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DBI1353

Refrigeration & Air Conditioning (New) (1210)

P. Pages : 3

Time : Three Hours

Max. Marks : 100

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answersheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory. Solve **any two** bits from a, b, c.
5. Use of scientific calculator, refrigerant property tables, charts and steam table is allowed.
6. Assume suitable data if necessary.
7. Black figures to right indicates full marks.

1. a) Explain the necessity of the aircraft refrigeration, write the advantages and disadvantages of air refrigeration system. 10
- b) A boot-strap air refrigeration system is used to take 20 tons of refrigeration load of an air - craft cabin. The ramming of air increases the pressure of air from atmospheric pressure to 1.1 bar. The air required for refrigeration is taken from main compressor at 3.5 bar and is further compressed to 4.5 bar in secondary compressor run by cooling turbine. Take the followings efficiency of both compressors.

$$\eta_{C_1} = \eta_{C_2} = 0.9$$

$$\eta_T = 0.8$$

$$\epsilon_1 = \epsilon_2 = 0.6$$

The ambient conditions are 0.85 bar and 5°C. The cabin is maintained at 1 bar and 25°C. Assuming ramming action is isentropic. Find the followings :

- 1) Power required to run the refrigeration system.
- 2) COP of the system.
- 3) Power used to run the exhaust fan.

The excess power of the cooling turbine is used for blowing out the ram cooling air to the atmosphere with the help of fan. 10

- c) i) Explain the methods of leak detection of refrigeration plant. 6
- ii) What is secondary refrigerant ? Where it is used ? 4

2. a) Explain cascade refrigeration system and draw on p - h diagram. 10
- b) A vapour compression refrigerator works between the pressure limits of 60 bar and 25 bar. The working fluid is just dry at the end of compression and there is no under cooling of the liquid before the expansion valve.
Determine :
- COP of the cycle.
 - Capacity of the refrigerator if fluid flow is at the rate of 5 kg/min. 10
- | P(bar) | $T_s(K)$ | $h_f(kJ/kg)$ | $h_g(kJ/kg)$ | $S_f(kJ/kgK)$ | $S_g(kJ/kgK)$ |
|--------|----------|--------------|--------------|---------------|---------------|
| 60 | 295 | 151.96 | 293.29 | 0.554 | 1.0332 |
| 25 | 261 | 56.32 | 322.58 | 0.226 | 1.2464 |
- c) Explain with neat sketch any one method of liquefaction of air. T - S diagram is also expected. 10
3. a) i) What are the advantages of vapour absorption system over vapour compression system ? 5
- ii) Why cooling is necessary in the absorber of VAS ? 3
- iii) Explain the role of absorption unit in VAS. 2
- b) In an aqua - ammonia absorption refrigeration system, the highest and the lowest pressures are 16 bar and 3 bar respectively. The concentration of strong solution is 0.4 and degassing range is 0.1 with suitable assumptions, determine for 20 TR-machine the following.
- Rate of heat transfer in different elements of the system.
 - HCOP. 10
- c) Explain the working of Lithium Bromide water absorption system by splitting it into - evaporator circuit, absorber unit, generator circuit and condenser circuit. 10
4. a) i) Define the psychometric terms, 4
- Adiabatic saturation, 2) Degree of saturation.
- ii) Prove that $\phi = \mu$, where ϕ is relative humidity and μ is degree of saturation. 6

- b) A class room of 60 seating capacity is to be air conditioned when outside design condition is 32°C DBT and 22°C WBT. The comfort condition to be maintained in the class room is 22°C DBT and 55% RH. The quantity of outdoor air circulated is $0.5 \text{ m}^3/\text{min}$. The required conditions are achieved by first chemical dehumidification and then cooling by cooling coil. Find the followings.
- 1) DBT of air leaving dehumidifier.
 - 2) Dehumidification capacity in kg/hr.
 - 3) Capacity of cooling coil.
 - 4) Surface temperature of cooling coil of $\text{bf} = 0.3$. 10
- c) Discuss all types of air conditioning processes, which can be arranged by using an air washer. Draw the diagram and plot all processes on psychrometric chart. 10
5. a) Define human comfort chart. Explain comfort chart in brief. 10
- b) The following data refers to summer air conditioning of a building.
 Outside design condition = 43°C DB, 27°C WB
 Inside design condition = 25°C DB, 50% RH.
 Room latent heat = $21 \text{ mJ} / \text{hr}$.
 Room sensible heat = $84 \text{ mJ} / \text{hr}$. By pass factor = 0.2
 The room air from the room is mixed with fresh air before entering the coil in the ratio 4 : 1 by mass. Determine.
- i) Coil ADP, ii) Entry and exit conditions of air for cooling coil.
 - iii) Refrigeration load on cooling coil in kJ/kg. 10
- c) i) Give the classification of air conditioning system. 5
- ii) Write a short note on the factors affecting comfort air conditioning. 5
