(b) Explain with the help of flow diagram and on p-h and T-S diagram multi-compression refrigeration system with flash cooler and single evaporator. 5

4. (a) Coefficient of Performance is higher for Carnot cycle than vapor compression refrigeration cycle and reversed Brayton cycle. Explain with the help of diagram. 3

(b) Differentiate between wet and dry compression. 2

(c) A Freon 12 vapour compression system operating at a condenser temperature of 40°C and evaporator temperature 0°C develops 15TR. Determine :

(i) Theoretical piston displacement

(ii) Heat rejected in system

(iii) Carnot COP and actual COP of cycle. 5

Section C

5. (a) Explain a three-stage cascade refrigeration system with figure. Show the system on p-h diagram. 5

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July-22-00434

B.Tech. EXAMINATION, 2022

Semester VII (CBCS)

REFRIGERATION AND AIR-CONDITIONING

ME-702

Time : 3 Hours *Maximum Marks : 60*

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt *Five* questions in all, selecting *one* question from each Sections A, B, C and D. Q. No. **9** is compulsory. Use of Psychrometric Chart and Refrigeration properties tables are permitted. Use of non-programmable calculator is allowed.

Section A

1. (a) With the help of necessary sketches prove that : 2

$$COP_{Heat\ Pump} = COP_{Refrigerator} + 1$$

(b) Enumerate the selection requirements of refrigerant for a particular application. 3

(c) An aircraft moving with speed of 1000 km/hr uses simple gas refrigeration system of 100 TR capacity for air-conditioning. The ambient pressure and temperature are 0.35 bar and – 10°C respectively. The pressure ratio of the compressor is 4.5. The heat exchanger effectiveness is 0.95. The isentropic efficiencies of compressor and expander are 0.8 each. The cabin pressure and temperature are 1.06 bar and 25°C. Determine (i) Temperature and pressures at all points of the cycle and calculate (ii) COP and (iii) Power required. 5

2. (a) Describe working of a simple air-conditioning system used for aircrafts. 2

(b) An aircraft refrigeration system has to handle a cabin load of 25 tonnes. The atmospheric temperature is 16°C. The atmospheric air is compressed to a pressure of 0.96 bar and temperature of 29°C due to ram action. The air is then further compressed in a compressor to 4.8 bar, cooled in a heat exchanger to 66°C

expanded in a turbine to 1 bar pressure supplied to cabin. The air leaves the cabin at temperature of 26°C. The isentropic efficiencies of both compressors and turbine are 0.9

Calculate :

(i) Mass of air circulated per minutes

(ii) COP.

Take for air C_p = 1.005 kJ/kg K and γ = 1.4. 5

(c) Derive COP of a Carnot refrigerator and point out the limitations of reversed Carnot cycle and establish the significance of cycle. 3

Section B

3. (a) A simple saturated heat pump working with refrigeration 134a for space heating operates between temperature limits of 15°C and 50°C. The heat required to be pumped is 100 MJ/hr.

Calculate :

(i) Theoretical piston displacement of compressor

(ii) Theoretical power requirements

(iii) COP. 5

(b) Explain the working principle of vapour absorption refrigeration cycle with a suitable diagram and also give merit/demerit. 5

6. (a) Explain with neat sketch working of Electrolux Refrigerator. Also explain the significance of Hydrogen used in system. 5

(b) Explain the working principle and construction of steam jet refrigerating system with a neat sketch. 5

Section D

7. (a) With a neat sketch explain the working of winter air-conditioning system ? 3

(b) With neat sketch explain construction and working of any *one* type of humidifier. 3

(c) The following data refer to summer air-conditioning of a building :

Outside design conditions : 38°C DBT and 27°C WBT. Inside design conditions : 27°C DBT and 21°C WBT, Room sensible heat gain : 46.5 kJ/sec, Room latent heat gain : 17.5 kJ/sec. The air supplies through ventilation and infiltration

in the system is 25 m^3/min. The outside air to be conditioned is passed through the cooling coil whose ADP is 15°C, while the quantity of recirculated air from the building is 60%. The conditioned fresh air is mixed with re-circuited air after the coil. Determine condition of the air after the coil and before the re-circuited air mixes with it, condition of air entering the hall, mass of fresh air entering the cooling coil and refrigeration load on the cooling coil. **4**

8. (a) Explain the following :

(i) Bypass factor

(ii) Effective sensible heat factor.

Discuss their importance in designing air-conditioning system. **3**

(b) Explain the difference between comfort air-conditioning and industrial air-conditioning. **2**

(c) Atmospheric air at 1.0132 bar has a DBT of 32°C and WBT of 26°C. Compute the partial pressure of water vapor, specific humidity, DPT, R.H., degree of saturation, density of dry air in the mixture, density of water vapor in the mixture, enthalpy of the mixture. **5**

(Compulsory Question)

9. (a) Explain the term "Tonne of Refrigeration".

(b) Explain the effects of super heating on COP of vapour compressor refrigeration.

(c) What are secondary refrigerants ?

(d) Define dry bulb and degree of saturation.

(e) Define absolute humidity.

(f) Which material in commonly used for making ducts in the air-conditioning system and why ?

(g) Why refrigeration is required in aircrafts ?

(h) What are the advantages and limitations of steam refrigeration system ?

(i) Explain ASHRAE comfort chart.

(j) Differentiate between air cooler and air conditioner. **10×2=20**