B.E. Mechanical Engineering (Model Curriculum) Semester-VIII

PCC-ME-404 - Refrigeration and Air Conditioning

P. Pages : 3 **GUG/W/23/14369**

Time : Three Hours * 7 9 0 8 * Max. Marks : 80

Notes :
1. Due credit will be given to neatness and adequate dimensions.
2. Assume suitable data wherever necessary.
3. Illustrate your answers wherever necessary with the help of neat sketches.
4. Use of slide rule, Logarithmic tables, Steam tables, Mollier's chart, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted.
5. Attempt Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6, Q. 7 or Q. 8, Q. 9 or Q. 10.

1. a) With the help of P-h and T-s diagram explain the effect of decrease in the evaporator pressure and increase in the condenser pressure on the performance of vapour compression refrigeration system? **6**

b) An ammonia ice plant operates between condenser temperature of 35ºC and evaporator temperature of -15ºC. It produces 10 tons of ice per day at -5ºC from water at 30ºC. Assume simple saturation cycle. Use refrigeration table for the properties of ammonia and Determine:- **10**

i) Plant capacity
ii) Refrigerant mass flow rate in kg/min
iii) Isentropic discharge temperature
iv) Stroke (L) and diameter (D) of single acting single cylinder compressor if its volumetric efficiency is 65%. Compressor runs at 1400 rpm and L/D = 1.2
v) Horse power of the compressor if its adiabatic efficiency is taken as 85% and mechanical efficiency as 95%.
vi) Theoretical and actual COP

Take :- Sp. Heat of water = 4.2 kJ/kg. K, Sp. heat of Ice = 1.94 kJ/kg. K, Latent heat of fusion of Ice = 335 kJ/kg., Sp. heat of ammonia vapors = 2.8 kJ/kg. K.

OR

2. a) What are the advantages of compound compression with intercooler over single stage compression? **4**

b) Explain with T-s and p-h diagram the processes occurring in an actual vapour compression refrigeration cycle? **6**

c) Explain with schematic and P-h chart the function of flash tank used for inter-cooling and flash gas removal in multi stage compression system? **6**

3. a) Enlist the desirable properties of an ideal refrigerant? **4**

b) Designate the refrigerant:- **4**

i) CH_2Cl_2 ii) $C_2Cl_3F_3$

c) Write a note on:- **8**
i) Global warming potential and ozone depletion potential of CFC refrigerants
ii) Secondary refrigerants

OR

4. a) Explain with neat sketch Hermetic, semi hermetic and open type reciprocating compressor? **8**

b) With neat sketch describe the working of evaporative condensers? **4**

c) Explain with neat sketch the working of flooded type evaporator? **4**

5. a) With neat sketch describe the working of Electrolux refrigerator? **8**

b) With neat sketch describe the working of Li-Br vapour absorption refrigeration system? **8**

OR

6. a) State the principle of operation of thermoelectric cooling and vortex tube? **6**

b) Describe with neat sketch and T-s diagram Claude air liquefaction method? **6**

c) With neat sketch and T-s diagram explain the working of simple air refrigeration system? **4**

7. a) Define the following psychrometric terms:- **8**

i) Saturated air,

ii) Relative Humidity,

iii) Degree of saturation,

iv) Dew point temperature.

b) A sample of air is having dry bulb temperature of 21ºC, and 30% relative humidity at barometric pressure of 760 mm of Hg. Find **8**
i) Partial pressure of vapor, ii) specific humidity, iii) WBT and corresponding saturation pressure, iv) Degree of saturation, v) specific volume of air per kg of dry air, vi) DPT, vii) specific enthalpy of moist air {Use steam table}

OR

8. a) Describe the factors affecting optimum effective temperature for human comfort? **6**

b) Air is supplied at flow rate of 300 m^3/ min from outdoor condition of 40ºC DBT and 26ºC WBT to an air conditioned room. Air is first dehumidified by passing it over a cooling coil having bypass factor of 0.32 and dew point temperature of 15ºC and then by chemical dehumidifier. Air leaves chemical dehumidifier at 30ºC DBT. Air is then passed over cooling coil whose surface temperature is 15ºC and bypass factor 0.26. Calculate the capacities of 2 cooling coils and dehumidifier? Show the processes on psychrometric chart? **10**

9. a) Define room sensible heat factor (RSHF) and explain the procedure to draw RSHF line on psychrometric chart? **4**

b) The following data refers for the space to be air conditioned: **12**

Inside design conditions	=	25ºC DBT, 50% RH
Outdoor air conditions	=	43ºC DBT, 27.5ºC WBT
Room sensible heat gain	=	20kW
Room latent heat gain	=	5kW
By pass factor of cooling coil	=	0.1

The return air from the space is mixed with the outside air before entering the cooling coil in the ratio of 4:1 by mass

Determine:

i) Apparatus dew point
ii) Condition of air entering and leaving the cooling coil
iii) Dehumidified air quantity
iv) Fresh air mass flow and volume flow rate
v) Total refrigeration load on the air conditioning plant.

OR

10. The following design data is available for an air conditioning system of a restaurant. **16**

Outdoor conditions = 34ºC DBT, 28ºC WBT
Indoor conditions = 24ºC and 50% RH
Solar heat gain through walls, roof and floor = 4.7 kW
Solar heat gain through glass area = 4.4 kW
Total occupants = 25 persons
Sensible heat gain per person = 85W
Latent heat gain per person = 105 W
Internal lighting load = 15 lamps of 100 watts capacity each and
10 fluorescent fixtures of 80 watts each
Sensible heat gain from other sources = 11.6 kW
Infiltration air = 14 m^3/min
Coil bypass factor = 0.15

If the return and outdoor air are adiabatically mixed in the ratio of 3:2 by mass and then passed through the conditioner, determine:

i) Condition of supply air
ii) Apparatus dew point
iii) Capacity of air conditioning plant.

****