Total No. of Questions : 12]

P5112

SEAT No. :

[Total No. of Pages : 5

[4958]-120
T. E.
REFRIGERATION AND AIR - CONDITIONING
(2008 Pattern)

Time : 3 Hours] *[Max. Marks : 100*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***Answer any three questions from each section.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right side indicate full marks.***
5) ***Use of calculator is allowed.***
6) ***Use of psychrometric chart is allowed.***
7) ***Assume suitable data if necessary, state clearly he assumption made.***

SECTION - I

Q1) a) Draw vapour compression cycle on T-s and p-h diagram. Name the various processes and derive expression for COP. **[8]**

b) Air enters the compressor of an ideal Brayton Refrigeration Cycle at 101 kPa and 270 K with a volumetric flow rate of 1.5 m^3/s. If the compressor pressure ratio is 3 and the turbine inlet temperature is 300 K, determine. **[8]**

i) the net power input

ii) the refrigeration capacity

iii) coefficient of performance

Take $\gamma = 1.4$ and $C_p = 1.005$ kJ/kg.K

OR

Q2) a) Explain working of vortex tube refrigeration. **[6]**

b) With neat diagram explain thermoelectric refrigeration. **[6]**

c) Explain applications of refrigeration in dairy plant. **[4]**

Q3) a) Discuss the effect of condenser and evaporator pressures on performance of VCC with the help of p-h or T-s diagram. **[8]**

b) An ideal vapour compression system uses R-12 as refrigerant. The system uses an evaporation temperature of 0^oC and condenser temperature of 40^oC, the capacity of the system is 10 TR. **[8]**

P.T.O.

Determine:

i) The mass flow rate of refrigerant

ii) Power required to run the compressor

iii) Heat rejected in the condenser, and

iv) COP of the system

Use the properties of R-12 from table given below:

Temp	Pressure	h_f	h_g	s_f	s_g
°C	bar	kJ/kg	kJ/kg	kJ/kg	kJ/kg.K
0	3.087	36.05	187.53	0.142	0.696
40	9.609	74.59	203.2	0.727	0.682

Take C_p for superheated vapour as 0.61 kJ/kg. K.

OR

Q4) a) Compare vapor absorption system with vapour compression system. **[4]**

b) Draw actual vapour compression cycle on p-h diagram and discuss the losses in the cycle and its effect on its performance. **[8]**

c) Prove that the maximum COP of an ideal vapour absorption refrigeration system is given by

$$COP_{max} = \left(\frac{T_L}{T_C - T_L}\right) \times \left(\frac{T_G - T_C}{T_G}\right)$$

Where T_L = evaporator temperature, T_C = condenser temperature and T_G = generator temperature. **[4]**

Q5) a) Draw the neat sketch of vapour compression system with two evaporators equipped with individual compressors and expansion valve and common condenser. Show all processes on p-h diagram and present the mathematical formulation of its COP. **[10]**

b) Explain the desirable properties of refrigerant. List some eco-friendly refrigerant and state why eco-friendly refrigerant must be used? **[8]**

OR

Q6) a) Explain cascade refrigeration system. List its applications. **[7]**

b) What is flash inter-cooling? Draw its p-h and T-s diagram for two stage VCC with flash intercooling. **[6]**

c) Explain: refrigerant recovery, reclaim and recharge. **[5]**

SECTION - II

Q7) a) What are the factors that affect the human comfort? Discuss their effect in brief. **[4]**

b) In the summer the outer surface of glass filled with ice water frequently 'sweets'. How can you explain its mechanism? **[4]**

c) Air at 38°C and 60% RH is cooled to 24°C DBT. It is achieved by cooling and dehumidification. Air flow rate is 50 cmm. Using psychrometric chart, calculate: **[10]**

i) Dew point temperature

ii) Mass of water drained per hour

iii) Capacity of cooling coil, and

iv) If by-pass factor of coil is 0.15, find ADP.

OR

Q8) a) Explain: thermodynamic wet bulb temperature. **[4]**

b) Prove that the specific humidity is given by

$$\omega = 0.622 \frac{p_v}{p - p_v}$$

Where p = total pressure of air, and p_v = partial pressure of moisture in air. **[6]**

c) Air enters a window air-conditioner at 101 kPa and 35°C and 80% RH at a rate of 10 cmm and leaves as saturated at 14°C. A part of moisture which condenses during the process is also removed at 14°C. Determine the heat flow rate and moisture removed from the air.

Show the process on psychrometric chart. **[8]**

Q9) a) Draw schematic of central air conditioning systems. Compare various types of central air conditioning systems. **[6]**

b) State different methods of air cleaning for air conditioning space. Discuss any two of them. **[6]**

c) What is coil selection criterion in an air conditioning system? Explain. **[4]**

OR

Q10)a) Explain construction and working of an air handling unit with a neat sketch. **[7]**

b) Discuss the procedure to calculate ventilation load? **[4]**

c) Explain the working of flooded evaporator with a neat sketch. **[5]**

Q11)a) What are desirable properties of duct materials? **[4]**

b) What is static regain factor? Explain the advantages and limitations of static regain method of duct design. **[4]**

c) A rectangular duct section 500mm × 350 mm carries 75 cmm of air having density of 1.12 kg/m^3. Calculate the equivalent diameter of circular duct for **[8]**

i) Same quantity of air handling in both cases.

ii) Same velocity of air in both cases.

iii) If $f = 0.001$ for sheet metal, find the paper drop per 100 m length of duct.

