(3 hours)

Max. Marks: 80

Instructions:
(1) Solve any four questions.
(2) Figures to the right indicate full marks.
(3) Assume suitable data wherever necessary and mention it clearly.
(4) Answers to the sub question of an individual question should be written together and one below other.
(5) Use of Refrigerant Charts, Psychrometric Chart and Steam Tables is allowed.
(6) All questions carry equal marks.

Q1   a. A two stage compression with intercooler and liquid sub-cooler refrigeration   15
system works between the pressure limits of 1 bar and 14 bar with Ammonia as the refrigerant. The pressure of the water intercooler is 5 bar. The refrigerant entering the LP compressor is dry saturated. The water intercooler desuperheats the compressed vapour upto 30 ^{0}C before it is supplied to HP compressor. The refrigerant leaving the condenser is saturated liquid and the temperature of refrigerant leaving the liquid sub-cooler is 25 ^{0}C.
If the capacity of the Plant is 50 TR; find :

i)   Mass of refrigerant circulated in Kg/min ;

ii)   Compressor power

iii)   COP of the system.

b. Classify compressors under different headings. What are the recent   5
technology developments in compressors ?

Q2   a. A sample of moist air has a dry bulb temperature of 27 ^{0}C and a relative humidity of 60   10
per cent. The barometric pressure is 730 mm of Hg. Without using Psychrometric chart, calculate : i) Partial pressure of water vapour and dry air ii) Dew point temperature iii) Specific humidity of air iv) Absolute humidity of air v) Enthalpy of air per Kg of dry air

b. Discuss how solar energy can be used to run an Air Conditioning system with   10
a Vapour Absorption chiller. Explain with a schematic diagram. .

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Q3   a. The peak cooling load calculations for a large dining hall results in the following   **15**
        data :

   Inside design   25 °C DBT, 50 % RH
   Outside design 32 °C DBT , 25 °C WBT
   Hall Sensible Load 110.5 kW , Hall Latent Load 72.7 kW
   Ventilation air 150 m³/min , mixed with recirculated air before the coil. Find

      i) Total quantity of air ii) Temperature of air entering the coil iii) Temperature of
   air leaving coil if RH is 90 % iv) Reheater load v) Coil ADP.

   State assumptions; if any.

   Hint : Assume BF = 0.05 and coil ADP = 8 °C as ESHF line does not cut saturated line

     b. Classify types of Condensers and Evaporators.Explain in brief.   **5**

Q4   a. What are non conventional HVAC systems? Explain any one of them in details.   **10**

     b. What is evaporative cooling ? Explain the psychrometric process.   **5**

     c. What are the types of throttling devices ? Discuss with a schematic diagram of   **5**
        Thermostatic Expansion Valve.

Q5   a. A vapour compression system using R12 works between – 15 °C and 35 °C as   **10**
         evaporator and condenser temperature respectively. Using P-h chart, determine :
         i)   COP
         ii)   Mass flow of refrigerant per TR
         iii)   Piston displacement per TR using volumetric efficiency = 80 %
         iv)   Heat rejected in the condenser per TR
         v)   Ideal COP

     b. Discuss salient features of Window type , Split type and Packaged type of Air   **10**
   Conditioners.

Q6   Write short notes on any 4 :   **20**
     i)   HCFC-22 phaseout schedule for India
     ii) Green Buildings
     iii) Fouling in Condensers
     iv) ASHRAE Comfort Chart
     v)   Mechanism of body heat loss
     vi) Railway Coach Air Conditioning.

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