

Dec-25-0280

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, selecting one question each from section A, B, C and D. Section E is compulsory. Assume any suitable missing data if any. Use of non-programmable calculator, refrigerant properties table and psychrometric chart is allowed.

SECTION - A

1. In a Bell-Colemann refrigeration plant, the air is drawn from cold chamber at 1 bar and 12°C, and compressed to 5 bar. The same is cooled to 25°C in the cooler before expanding in the expansion cylinder to cold chamber pressure of 1 bar. Determine the theoretical COP of the plant and the theoretical net refrigeration effect/kg of air. The compression and expansion be assumed isentropic. Assume $\gamma = 1.41$ and $c_p = 1.009$ kJ/kg-K. (10)

2. A Carnot refrigeration cycle absorbs heat at -20°C and rejects it at 40°C. (a) Calculate the COP of this cycle, (b) If the cycle is absorbing 850 kJ/min at -20°C, how much work in kJ/min is required, (c) If the same cycle operates on simple vapour compression cycle with R134a refrigerant, what are the deviations in COP and the work input per kg of mass circulated? (10)

SECTION - B

3. Write short notes on the following: (a) Actual vapour compression cycle, (b) Effect of increase in condenser pressure and decrease in evaporator pressure on the

performance of vapour compression cycle, (c) Effect of subcooling on the performance of vapour compression cycle. (10)

4. (a) A vapor compression refrigerating system operates at -6°C evaporating temperature and condensing temperature of 36°C. If the volume flow rate of R22 through the system is 0.05m³/s, determine the refrigerating capacity of the system. (7)
(b) Enumerate the limitations and drawbacks of a single-stage vapour compression plant required to operate between high condenser temperature and low evaporator temperature. (3)

SECTION - C

5. (a) Write down the chemical formulae of the following refrigerants: R-14, R-111, R-151, R-728.9. (5)
(b) What are the refrigerant numbers of the refrigerants whose chemical formulae are: Monochloro-difluoromethane, Tetrachloroethane, Trichloro-monofluoromethane, Sulphur dioxide. (5)
6. (a) What is cryogenics? Explain the principle of operation of an ideal gas liquefaction system. (7)
(b) What is dry ice and how is it manufactured? (3)

SECTION - D

7. A reversible absorption refrigerator consists of a reversible heat engine and a reversible refrigerator. The system removes heat from a cooled space at -10°C at a rate of 22 kW. The refrigerator operates in an environment at 25°C. If the heat is supplied to the cycle by condensing saturated steam at 200°C, determine (a) the rate at which the steam condenses and (b) the power input to the reversible refrigerator, (c) If the COP of an actual absorption chiller at the same temperature limits has a COP of 0.7, determine the second law efficiency of this chiller. (10)

[P.T.O.]

8. Air flowing at the rate of $100 \text{ m}^3/\text{min}$ at 40°C DBT and 50% RH is mixed with another stream flowing at the rate of $20 \text{ m}^3/\text{min}$ and 26°C DBT and 50% RH. The mixture flows over the cooling coil whose Apparatus Dew Point (ADP) is 10°C and BPF is 0.2. Find the DBT and RH of the air leaving the coil.

If this air is supplied to an air conditioned room where DBT of 26°C and 50% RH are maintained, estimate (i) Room sensible heat factor (ii) Cooling load capacity of the coil in tonnes of refrigeration. (10)

SECTION - E
(Compulsory Questions)

9. Attempt all of the following.

- (i) What are the limitations of Carnot cycle with gas as refrigerant?
- (ii) In a refrigeration system, would you recommend condensing the refrigerant R134a at a pressure of 0.8 MPa or 1 MPa if heat is rejected to a cooling medium at 30°C ?
- (iii) In an aircraft, cooling systems are required to keep the cabin temperatures at a comfortable level. Even though the outside temperatures are very low at high altitudes, still cooling of cabin is required. Why?

- (iv) What is fog? Why does fog occur during nights in winter and not during nights in summer?

- (v) "In the vapour compression refrigeration cycle, expansion is carried out using a throttling device and not an expansion engine." Comment.

- (vi) Define 1 TR and derive its conversion units in kW.

- (vii) Name any two combinations of refrigerant-absorbent and their applications. Which combination is used in the air-conditioning application?

- (viii) What is Joule—Thomson effect? Give an example of an application of Joule—Thomson effect.

- (ix) What is By Pass Factor (BPF) of the cooling coil?

- (x) How does an absorption refrigeration system differ from a mechanical refrigeration system? (10×2=20)