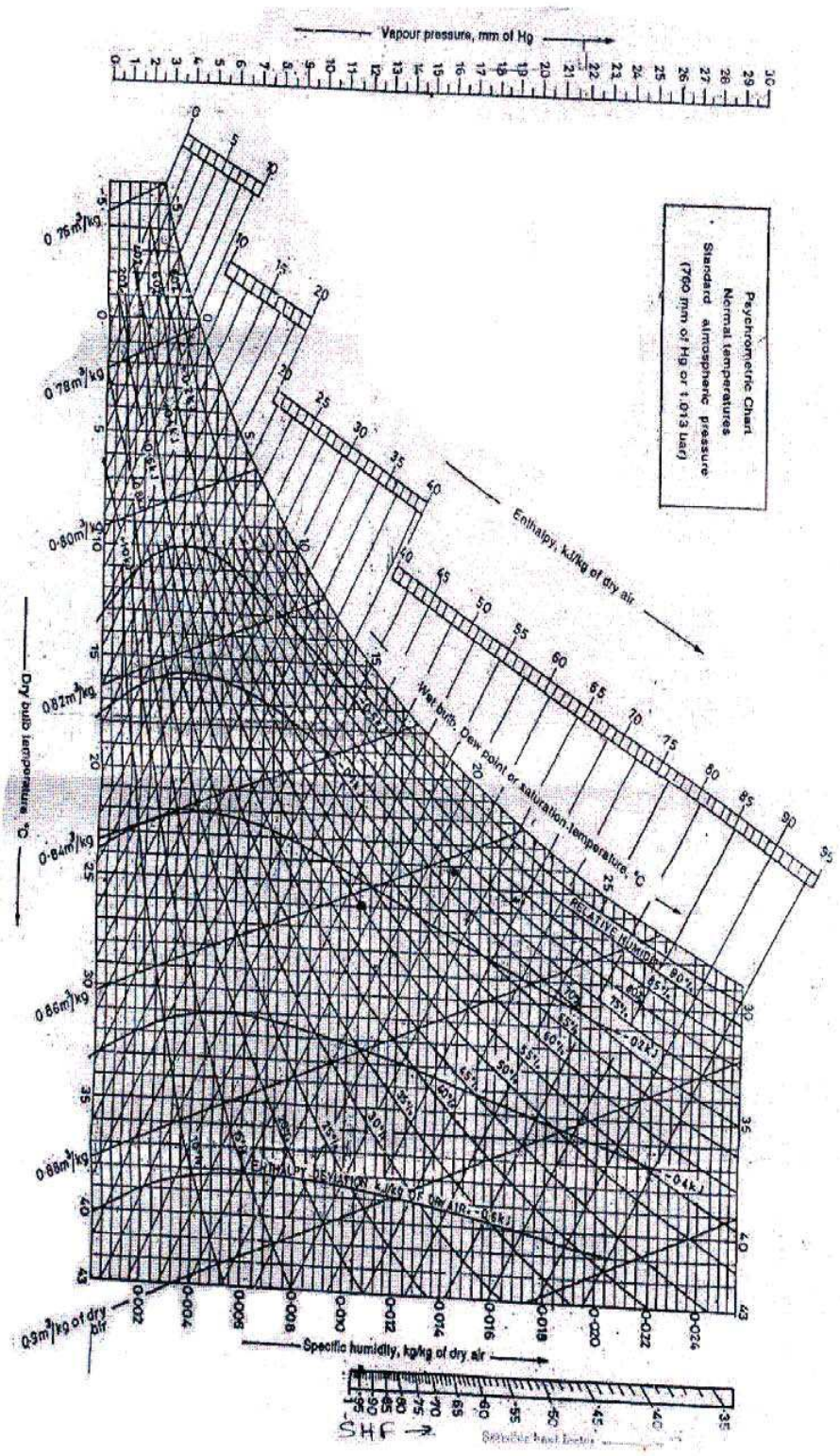
OR

Q12)a) What are dynamic losses in duct? Explain. **[4]**

b) Prove that for a rectangular duct of side a and b, the hydraulic diameter for same flow rate is given by **[6]**

$$D = 1.265\left(\frac{a^3b^3}{a+b}\right)^{1/5}$$

c) Write short note on: cold chain. **[6]**


Vapour pressure, mm of Hg
Psychrometric Chart
Normal temperatures
Standard atmospheric pressure
(760 mm of Hg or 1.013 bar)
Enthalpy, kJ/kg of dry air
Wet bulb, Dew point or saturation temperature, °C
Dry bulb temperature, °C
Specific humidity, kg/kg of dry air
RELATIVE HUMIDITY
SHF

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