UPES
End Semester Examination, May 2023

Course: B.Tech (Food Technology)   **Semester: IV**
Program: Refrigeration and Cold Chain   **Time : 03 hrs.**
Course Code: MECH2038   **Max. Marks: 100**

Instructions:

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	a. The vapour compression refrigerator employs the following cycle (A) Rankine (B) Carnot (C) Reversed Rankine (D) Reversed Carnot b. Condensing temperature in a refrigerator is the temperature (A) Of cooling medium (B) Of freezing zone (C) Of evaporator (D) At which refrigerant gas becomes liquid c. The evolution of heat of solution takes place in ammonia absorption plant when (A) Ammonia vapour goes into solution (B) Ammonia vapour is driven out of solution (C) Lithium bromide mixes with ammonia (D) Weak solution mixes with strong solution d. The ratio of the actual mass of water vapour in a unit mass of dry air to the mass of water vapour in the same mass of dry air when it is saturated at the same temperature and pressure, is called	4	CO1

	(A) Humidity ratio		
	(B) Relative humidity		
	(C) Absolute humidity		
	(D) Degree of saturation		
Q 2	On what factors does the volumetric efficiency of the compressor depends?	**4**	**CO1**
Q 3	Differentiate between primary and secondary refrigerants.	**4**	**CO1**
Q 4	Write the chemical formula of R_{22} and $R_{114.}$	**4**	**CO1**
Q 5	Enumerate the advantages of vapour absorption system over vapour compression system.	**4**	**CO1**
**SECTION B  ** **(4Qx10M= 40 Marks)**
Q 6	Describe various classification of refrigerant along with their application.	**10**	**CO2**
Q 7	Write note on: (a) reciprocating compressor (b) Screw compressor. Or Briefly with the schematic diagram explain the working of centrifugal compressor	**10**	**CO2**

Q 8	A Carnot refrigeration cycle absorbs heat at 270 K and rejects it at 300 K. Calculate
	     (a) The C.O.P of this refrigeration cycle.
	     (b) If the cycle is absorbing1130 kJ/min at 270K how many kJ of work is required per second?
	     (c) If the Carnot heat pump operates between same temperature limits. What will be C.O.P of the system?
	     (d) How many kJ/min will the heat pump deliver at 300 K if it absorbs 1130kJ/min at 270 K.
		10	**CO3**

Q 9	An ammonia refrigerator produces 20 tons of ice at 0°C in 24 hours. The temperature range of the system is -15°C to 25°C .The vapour leaving the compressor is dry saturated. Assuming actual C.O.P is 75% of the theoretical; calculate the power required to run the compressor.Use the following properties of ammonia.	**10**	**CO3**
**SECTION-C  ** **(2Qx20M=40 Marks)**
Q 10	An ammonia ice plant operates between condenser temperature of 35°C and an evaporator temperature of -15°C.it produces 5 tons of ice per day from	**20**	**CO3**

water at 25°C to ice at -5°C .The NH₃ enters the compressor as dry saturated vapour and leaves the condenser as saturated liquid. Determine The capacity of the refrigerating plant (b) mass low rate of the refrigerant (c) discharge temperature of NH₃ from the compressor .(iv) Power of the compressor motor if the isentropic efficiency of the compressor is 85% and the mechanical efficiency of the compressor is 90%.(v) relative efficiency.

Take latent heat of ice =335 kJ/kg K
Specific heat of ice =1.94kJ/kgK
Specific heat of water=4.2 kJ/kgk
Use following properties of NH₃

Saturation temperature °C	Enthalpy kJ/kg		Entropy kJ/kgK		Specific heat KJ/kg-K	
	h_f	h_g	s_f	s_g	C_{pf}	C_{pg}
-15	112.3	1426	0.457	5.549	-	-
35	347.5	1471	1.282	4.930	4.6	2.8

Q 11	A refrigeration system works on vapour compression cycle. Enthalpies at various points are given below. Compressor inlet – 1460 kJ/kg. Compressor outlet – 1796 kJ/kg. Inlet to expansion valve – 322 kJ/kg. Calculate :(i) COP and(ii) Power required for 1 kg of refrigerant circulated per min. The refrigerant is superheated by 15 °C before it enters the compressor and sub cooled by 3 °C before expansion. Sketch the cycle on p-h & T-S diagram OR Discuss the working of cold chain systems for marine food items	20	CO2/CO3