(Pages : 4) **M – 6542**

Reg. No. : .....

Name : .....

Seventh Semester B.Tech. Degree Examination, December 2021

13.704 : REFRIGERATION AND AIR CONDITIONING (M)

(2013 Scheme)

Time : 3 Hours Max. Marks : 100

Instructions :

1. Use of psychrometric chart and Refrigeration properties table permitted.
2. Answer all questions from *Part A* and any four full questions from *Part B*.

PART – A

(Answer **all** questions. Each question carries **2** marks.)

1. A heat pump works on reversed Carnot cycle between temperature limits of –10°C and 27°C. Find its COP.
2. Which air refrigeration system will you prefer for cooling exceptionally high speed aircrafts? Why?
3. Give the p-V diagram of Reversed Joule cycle showing various processes on it.
4. Draw the P-h and T-s diagram of a refrigerant in its superheated state entering the compressor and leaving the condenser as saturated liquid.
5. What are mixed refrigerants? Where they are used?
6. What is the function of LSHE? Where is it used? Explain.
7. Mention any two advantages of vapour absorption refrigeration system over vapour compression refrigeration system.
8. Write the equation for enthalpy of moist air in its superheated state.

P.T.O.

9. Briefly explain the working of thermostat with sketches.

10. Show the diagram of year round air-conditioning.

(10 × 2 = 20 Marks)

PART – B

(Answer **any one full** question from each module; each carries **20** marks)

Module – I

11. (a) Describe with neat sketches the principle of working of Boot strap air refrigeration system and derive the expression for COP and power required. **10**

(b) Explain with neat sketches the working of :

(i) Vortex tube refrigerator

(ii) Magnetic refrigerator **10**

OR

12. (a) A bootstrap cooling system of 9 tonnes refrigeration capacity is employed in an airplane. The ambient air temperature and pressure are 20°C and 0.86 bar respectively. The pressure of air increases from 0.86 bar to 1 bar due to ramming action of air. The pressure of air discharged from the main compressor is 3.2 bar. The discharge pressure of air from the auxiliary compressor is 4.2 bar. The isentropic efficiency of each of the compressor is 82 percent, while that of turbine is 86 percent. 45 percent of enthalpy of air discharged from the main compressor is removed in the first heat exchanger and 32 percent 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 0.92 bar and temperature of the air leaving the cabin not more than 21°C, find:

(i) The power required to operate the system, and (ii) COP of the system

Draw the schematic and temperature-entropy diagrams of the system

Take for air: $C_p = 1\,kJ/kg\ K$; $\gamma = 1.4$ **10**

(b) Describe the historical development of Refrigeration. **10**

Module – II

13. (a) Describe the effect of various operating parameters on the COP of vapour compression refrigeration system. **10**

(b) A standard vapour compression refrigeration system uses R-12 as refrigerant. The system has a condensing temperature of 50°C and evaporating temperature of 0°C. The refrigeration capacity is 7 TR. The liquid leaving the condenser is saturated liquid and vapour entering the compressor is dry saturated and compression is isentropic. Determine:

(i) The refrigerant flow rate

(ii) The power required to run the compressor

(iii) The heat rejected in the plant

(iv) COP of the system

The properties of R-12 are:

Saturation temperature °C	Pressure bar	Enthalpy kJ/kg		Entropy kJ/kgK	
		Liquid	Vapour	Liquid	Vapour
50	12.199	84.868	206.298	0.3034	0.672
0	3.086	36.022	187.397	0.1418	0.6960

Take enthalpy at the end of isentropic compression = 210 kJ/kg. **10**

OR

14. (a) Explain a multi-evaporator system with flash intercooling with sketches. **10**

(b) What are the different desirable properties of refrigerants? **6**

(c) How mixing of refrigerants are significant in developed improved systems. **4**

Module – III

15. (a) Describe the working of Lithium bromide water vapour absorption refrigeration system with neat sketches. **10**

(b) Derive the expression for maximum coefficient of performance of an ideal vapour absorption refrigeration system. **10**

OR

16. (a) Describe with neat sketches the working of ice plant and cold storage **10**

(b) Describe the different refrigerant leakage and detection methods. **10**

Module – IV

17. (a) Define and derive expressions for the following terms :
(i) Specific humidity
(ii) Relative humidity **10**

(b) In an air-conditioning plant, an air handling unit supplies a total of 4000 m^3/min of dry air which comprises by mass 20% fresh air at 39°C DBT and 26°C WBT and 80% recirculated air at 24°C DBT and 50% RH. The air leaves the cooling coil at 12°C saturated. Calculate the following:
(i) Total cooling load; and
(ii) Room heat gain **10**

OR

18. (a) A mixture of dry air and water vapour is at a temperature of 22°C under a total pressure of 730 mm Hg. The dew point temperature is 15°C. Find:
(i) Partial pressure of water vapour
(ii) Relative humidity
(iii) Specific humidity
(iv) Enthalpy of air per kg of dry air
(v) Specific volume of air per kg of dry air **10**

(b) Write short notes on the following :
(i) Dew point temperature
(ii) Adiabatic saturation process
(iii) Degree of saturation
(iv) BPF of cooling coil
(v) Adiabatic mixing of air streams **10**