B.E. Mechanical Engineering Eighth Semester

ME802 - Refrigeration and Air-Conditioning

P. Pages : 3 **GUG/W/18/2069**

Time : Three Hours * 1 5 8 4 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Answer **five** questions from 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.
3. Due credit will be given to neatness and adequate dimensions.
4. Assume suitable data wherever necessary.
5. Diagrams and Chemical equation should be given wherever necessary.
6. Illustrate your answers wherever necessary with the help of neat sketches.
7. Use of slide rule, Logarithmic tables, Steam tables, Mollier's chart and Refrigeration Table, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted.

1. a) What is the difference between refrigerator & Heat pump? Derive the expression for the performance factor for both if they are running on reversed Carnot Cycle? **8**

b) A vapour compression refrigeration machine, with R – 12 as refrigerant, has a capacity of 12 TR operating between -28ºC & 26ºC. The refrigerant is subcooled by 4ºC before entering the expansion valve and vapour is superheated by 5ºC before leaving the evaporator. The machine has six cylinder single acting compressor with stroke equal to 1.25 times the bore. It has a clearance of 3% of the stroke volume. **8**
Determine : 1) Theoretical power required, 2) C.O.P. 3) Volumetric Efficiency, 4) Bore & stroke of the cylinder.

The speed of compressor is 1000 r.p.m. sp. heat of liquid refrigerant $= .963 \frac{kJ}{kg.k}$

sp. heat of superheated vapour $= 0.615 \frac{kJ}{kg.k}$. Use properties of R – 12 from table.

OR

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

b) A 2 – stage refrigerating system is operating between the pressure limits of 8 bar & 1.4 bar. The working fluid is R–134a. The refrigerant leaves the condenser as a saturated liquid and is throttled to flash chamber operating at 3.2 bar. The part of refrigerant evaporates during the flashing process and this vapour is mixed with the refrigerant leaving the low pressure compressor. Mixture is then compressed to condenser pressure by high pressure compressor. The liquid in flash chamber is throttled to evaporator pressure and cools the refrigerated space as it vaporizes in the evaporator. Assuming the refrigerant leaves the evaporator as a saturated vapour & both compressions are isentropic, determine : **12**

i) Fraction of refrigerant that evaporates as it is throttled to flash chamber.

ii) Refrigeration effect & compressor work per unit mass of refrigerant flowing through condenser.

iii) The coefficient of performance.

3. a) What are the desirable properties of ideal refrigerant. **3**

b) Designate the refrigerants whose chemical formulae are : **4**

i) $CC\ell F_3$ ii) $CHC\ell_2F$

iii) $CH_3C\ell$ iv) $CHC\ell_2CF_3$

c) Write short note on following All. **9**

i) CFCs and Ozone depletion Potential.

ii) Alternate Refrigerants.

iii) Secondary Refrigerants.

OR

4. a) Describe hermetic sealed compressor? Give its advantages? **4**

b) Compare air – cooled & water cooled condensers. **4**

c) Explain dry expansion evaporator with neat sketch. **4**

d) Discuss the operation of capillary tube in refrigeration system with neat sketch. **4**

5. a) Explain the working of 3 – fluid refrigerator. **8**

b) With neat sketch & T – S diagram. Explain the working of any one of the method of air refrigeration systems. **8**

OR

6. a) Discuss any one of the methods of liquification of air? **8**

b) Describe operation of vortex tube? Give its applications. **8**

7. a) Define the following **any four.** **8**

i) Specific humidity

ii) Absolute humidity

iii) Relative humidity

iv) Dew point Temperature.

v) Degree of Saturation.

b) Air at 10ºC DBT and 90% RH is to be heated & humidified to 35ºC DBT and 22.5ºC WBT. The air is preheated sensibly before passing to the air washer in which water is recirculated. The RH of air coming out of the air washer is 90%. This air is again reheated. Sensibly to obtain the final desired condition. **8**

Find :

i) Temperature to which air should be preheated.

ii) Total heating required.

iii) Make up water required in the air washer.

iv) Humidifying efficiency of air washer.

OR

8. a) The room sensible and latent heat loads for an air conditioned space are 25 kW & 5 kW respectively. The room condition is 25ºC DBT & 50% RH. The outdoor condition is 40ºC DBT and 50% RH. The ventilation requirement is such that on mass flow rate basis 20% of fresh air is introduced and 80% of supply air recirculated. The by – pass factor of the cooling coil is 0.15. **8**

Determine :

i) Supply air flow rate.
ii) Outside air sensible heat
iii) Outside air latent heat
iv) Effective room sensible heat.

b) Write a short note on **any two.** **8**

i) Winter air conditioning system.

ii) Summer air conditioning system.

iii) Factors affecting comfort air conditioning.

9. a) State the factors that determine human comfort? **3**

b) Define the term effective temperature? What factors affect effective temperature? **5**

c) Explain the terms, static, dynamic & total pressure in a duct? **4**

d) Discuss the functions of H.P. & L.P. cut – out? **4**

OR

10. a) Describe the components of cooling load of Air conditioner. **4**

b) Following data relates to the office air conditioning plant having maximum seating capacity of 25 occupants : **12**

Outside design conditions = 34ºC DBT, 28ºC WBT
Inside design condition = 24ºC DBT, 50% RH
Solar heat gain = 9120 W
Latent heat gain per occupant = 105 W
Sensible heat gain per occupant = 90 W
Lightening Load = 2300 W
Sensible Load from other sources = 11630 W
Infiltration Load = $14\,m^3/min$

Assuming 40% fresh air and 60% of recirculated air passing through the evaporator coil and by – pass factor of 0.15; find the dew point temperature of the coil and capacity of the plant.

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