Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER- VII EXAMINATION-SUMMER 2023

Subject Code: 3171918 Date: 23/06/2023

Subject Name: Refrigeration and Air conditioning

Time: 10:30 AM TO 01:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

MARKS

Q.1 **(a)** How to calculate the Total Equivalent Warming Impact (TEWI) of refrigerant? **03**

(b) Enlist requirement for working fluid to use as a refrigerant in vapour compression cycle. **04**

(c) Differentiate all-air, all-water and air-water air conditioning system with neat sketch. **07**

Q.2 **(a)** List out the different method of improving the COP of simple compression refrigeration cycle **03**

(b) Enlist various methods for food preservation. How does Cold Storage Work? **04**

(c) Calculate the power needed to compress 20 kg/min of ammonia from saturated vapour at 1.4 bar to a condensing pressure of 10 bar by two stage compression with intercooling by liquid refrigerant at 4 bar. Assume saturated liquid to leave the condenser and dry saturated vapour to leave the evaporator. Also determine the power needed when intercooling is not employed. **07**

Use following properties:

Point	Enthalpy, h (kJ/kg)	Entopy, s (kJ/kg K)
Saturated vapour at low pressure compressor inlet	1400	5.75
Superheated vapour at low pressure compressor exit	1525	-
Saturated vapour leaving intercooler	1428	5.39
Superheated vapour at high pressure compressor exit	1550	-
Saturated liquid at condenser exit	284	-

OR

(c) Why is compound refrigeration system employed when condenser temperature to evaporator temperature range is very large? Explain the difference between compound vapour compression system with flash cooling and flash intercooling. **07**

Q.3 **(a)** Why air cycle refrigeration is most suitable for aircraft refrigeration compared to vapour compression refrigeration system? **03**

(b) Explain the factor affecting human comfort. **04**

(c) In a Bell-Coleman refrigeration plant, the air is drawn from cold chamber at 1 bar and 10°C and compressed to 5 bar. The same is cooled to 25°C in the cooler before expanding in the expansion cylinder to cold chamber pressure of 1 bar. Calculate theoretical COP of the plant and the theoretical rate refrigeration effect per kg of air. The compression and expansion be assumed isentropic. Assume γ=1.41 and Cp=1.009 kJ/kg°C. **07**

OR

Q.3 **(a)** How the human body reacts to changes in temperature of environment? **03**

(b) Discuss the latent heat loss from human body and how it varies with dry bulb temperature and activity of human beings. **04**

(c) Why regenerative system is useful at high flight speeds compared to simple cooling cycle? Explain regenerative cooling system with diagrammatic layout and T-s representation. **07**

Q.4 **(a)** Under what situation the vapour absorption system of refrigeration is preferred to vapour compression system of refrigeration? **03**

(b) Discuss the influence of suction temperature on compressor power, capacity and COP of reciprocating refrigerant compressor when condenser temperature is fix. **04**

(c) What are desirable characteristics of absorbent and absorbent refrigerant combination in vapour absorption refrigeration cycle? Explain working of Li-Br vapour absorption refrigeration system with neat sketch. **07**

OR

Q.4 **(a)** Explain the function of capillary tube in a vapour compression refrigeration system. Under what situations is this used. **03**

(b) Why a minute leak in hermatic compressor based refrigeration system can affect the windings of the compressor motor? **04**

(c) The following data apply to Vapour absorption refrigeration system. **07**

Capacity =25 ton,
Evaporator temperature = - 20°C
Temperature of condensed NH_3 from condenser = 20°C exit from the operator dry saturated
Pressure maintained in generator = 11.67 bar
Temperature of strong aqua-ammonia solution = 70°C Temperature of week aqua-ammonia solution = 100°C Enthalpy of 1 kg anhydrous NH_3 released from generator = 1930 kJ/kg
Mass concentration of strong aqua-ammonia =0.35
Mass concentration of week aqua-ammonia = 0.25
Mean specific heat of aqua-ammonia solution = 4.7 kJ/kg°C Assume the enthalpy of strong and weak solution as that of NH_3 liquid at -50°C i.e. 200kJ/kg. Heat given by 1 kg steam is 2021.95 kJ/kg. Enthalpy at inlet of generator at - 20°C = 1655 kJ/kg, Enthalpy after generator at 11.67 bar = 1930 kJ/kg and Enthalpy at evaporator inlet = 520 kJ/kg. The mass of ammonia fed to evaporator is 4.625 kg/min.
Heat of absorption in the generator is given by

$$Q_{absorbed}=804-586x_w-5950x_w^3$$

Neglecting any heat loss to surroundings, determine the required steam per hour for heat input to the generator from outside source at 4 bar and 0.9 dry if the temperature at the exit of the condensate is 120°C.

Q.5 **(a)** List out different factors affecting the grill performance of air distribution system. **03**

(b) Illustrate the differences between unitary and central air conditioning system. **04**

(c) A rectangular duct section of 500 mm x 350 mm size carries 75 m^3/min of air having density of 1.15 kg/m^3. Determine the equivalent diameter of a circular duct if 1) the quantity of air carried in both the cases is same and 2) the velocity of air in both the cases is same. If friction factor f=0.01 for sheet metal, find the pressure loss per 100 m length of the duct. **07**

OR

Q.5 **(a)** Why all water air conditioning system for commercial use is compact and less expensive than all air system? **03**

(b) Explain the effect of duct heat gain or loss on the temperature of supply air. **04**

(c) An office for seating 30 occupants is to be maintained at 22°C DBT and 55% RH. The outdoor conditions are 36°C DBT and 27°C WBT. The various loads in the office are: **07**

- Sensible heat gain per occupants : 83 W
- Solar heat gain : 8500W
- Latent heat gain per occupant : 100W
- Lighting load : 2600W
- Sensible heat load from other sources : 12000W
- Infiltration load : 15m^3/min

Assuming 40% fresh air and 60% of re-circulated air passing through the evaporator coil and the bypass factor of 0.12
Calculate:
1) Dew point temperature of the coil
2) Capacity of the plant

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