

P. Pages : 3

Time : Three Hours



NJR/KS/18/4724

Max. Marks : 80

- Notes :
1. All questions carry marks as indicated.
 2. Solve Question 1 OR Questions No. 2.
 3. Solve Question 3 OR Questions No. 4.
 4. Solve Question 5 OR Questions No. 6.
 5. Solve Question 7 OR Questions No. 8.
 6. Solve Question 9 OR Questions No. 10.
 7. Solve Question 11 OR Questions No. 12.
 8. Due credit will be given to neatness and adequate dimensions.
 9. Assume suitable data whenever necessary.
 10. Illustrate your answers whenever necessary with the help of neat sketches.
 11. Use of non programmable calculator is permitted.
 12. Use of steam table & psychometric chart is permitted.

1. a) Comment in brief about the following for vapour compression refrigeration system. 4
- i) Wet compression is not desirable
 - ii) Throttling device is used in place of expanders.

- b) A food storage locker requires a refrigeration system of 2400kJ/min capacity at an evaporator temperature of 263K and a condenser temperature of 303K. The refrigerant used in Freon - 12 and subcooled by 6°C before entering the expansion valve and vapour is superheated by 7°C before leaving the evaporator coil. The compression of refrigerant is reversible adiabatic. The refrigeration compressor have two cylinders, single acting with stroke equal to 1.25 times the bore and operates at 1000 rpm. 10
- Determine.

- i) Refrigerating effect per kg.
- ii) Mass of Refrigerant to be circulated per minute
- iii) Theoretical piston displacement per minute
- iv) Theoretical power required to run the compressor
- v) Heat removed through condenser per minute
- vi) Theoretical bore and stroke of compressor.

Take specific heat of liquid: $1.235 \frac{\text{kJ}}{\text{kg K}}$

specific heat of vapour = $0.733 \frac{\text{kJ}}{\text{kg K}}$.

OR

2. a) Discuss in brief working of three fluid refrigerator with suitable diagram. 5
- b) Explain in brief **any two**. 9
- i) Alternate Refrigerants
 - ii) Montreal protocol
 - iii) Global Warming and Ozone depletion Potential.

3. a) What is Hermetically sealed compressor. Compare it's advantages and disadvantages with open type compressor. 4
- b) In a 15TR ammonia plant, compression is carried out in two stages with water and flash intercooling and water sub cooling. The particulars of the plant are as follows: 10
 Condenser Pressure : 12 bar
 Evaporator Pressure : 3 bar
 Flash Intercooler Pressure: 6 bar
 Limiting temperature for intercooling and subcooling = 20°C
 Draw the cycle on p-h chart and Estimate:
 i) COP of the plant
 ii) The power required for each compressor
 iii) The swept volume for each compressor if the volumetric efficiency of both the compressors is 80%.

OR

4. a) What do you mean by defrosting? List out various defrosting methods. 4
- b) A single compressor using R-12 as refrigerant has three evaporators of capacity 30TR, 20TR & 10TR. The temperature in the three evaporators is to be maintained at -10°C, 5°C and 10°C respectively. The system is provided with multiple expansion valves and back pressure valves the condenser temperature is 40°C. The liquid refrigerant leaving the condenser is subcooled to 30°C. The vapours leaving the evaporators are dry & saturated. Assuming isentropic compression 10
 Find:
 a) The mass of refrigerant flowing through each evaporator
 b) The power required to drive the compressor
 c) COP of the system.
5. A Boot strap cooling system of 10TR capacity is used in an aeroplane. The ambient air temperature and pressure are 20°C and 0.85 bar respectively. The pressure of air increases from 0.85 bar to 1 bar due to ramming action of air. The pressure of air discharged from the main compressor is 3 bar. The discharge pressure of air from the auxiliary compressor is 4 bar. The isentropic efficiency of each of the compressor is 80%, while that of turbine is 85%. 50% of the enthalpy of air discharged from the main compressor is removed in the first heat exchanger and 30% of the enthalpy of air discharged from the auxiliary compressor is removed in the second heat exchanger using rammed air. Assuming ramming action to be isentropic, the required cabin pressure of 0.9 bar and temperature of the air leaving the cabin not more than 20°C. Find: 13
 i) The power required to operate the system
 ii) The COP of the system.

Draw the schematic & T-S i.e. Temperature & Entropy diagram of the system.

$$\text{Take } \gamma = 1.4, \quad C_p = 1 \frac{\text{kJ}}{\text{kg K}}$$

OR

6. a) What do you mean by thermo-electric Refrigeration system. Explain various advantages of thermoelectric Refrigeration. 7
- b) Explain Steam Jet Refrigeration system with neat sketch. 6

7. a) Explain Cascade Refrigeration system with neat sketch. 7
b) Write short note on applications of cryogenics. 6

OR

8. a) Explain Linde's system of air liquification with neat sketch and its representation on T-S diagram. 6
b) Explain in brief Joules Thomson coefficient & Inversion curve. 7
9. a) Define the following psychrometric terms: 3
i) Relative Humidity ii) Dew point Temperature
iii) Vapour density
- b) Derive the expression for specific Humidity of moist air. 4
- c) The readings from a sling psychrometer are as follows: 6
Dry Bulb temperature = 30°C
Wet Bulb temperature = 20°C
Barometer Reading = 740mm of Hg.
Using Steam table.
Determine:
i) Dew point temperature ii) Relative Humidity
iii) Specific Humidity iv) Degree of saturation
v) Vapour Density vi) Enthalpy of mixture per kg of Dry air.

OR

10. The following Data refers to summer Air conditioning of a Building. 13
Outside Design conditions: 43°C DBT and 27°C WBT
Inside Design Conditions: 25°C DBT, 50% RH
Room Sensible Heat gain: 84000 kJ/hr.
Room latent heat gain: 21,000 kJ/hr.
By pass factor of the cooling coil used = 0.2.
The return air from the room is mixed with the outside air before entry to cooling in the ratio of 4:1 by mass.
i) Apparatus Dew point of the coil.
ii) Entry & Exit conditions of air for cooling coil.
iii) Fresh air mass flow rate.
iv) Refrigeration load on the cooling coil.

11. a) Name the types of air distribution system used. Explain any one. 6
b) Describe various air outlets used in air distribution system. 7

OR

12. a) What are various methods of duct design? Explain any one in detail. 4
b) Explain the terms throw, spread & drop in connection with air conditioning. 5
c) Explain the grills and diffusers as air outlets for air conditioning system. 4
