Printed Pages : 4

TME – 606

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4097 Roll No. | | | | | | | | | | |

B. Tech.

(SEM. VI) EXAMINATION, 2008-09

REFRIGERATION & AIR CONDITIONING

Time : 3 Hours] *[Total Marks : 100*

Note : (1) Attempt **all** questions.
(2) All questions carry **equal** marks.
(3) All symbols have usual meaning.
(4) Assume missing data suitably, if any.
(5) Use of refrigerant tables and charts, psychrometric chart, and enthalpy-concentration chart for mixtures is permitted.
(6) Be precise and to the point in your answer.

1 Attempt any **two** of the following : 10×2

(a) A plane moving with a speed of M/3 uses simple air refrigeration system with ambient conditions of 0.5 bar and - 5°C. The pressure ratio in the main compressor is 5 and isentropic efficiency of compression is 0.85. The compressed air is cooled to a temperature which is 5°C above the rammed air temperture. This air is expended to cabin pressure of 1bar in a turbine having isentropic efficiency of 0.9. If the air leaves the cabin at 25°C, Find

(i) COP,

(ii) mass flow rate of air for a system of 50 TR capacity.

Take : $\gamma = 1.4$, and $C_p = 1.004$ KJ/kg K.

(b) Attempt the following :

(i) Discuss the effect of variation of evaporator and condenser temperatures on the COP of Carnot cycle.

(ii) Give the classification of Aircraft refrigeration systems.

(iii) What do you understand by "Dense air refrigeration cycle" ?

(c) A refrigeration system working on Reversed Brayton cycle operates between 1 bar and 5 bar. The temperatures at the inlet to the compressor and expander are 30°C and 40°C, respectively. Isentropic efficiency for the compression is 0.8 and the same for the expansion is 0.9. If the capacity of the system is 5 Tons of refrigeration, determine :

(i) mass flow rate of refrigerant (air)

(ii) power input to the compressor.

Take : $\gamma = 1.4$, and $C_p = 1.004$ KJ/kg K.

2 Attempt any **two** of the following : **10×2**

(a) (i) Plot the pressure drop at the compressor valves on P-h or T-s diagram.

(ii) What is "Flash Chamber"? Explain its significance in vapour compression refrigeration system, expecially multi-pressure system.

(b) In a 15 Ton ammonia refrigeration plant, the condensing temperature is 25 °C and evaporating temperature is -10 °C. The refrigerant is subcooled by 5°C before reaching the inlet of the throttle valve. The vapor leaving the evaporator is dry saturated. Find the COP and mass flow rate of the refrigerant.
Use the following table for properties of the Ammonia :

T_s (°C)	Enthalpy (kcal/kg)		Entropy (kcal/kg.K)		Specific heat (kcal/kg.K)	
	Liquid	Vapour	Liquid	Vapour	Liquid	Vapour
25	128.1	406.8	1.097	2.0324	1.1	0.67
–10	89.6	398.7	0.9593	2.1362	0.98	0.59

(c) Using schematic and P-h diagram, explain the working of Cscade refrigeration system. Compare it with multi-stage system.

3 Answer any **two** of the following : **10×2**

(a) With the help of schematic diagram, explain the working of a practical aqua ammonia vapour absorption refrigeration system. Highlight the advantage of using Analyser, Rectifier, and Heat Exchangers. Derive an Expression for the maximum COP of a simple vapour absorption refrigeration system.

(b) Define primary refrigerant. What are the desirable properties of a primary refrigerant? Give the refrigerant number for the following : $CHCLF_2$, NH_3, $CH_2F\text{-}CF_3$, and $CH_3CH_2CH_2CH_3$.

(c) Two aqua ammonia streams at a pressure of 20 bar with a mass flow rate of 2 kg/s each are adiabatically mixed. First stream is saturated liquid at concentration of 0.8 while second stream is at a temperature of

150°C and concentration of 0.2. Find the temperature, concentration, and specific enthalpy of mixed stream after adiabatic mixing. Also determine the concentration of liquid and vapour phases

4 Attempt any **two** of the following : **10×2**

(a) In an air conditioner the out door air (at 40°C DBT and 43% RH) is mixed with return (from room) air (at 25°C DBT and 50% RH) in the ratio of 3:2 before entering the cooling coil. The by-pass factor for the cooling coil is 0.25 and the room sensible heat factor (RSHF) is 0.8. Air flow rate (total) through the cooling coil is 8 kg/s. Determine :

(i) ADP,

(ii) Condition of air at inlet and exit of the cooling coil,

(iii) Tonnage of the plant, and

(iv) rate of condensation.

(b) Define "Relative Humidity" and "Degree of Saturation" and derive a relation between them. Derive an expression for by-pass factor.

(c) Plotting Psychrometric chart(s) (on your answer book) explain common Psychrometric processes on this chart.

5 Attempt any **two** of the following : **10×2**

(a) With the help of example, explain any one of the following methods of duct design

(i) Equal Friction method

(ii) Velocity Reduction method

(b) With the help of neat sketch describe the working of Ice Plant.

(c) Explain the working of Refrigeration and Freezer with the help of sketches.