Hall Ticket Number:

Code No. : 17553 N/O

VASAVI COLLEGE OF ENGINEERING *(AUTONOMOUS)*, HYDERABAD

Accredited by NAAC with A++ Grade

B.E. (Mech. Engg.) VII-Semester Main & Backlog Examinations, Dec.-23/Jan.-24

Refrigeration and Air Conditioning (PE-II)

Time: **3 hours** Max. Marks: **60**

*Note: Answer all questions from **Part-A** and any **FIVE** from **Part-B***

Use of Refrigerant and Psychrometric Properties [Tables and Charts] is permissible.

Part-A (10 × 2 = 20 Marks)

Q. No.	Stem of the question	M	L	CO	PO
1.	Define "Refrigerating Effect" and "Refrigeration System Capacity". Give their SI units.	2	1	1	1
2.	Distinguish between "Primary Refrigerant" and "Secondary Refrigerant". Give One example for each.	2	2	1	1
3.	Mention the functions performed by the components, viz., (i) Filter cum Drier and (ii) Capillary Tube in a Vapor Compression Refrigeration System.	2	1	2	1
4.	Calculate the COP of the standard vapor compression refrigeration cycle in which the refrigerant exhibits enthalpies, viz., 404 kJ/kg, 431 kJ/kg and 237 kJ/kg, at compressor suction, compressor discharge and condenser discharge, respectively.	2	3	2	1
5.	A Vapor Absorption Refrigeration System comprises the generator, condenser and evaporator working at temperatures 87°C, 27°C and -23°C. Find the COP of the system.	2	3	3	1
6.	List the principal components of Steam Jet Refrigeration System.	2	2	3	1
7.	Air at standard atmospheric pressure possesses water vapor at partial pressure 0.0301 bar. Find the specific humidity of air.	2	3	4	1
8.	Distinguish between "Absolute Humidification" and "Absolute Dehumidification". Show these processes on Psychrometric Chart.	2	1	4	1
9.	Define "Room Sensible Heat Factor" and "Gross Sensible Heat Factor" as referred to air-conditioning system.	2	3	5	1
10.	In a "Split Air-Conditioner", what are the components that exist inside the room and what are the components that exist outside the room?	2	2	5	1
	Part-B (5 × 8 = 40 Marks)				
11. a)	Explain at least eight desirable properties to be satisfied by refrigerants used in Vapor Refrigeration Systems.	4	1	1	1, 2
b)	A Bell-Coleman air refrigeration system takes air from the refrigerated space at 1 bar and –5°C and compresses to 6 bar in accordance with the law $Pv^{1.25}$ = constant. The compressed air is cooled to 37°C in the heat exchanger before entering the expander. The expansion is isentropic. Determine (i) COP of the cycle, (ii) mass of air circulated per minute. Take Refrigeration capacity of the plant as 10TR.	4	4	1	1, 2
12. a)	With the help of a neat line diagram and the corresponding T-s diagram, explain the working of a Vapor Compression Refrigeration System.	4	2	2	1, 2

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b)	A refrigerating plant works between the temperature limits of –5°C and 25°C. The working fluid is CO_2 and it has a dryness fraction 0.6 at compressor entry and is still wet even after compression. If the actual COP of the machine is 50% of the theoretical COP, calculate the mass of ice formed during a period of 24 hours. Ice is to be formed at 0°C from water at 10°C, and for doing this, a power input of 2.782 kW is needed. Use the following table of properties of CO_2 to solve the problem:	4	4	2	1, 2

T (K)	h_f [kJ/kg]	h_{fg} [kJ/kg]	s_f [kJ/kg K]
298	81.25	121.5	0.2513
268	7.53	245.8	0.04187

13. a)	Explain the working principle of an Aqua-Ammonia Vapor Absorption Refrigeration System together with a neat schematic diagram.	4	2	3	1, 2
b)	What are the essential differences between Vapor Compression and Vapor Absorption Refrigeration Systems?	4	2	3	1, 2
14. a)	Define (i) Psychrometry, (ii) Dew point temperature, (iii) Degree of saturation and (iv) Relative humidity.	4	2	4	1, 2
b)	A quantity of air having 300m^3/min at 30°C DBT and 25°C WBT is heated to 40°C DBT. Estimate the i) amount of heat added in kW ii) Final relative humidity iii) Final WBT and iv) Final specific humidity in gms/ kg of dry air.	4	4	4	1, 2
15. a)	Discuss the procedure for estimating the heat loads of an office building.	4	2	5	1, 2
b)	The following data refers to an industrial air-conditioning system working in hot and wet climatic conditions: Outdoor Conditions: 30°C dry bulb temperature and 75% relative humidity. Required Inside Conditions: 20°C dry bulb temperature and 60% relative humidity. The volume flow rate of air: 20 m^3/min. If the required condition is achieved by a "combination" of two psychrometric processes, viz., (i) cooling with dehumidification accompanied by (ii) sensible heating. Calculate (i) the capacity of the cooling cum dehumidifying coil in tons of refrigeration, (ii) the capacity of the heating coil in kW, and (iii) the rate of removal of water vapor in kg/h.	4	4	5	1, 2
16. a)	Explain (i) Ice Refrigeration and (ii) Evaporative Refrigeration.	4	1	1	1, 2
b)	Though most efficient, one can not use "Carnot Vapor Compression Refrigeration System" in actual practice. Explain the main limitations responsible for the above.	4	3	2	1, 2
17.	Answer any ***two*** of the following:				
a)	With the help of an appropriate block diagram, derive the expression for the COP of the Vapor Absorption Refrigeration System.	4	1	3	1, 2
b)	Explain the requirements of human comfort.	4	4	4	1, 2
c)	With the help of a neat sketch, explain the working of a Central Air-Conditioning System.	4	2	5	1, 2

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

i)	Blooms Taxonomy Level – 1	22.5%
ii)	Blooms Taxonomy Level – 2	37.5%
iii)	Blooms Taxonomy Level – 3 & 4	40%

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