CS/B.Tech(ME)/Even/6th Sem/ME-604A/2014

2014
Air Conditioning & Refrigeration

Time Allotted : 3 Hours   **Full Marks : 70**

The figure in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternative from the following:

   10x1=10

   i. Air refrigerator works on
      a) Carnot cycle   b) Rankine cycle
      c) Reversed Carnot cycle   d) Bell-Coleman cycel

   ii. In Air-Conditioning of aeroplanes, using air as a refrigerant, the cycle used is
      a) Reversed Carnot cycle   b) Reversed Joule cycle
      c) Reversed Otto cycle   d) Reversed Brayton cycle

   iii. In reciprocating compressors, clearance is provided
      a) to improve the volumetric efficiency of the compressor
      b) to accommodate valves
      c) to increase the isentropic efficiency
      d) to reduce power consumption of the compressor

   iv. Equal friction method is a method to design
      a) evaporator   b) condenser
      c) air distribution duct   d) compressor

   v. The most commonly used method for the design of duct size is the
      a) Velocity reduction method   b) Equal friction method
      c) Static region method   d) Dual or double method

   vi. During the adiabatic cooling of moist air
      a) DBT remain constant

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      b) Specific humidity remains constant
      c) Relative humidity remain constant
      d) WBT remains constant

   vii. The Refrigerant R764 stands for
      a) NH₃   b) CO₂   d) SO₂   d) CH₃Cl

   viii. The wet bulb depression is zero when relative humidity is equal to
      a) Zero b) 50%   c) 70%   d) 100%

   ix. Hunting of the thermostatic expansion valve is
      a) variation of the evaporator load with the degree of superheat
      b) variation of the pressure of the evaporator load with variation of load
      c) alternate overfeeding and starving of the refrigerant flow to the evaporator
      d) the term is not used at all.

   x. The pressure in a capillary tube decreases due to
      a) frictional resistance offered by the tube wall
      b) acceleration of refrigerant in the tube
      c) heart transfer from the tube
      d) both (a) and (b)

Group-B
(Short answer type questions)
Answer any *three* questions

   5x3=15

2. With a neat sketch and describe how sub cooling can be achieved in vapour compression refrigeration system with suction line heat exchanger. Also draw corresponding help of P-h and T-s diagram.
   5

3. What are the desirable properties of refrigerants?   5

4. a) Derive the following relation :

   Specific Humidity, $W = 0.622 \dfrac{Pv}{pt - pv}$ P_v=Partial pressure

   of water vapour & P_t = Total Pressure of the moist air.   3

   b) Write a short note on "By pass factor".   2

5. In a Bell-Coleman refrigeration plant, the air is drawn from the 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 cylinder to cold

chamber pressure of 1 bar. Determine –
    I) Theoretical C.O.P
    II) Theoretical net refrigeration effect/kg of air
    Assume, $\gamma = 1.4, C_p = 1.009 kJ/kgE.$ 5

6. The atmospheric conditions are 20°C and specific humidity of 0.0095 kg/kg of dry air. Calculate the following –
a) Partial pressure of vapour b) Relative humidity.

Group – C
(Long answer type questions)
Answer any *three* of the following
                                                    3x15=45

7. a) Write the working principle of Electrolux Refrigerator.
                                    5+10

b) Determine the theoretical C.O.P. for CO_2 machine working between the temperature range of 25°C and –5°C. The dryness fraction of CO_2 gas during the suction stroke is 0.6. The following

Temperatures	Enthalpies (kJ/kg)		Latent Heat (kJ/kg)	Entropy (kJ/kg)	
°C	Liquid	Vapour		Liquid	Vapour
25	81.17	202.5	121.34	0.251	0.644
-5	-7.53	236.8	245.2	-0.042	0.841

How many tonnes of ice would a machine working between the same limits and having a relative COP of 45% make in 24 hrs? The water for the ice is supplied at 15°C and the compressor take 8.2 kg of CO_2 per minute. Sp. Heat of water may be taken as 4.18kJ/kg°C and latent heat of ice as 335kJ/kg.

8. a) Briefly explain different types of condensers used in refrigeration.
b) What are the advantages of vapour absorption refrigeration system over vapour compression refrigeration system.
c) A dense air refrigeration cycle operates between 5 bar and 20 bar. The air temperature after eat rejection to surroundings is 37°C and air temperature at exit of refrigerator is 7°C. The isentropic efficiencies of compressor and turbine are 0.84 and 0.82 respectively. Determine
    I) Compressor and turbine work per ton of refrigeration

ii) Co-efficient of performance of the system Take $\gamma = 1.4$ and $C_p = 1.005$ kJ/kg K   4+4+7

9. (a) Derive the expression for the equivalent diameter of circular duct corresponding to a rectangular duct of sides a and b for the same pressure loss per unit length when the velocity of air flowing through both the ducts is the same.   5

b) A rectangular duct section of 500x350 mm size carries 75 m³/min of air having density of 1.15 kg/m³. Determine the equivalent diameter of a circular duct if
    i) The quantity of air carried in both cases is same
    ii) The velocity of air in both cases is same
    iii) If f=0.01, find the pressure loss per 100 m length of the duct.
                                    3+2+5=10

10. a) What are the types of cooling towers? Briefly describe ay one
    b) Write a short note on the following : (I) Air washer (II) convector
    c) What is the effect of sub cooling of liquid in a simple vapour compression cycle?   5+8+2

11. a) Explain the factors effecting the volumetric efficiency of a reciprocating compressor.
    b) State the principle of air distribution. What is an air-handling system?
    c) In a 18-tons absorption refrigeration system the heating in generator is carried out by using steam at 3 bar and 85% dry. The refrigeration temperature is –10°C. The condensation of the refrigerant is carried out at 30°C using cooling water. Determine
    (I) Maximum possible C.O.P. of system ; and
    (II) Quantity of steam required per hour to run the plant if the system leaves the generator as saturated water at same pressure. Assume relative C.O.P. = 0.4   4+4+7

_____X-X-X_____