

B.E. Eighth Semester (Mechanical Engineering) (CGS)
10890 : Elective-III : Refrigeration & Air conditioning : 8 ME 02

P. Pages : 3

Time : Three Hours



AU - 2983

Max. Marks : 80

- Notes :
1. Answer **three** question from Section A and **three** question from Section B.
 2. Due credit will be given to neatness and adequate dimensions.
 3. Assume suitable data wherever necessary.
 4. Diagrams and chemical equations should be given wherever necessary.
 5. Illustrate your answer necessary with the help of neat sketches.
 6. Use of slide rule logarithmic tables, Steam tables, Moller's Chart, Drawing instrument, Thermodynamic table for moist air, Psychrometric Charts and Refrigeration charts is permitted.
 7. Use of pen Blue/Black ink/refill only for writing the answer book.

SECTION - A

1. a) Discuss the effect of the following factors on the performance of VCR system. Show effect on p - h diagram. 6
i) Subcooling of liquid refrigerant
ii) Superheating of vapour refrigerant
- b) The following data refers to a two stage NH_3 refrigerating system with water intercooler; 7
Condenser pressure = 14 bar
Evaporator pressure = 2 bar
Intercooler pressure = 5 bar
Load on evaporator = 10 TR
If the temperature of the de-superheated vapour and subcooled liquid refrigerant are limited to 30°C find,
i) Power required to drive the system
ii) COP of the system.

OR

2. a) What do you mean by ecofriendly refrigeration? Discuss ODP and GWP terms in detail. 6
- b) A two stage compression NH_3 refrigeration system operates between overall pressure limits of 14 bar and 2 bar. The temperature of de-superheated vapour and subcooled liquid refrigerant are limited to 30°C . The flash tank separates dry vapour at 5 bar pressure and the liquid refrigerant then expands to 2 bar. 7
Estimate the COP of the machine and power required to drive the compressor, if the mechanical efficiency of the drive is 80% and the load on evaporator is 10TR.
3. a) Sketch and explain the working of Automatic Expansion Valve. (AEV) 6
- b) Sketch and explain the working of Evaporative condenser. 7

OR

4. a) With a neat sketch explain Reverse cycle defrosting method. 6
- b) Classify refrigeration compressors and explain the working of hermetically sealed compressor. 7
5. a) What do you mean by air liquefaction process, explain any one with neat sketch. 6
- b) A single compressor using R – 12 as refrigerant has three evaporators of capacity 30 TR, 20 TR, and 10TR. The temperature in the three evaporators is to be maintained at -10°C , 5°C and 10°C respectively. The condenser pressure is 9.609 bar. The liquid refrigerant leaving the condenser is subcooled to 30°C . The vapours leaving the evaporators are dry and saturated. Assuming isentropic compression, find
- i) Mass flow of refrigerant flowing through each evaporator.
 - ii) The power required to drive the compressor.
 - iii) COP of the system.

OR

6. a) What do you mean by cascade refrigeration? Explain with neat sketch. 6
- b) A refrigeration system using R – 12 as a refrigerant consists of three evaporators of capacity 10TR at 10°C , 20TR at 5°C and 30TR at -10°C . The system has individual expansion valves with compound compression and flash intercoolers. The condenser operates at 40°C and subcooling the liquid refrigerant to 30°C . Compression is assumed isentropic. Evaporator discharge is dry saturated in each of the evaporators. Determine,
- i) Mass flow rate of refrigerant flowing through each compressor.
 - ii) The power required to drive the system.
 - iii) COP of the system.

SECTION – B

7. a) Explain thermal exchanges of body with environment. 6
- b) Moist air enters a refrigeration coil at 35°C DBT and 55% RH at the rate of $100\text{m}^3/\text{min}$. The barometric pressure is 1.013 bar. The air leaves at 27°C . Calculate TR required and the final relative humidity. 7
- If the surface temperature of cooling coil is 10°C and by pass factor 0.1. Calculate the tonnes of refrigeration required and the condensate flow.

OR

8. a) Atmospheric air at a DBT of 16°C and 25% RH passes through Furnace and then through humidifier, in such a way that the final DBT is 30°C and 50% RH. Find heat and moisture added to the air. Also determine SHF of the process. 7
- b) Define and explain following terms, 6
- i) Apparatus dew point.
 - ii) By pass factor
 - iii) Sensible heat factor
9. a) Explain the following Air-conditioning system with neat sketch: 8
- i) Summer air-conditioning.
 - ii) Winter air conditioning.

- b) Air-conditioning plant is required to supply $60\text{m}^3/\text{min}$ of air at DBT of 21°C and 55% RH. The outside air is at DBT of 28°C and 60% RH. Determine the mass of water drained and capacity of the cooling coil. Assume the air conditioning plant first to dehumidify and then to cool the air. 5

OR

10. a) Classify air conditioning systems and compare merits and demerits of unitary and central air conditioning system. 4

- b) The following data refers to summer air conditioning of a building: 9

Outside design conditions = 43°C DBT, 27°C WBT

Inside design conditions = 25°C DBT; 50% RH

Room sensible heat gain = $84,000\text{ kJ/hr}$

Room latent heat gain = $21,000\text{ kJ/hr}$

Bypass factor of cooling coil = 0.2

The return air from the room is mixed with the outside air before entry to cooling coil in the ratio of 4:1 by mass. Determine

- ADP of cooling coil
- Entry and exit conditions of air for cooling coil
- Fresh air mass flow rate and
- Refrigeration load on the cooling coil.

11. The following data refers to the office air conditioning plant having maximum seating capacity of 25 occupants: 14

Outside design conditions = 34°C DBT, 28°C WBT

Inside design conditions = 24°C DBT, 50%RH

Solar heat gain = 9120 watts

Latent heat gain = 105 watts / occupant

Sensible heat gain = 90 watts / occupant

Lightening load = 2300 watts

Sensible heat load from other sources = 11630 watts

Infiltration load = $14\text{m}^3/\text{min}$

Assuming 40% fresh air and 60% recirculated air passing through the evaporator coil and the Bypass factor is 0.15. Find dew point temperature of the coil and the capacity of the plant.

OR

12. A conference room for seating 100 persons is to be maintained at 22°C DBT and 60% RH. The outdoor conditions are 40°C DBT and 27°C WBT. The various load are as follows: 14

Sensible and latent heat load per person, 80W and 50W respectively, lights and fans 15000W, sensible heat gain through glass, walls, ceiling etc. are 15000W.

The air infiltration is $20\text{m}^3/\text{min}$ and fresh air supply is $100\text{m}^3/\text{min}$. Two-third of recirculated room air and one-third of fresh air are mixed before entering the cooling coils. The By-pass factor of the coils is 0.1

Determine ADP, GTH and ERSHF.
