

Dec.-22-0301

ME-702 (Refrigeration & Air Conditioning)

B.Tech. 7th (CBCS)

Time : 3 Hours

Max. 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 Sections. Selecting one question from each section A, B, C, D and Section E Question 9 is compulsory. Use of Refrigeration Air-Conditioning charts and Steam tables is permitted.

SECTION - A

1. (a) The COP of air refrigeration system is very low, even then why air refrigeration system is most common in the aircraft. Explain? (4)
- (b) An air refrigerator is working on the principle of Bell-Coleman cycle. The air enters into the compressor 1 atm at -10°C . It is compressed to 10 atm and cooled to 40°C at the same pressure. It is then expanded to 1 atm and discharged to take cooling load. The air circulation is 1 kg/s. The isentropic efficiency of the compressor = 80%. The isentropic efficiency of the expander = 90% , Find the following: i) Refrigeration capacity of the system ii) C.O.P of the system Take $\gamma = 1.4$, $C_p = 1.00 \text{ kJ/kg}^{\circ}\text{C}$. (6)

OR

2. (a) How are refrigerants classified? Explain the properties of ammonia refrigerant. (4)
- (b) A Two stage ammonia refrigeration system operates between overall pressure limits of 15 bar and 2 bar respectively. The liquid is sub-cooled to 30°C . The

temperature of de-superheated vapour leaving the water intercooler is also 30°C . The flash chamber separates the dry vapour at 5 bar pressure. The liquid refrigerant then expands to 2 bar, the evaporator pressure. The load on the evaporator is 50 kW. Calculate i). Mass flow rate in different lines ii) Power required iii) COP. (6)

SECTION - B

3. (a) Explain the effects of sub cooling and super heating on the performance of a vapour compression refrigeration system. (4)
- (b) An ammonia ice plant operates between a condenser temperature of 30°C and an evaporator temperature of -20°C . It produces 10 tons of ice per day from water at 25°C to ice at -10°C . Assuming simple saturation cycle, determine i) the capacity of refrigerating plant ii) mass flow rate of refrigerant and iii) COP of the cycle. (6)

OR

4. (a) Explain the working of Vapour compression refrigeration system with the help of a neat sketch. (6)
- (b) Mention the advantages of vapour compression refrigeration system over air refrigeration system. (4)

SECTION - C

5. (a) With a neat sketch explain the working of Li-Br absorption refrigeration system. (5)
- (b) In a vapour absorption refrigeration system, the refrigeration temperature is -15°C . The generator is operated by solar heat where the temperature reached is 100°C . The temperature of the heat sink is 55°C . What is the maximum possible COP of the system? (5)

[P.T.O.]

OR

6. (a) What are the advantages and disadvantages of steam jet refrigeration system over other types of refrigeration system. (3)
- (b) A steam jet refrigeration system is to supply 1200 kg per minute of chilled water at 6.5°C. The makeup water from the mains is at 27°C. If the steam supply is available at 9.5 bar and 200°C and nozzle, entrainment and diffuser efficiency can be assumed as 89%, 63% and 72% respectively, the quality of vapour entering the ejector may be assumed 0.98, and condensate leaves the condenser at 33°C. Determine: i) Steam consumption in kg/hour and kg/hr per ton of refrigeration ii) Heat rejected in the condenser in kJ/hr and kJ/hr per ton of refrigeration. (7)

SECTION - D

7. (a) Explain the requirements of comfort air conditioning. (4)
- (b) Air flowing at the rate of 100 m³/min at 40°C DBT and 50% RH is mixed with another stream flowing at the rate 20 m³/min at 26°C DBT and 50%RH. The mixture flows over a cooling coil whose ADP temperature is 100C and by-pass factor is 0.2. Find DBT and RH of air leaving the coil. If this air supplied to an air-conditioned where DBT of 26°C and RH of 50% are maintained, estimate (i) Room sensible heat factor and (ii) Cooling load capacity of the coil in tons of refrigeration. (6)

OR

8. (a) What are the different methods of humidifying the air? Explain the working of any one of the atomizing the water type humidifier. (5)
- (b) What are the different loads to be considered to estimate the total cooling load in the design of air-conditioning

systems? Discuss in detail each of these loads and give the design procedure considering various parameters. (5)

SECTION - E
(Compulsory Question)

9. (a) Explain the following terms i) Heat Pump ii) C.O.P.
- (b) Name some secondary refrigerants.
- (c) Define one ton of refrigeration.
- (d) Explain the effect of sub-cooling in vapour compression refrigeration system.
- (e) Classify refrigerants.
- (f) What are the refrigerant and absorbent in Li-Br and water absorption system?
- (g) What is purpose of condenser in vapour compression system?
- (h) Differentiate between air cooler and air conditioner.
- (i) Explain the following terms i) Wet bulb temperature ii) Dry bulb temperature.
- (j) Explain the following: i) Bypass factor, ii) Effective sensible heat factor. (10×2=20)