerator with suitable diagrams. Develop the expression for COP of the Carnot Refrigerator. From the expression how can you justify the COP of Carnot Refrigerator is maximum?	L2	CO1	5 M
		OR			
3	a)	Classify the different methods of air refrigeration and explain the simple air-cooling system with T-S diagram.	L2	CO1	4 M
	b)	A dense air refrigeration cycle operates between pressures of 4 bar and 16 bar. The air temperature after the heat rejection to surroundings is 37^0C and temperature at exit of refrigeration is 7^0C. The isentropic efficiencies of the turbine and compressors are 85% and 80% respectively. Determine the compressors work and turbine work per TR (ii) C.O.P (iii) power per TR, represent the cycle on the p-v and T- S diagrams.	L3	CO1	6 M
		UNIT-II			
4	a)	Classify the different methods of vapour compression refrigeration system and draw the	L3	CO2	5 M

		neat diagram of simple vapour compression refrigeration system if the arrangement after the compression is super heating and after the condensation is subcooling and write the relevant equations.			
	b)	Explain the desirable properties of refrigerants.	L3	CO2	5 M
		OR			
5		A cold storage of 120 TR capacity operates between the temperature limits of -30°C and +30°C. The refrigerant at the suction of the compressor is dry and saturated and at the exit of the condenser, it is sub-cooled by 10°C. The actual COP is 70% of the theoretical. Find the following: (i) Actual and theoretical COP (ii) Mass of refrigerant circulated in kg/s. (iii) Compressor power (iv) Piston diameter if L/D = 1.2, speed is 300 rpm and volumetric efficiency is 85%. Take Cp_v = 0.55 kJ/kg-K and Cp_l, = 1.19 The properties of refrigerant are:	L3	CO2	10 M

Temp ^0C	*P bar*	*Vg* m^3/kg	h_f *kJ/kg*	h_g *kJ/kg*	s_f *kJ/kg K*	s_g *kJ/kg K*
-30	1.6	0.136	166.2	393	0.87	1.803
30	12	0.020	236.8	415	1311	1.712

		UNIT-III			
6	a)	Derive an expression for the maximum COP of an ideal Vapour absorption system in terms of heating, cooling and refrigerator temperatures.	L3	CO3	5 M
	b)	Explain the working principle of steam jet refrigeration system with neat diagram.	L3	CO3	5 M
		OR			
7	a)	With the help of a neat sketch, explain the working principle of Thermoelectric refrigeration system with their advantages and limitations.	L3	CO3	5 M
	b)	Differentiate vapour absorption refrigeration system and vapour compression refrigeration system.	L3	CO3	5 M

UNIT-IV					
8	a)	Derive the expression for the by-pass factor of the coil with clear sketch.	L3	CO4	4 M
	b)	Explain the following terms related to the psychrometric properties of air with a suitable diagram on psychrometric chart. (i) Dry bulb Temperature (ii) Wet Bulb temperature (iii) saturation temperature. (iv) relative humidity (v)dewpoint temperature.	L3	CO4	6 M
OR					
9		Air at 10^0C DBT and 90% RH is to be heated and humidified to 35^0C DBT and 22.5^0C WBT. The air is preheated sensibly before passing to the air washer in which water is recirculated. The relative humidity of the air coming out of the air washer is 90%. The air is again heated by sensible process to obtain the final desired condition. Find (i) the temperature of the air should be preheated. (ii) total heating required. (iii) make up water required in the air washer (iv) the humidifying efficiency of the air washer.	L3	CO4	10 M
UNIT-V					
10	a)	Discuss the importance of human comfort in AC design with reference to effective temperature and comfort chart.	L4	CO5	5 M
	b)	Explain in detail the functions and types of filters, grills, registers, fans, and blowers used in air-conditioning systems.	L3	CO5	5 M
OR					
11	a)	Discuss the different applications of comfort air conditioning and write the design procedure for air conditioning of cold storage plants.	L4	CO5	5 M
	b)	Compare unitary and central air-conditioning systems with advantages and disadvantages.	L3	CO5	5 M