Exam.Code:0943
Sub. Code: 33880

2125

B.E. (Mechanical Engineering)

Seventh Semester

MEC-701: Refrigeration and Air Conditioning

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: ***Attempt five questions in all, including Question No. 1(Section-A) which is compulsory and selecting two questions each from Section B-C. Use of Refrigeration and Air conditioning tables and charts is allowed.***

x-x-x

Section-A

$1 \times 10 = 10$

1. (i) Name two refrigerants each having high and low values of GWP and ODP.
   (ii) What is the designation of Trifluoro ethane as a refrigerant?
   (iii) What is wet bulb depression. Define enthalpy deviation?
   (iv) Write Carrier equation to calculate value of p_v.
   (v) Write a brief note on alignment circle.
   (vi) For a refrigeration system undergoing irreversible cycle, value of $\oint \frac{\delta Q}{T}$ is _____
   (vii) Subcooling with regenerative heat exchanger is used in a refrigeration cycle. The enthalpies at condenser outlet and evaporator outlet are 72 and 178 kJ/kg respectively. The enthalpy at outlet of isentropic compressor is 220 kJ/kg and enthalpy of sub-cooled liquid is 72 kJ/kg. The COP of the cycle is _____.
   (viii) Round the clock cooling of an apartment having a load of 350 MJ/day requires an air-conditioning plant of capacity _____
   (ix) Write the advantages of cooling towers used in Refrigeration Industry.
   (x) Discuss the importance of ODP and GWP by giving examples of refrigerants.

Section-B

$10 \times 2 = 20$

2. A compound compression with water inter cooling ammonia refrigeration system is used to take a load of 50 tons at -25°C. The intercooling and condenser pressures are 4.92 and 14 bar respectively. The volumetric efficiencies of the L.P. and H.P. cylinders are 85% and 80% respectively. The pressure losses in the valves are listed below:
   suction valve of L.P. cylinder = 0.14 bar, discharge valve of L.P. cylinder = 0.35 bar, suction valve of H.P. cylinder = 0.28 bar, discharge valve of H.P. cylinder = 0.7 bar.
   The temperature of refrigerant at different points are listed below:
   temperature of the refrigerant leaving the intercooler = 32°C, temperature of the refrigerant leaving the condenser = 30°C, temperature of the refrigerant leaving the suction valve of L.P. cylinder = -18°C.
   Law of compression in L.P. is isentropic, Law of compression in H.P. is $pv^{1.27}$ = constant, R.P.M = 300.
   Assuming both the cylinders are single acting and common stroke is equal to diameter of L.P. cylinder, find the following:(i) The rate of refrigerant circulation per minute. (ii) I.P. of the system in kW. (iii) Diameters of L.P. and H.P. cylinders. (iv) Heat rejected to intercooler and condenser per minute. (v) C.O.P of the system on I.P basis.

P.T.O.

3. Explain the process of throttling for real gas in detail. A simple saturation ammonia compression system has a high pressure of $1.35 MN/m^2$ and low pressure of $0.19 MN/m^2$. Find per $400000 kJ/h$ of refrigeration capacity, the power consumption of the compressor and COP of the cycle.

4. Calculate,

   (i) relative humidity

   (ii) humidity ratio

   (iii) dew point temperature

   (iv) density

   (v) enthalpy

   of atmoshperic air when the DBT is 35°C, WBT is 23°C and the barometer reads 750 mm Hg.

Section-C

$10 \times 2 = 20$

5. A cooling tower is to be designed to take the heat load of 200 tons refrigerating plant using R12 as refrigerant. The heat rejection ratio of the system is 1.2. The rise in temperature allowed in the condenser is 5°C. The atmospheric air condition is 35°C DBT and 25°C WBT. The air leaves the tower at 30°C and 90% relative humidity. Neglecting the heat losses in the system and carry over loss through the cooling tower, find (i) quantity of air required to pass through the cooling tower per minute, and (ii) quantity of make up water.
   The temperature of water coming out of tower is 30°C.

6. Discuss in detail various thermodynamic, chemical, physical properties of refrigerants in detail?

7. A summer air conditioning plant mixes 70 cmm of outside air at 35°C DBT and 23°C WBT with 210 cmm of return air at 24°C DBT and 50% RH. The mixture passes over a cooling coil. Air off the coil has 90% RH. The room SHF is 0.7. (i) Find the ADP, and air off the coil dew point and dry bulb temperatures. (ii) How much cooling in KW is the unit doing? (iii) How much of the total load is sensible, and how much is latent?

x-x-x