

180344**B. Tech. EXAMINATION, 2018**

Semester VII (CBS)

REFRIGERATION AND AIR-CONDITONING

ME-702

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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. Section E is compulsory. All questions carry equal marks. Use of psychometric charts and ammonia tables is allowed.

Section A

1. (a) What is the use of condenser and evaporator in vapour compression system ? 4

(b) Atmospheric air at 10°C WBT and 15°C DBT enters a heating coil whose temperature is 40°C DBT. The bypass factors of heating coil is 0.4. Determine DBT, WBT and RH of the air leaving the coil and the amount of sensible heat added per kg of air.

6

2. (a) Explain the concept of regenerative type of Air Refrigeration System.

4

(b) A Bell-Coleman refrigerator operates between pressure limits of 1 bar and 8 bar. Air is drawn from the cold chamber at 9°C , Compressed and then it is cooled to 29°C before entering the expansion cylinder. Expansion and compression follows the law $PV^{1.25} = \text{Constant}$. Calculate COP of the system. For air take $\gamma = 1.4$, $C_p = 1.003 \text{ kJ/kg.K}$.

6

Section B

3. (a) Explain with neat sketch complete multistage vapour compression system.

4

(b) An ammonia ice plant operates between condenser temperature of 35°C and an evaporator temperature of -15°C . It produces 5 tonnes of ice per day from water at 25° to ice at -5°C . The ammonia enters as dry saturated vapour and leaves the condenser as saturated liquid. Determine :

- (i) The capacity of the refrigerating plant
- (ii) Mass flow of the refrigerant
- (iii) Discharge temperature of ammonia from the compressor
- (iv) Power of the compressor motor if the isentropic efficiency of the compressor is 85% and mechanical efficiency of the compressor is 90%
- (v) Relative efficiency.

The latent heat of formation of ice is 335 kJ/kg and specific heat of ice is 2.1 kJ/kg-K . 6

4. Explain with schematic the working of a refrigeration system with a single evaporator and two-stage compression system, with a water inter-cooler and flash inter-cooler interposed between the stages. Represent there cycle on a P-h diagram. 10

Section C

5. (a) Explain with the help of neat sketches, vapour absorption cycle for refrigeration. How is it different from vapour compression refrigeration system ? 5
- (b) Explain with a block diagram the working of a practical Ammonia Water Vapour absorption refrigeration system. 5
6. (a) Explain cascade system of refrigeration. 3
- (b) The operating temperature of a single stage vapour absorption refrigeration system are : generator : 80°C ; condenser and absorber : 45°C ; evaporator : 0.5°C . The system has a refrigeration capacity of 90 kW and the heat input to the system is 150 kW. The solution pump work is negligible. Find the COP of the system and the total heat rejection rate from the system. 7

Section D

7. (a) What is comfort air-conditioning ? Draw a rough comfort chart. 4

(b) The design conditions for an air conditioned hall is :

Inside condition 24°C DBT and 60% RH

Outside condition 38°C DBT and 28°C WBT

Sensible heat gain 167040 kJ/hr

Latent heat gain 41760 kJ/hr

Infiltrated air 20 C MM

Coil ADP 10°C 60% of total air is recirculated and mixed with conditioned air after cooling coil.

Determine :

(i) The condition of air before entering the hall

(ii) The condition of air leaving the conditioner coil. 6

8. (a) Describe cooling towers with important performance related terms. 4

(b) Aspect ratio of a rectangular duct is 7 and its equivalent circular duct diameter is 100 mm. The ratio of longer side of rectangular duct to the diameter of circular duct is 2.6. Find the dimension of shorter side of the duct. 6

Section E

9. (a) Write a short note on centralized air cooling systems.
- (b) Define Energy Performance Ratio (EPR) and express its relationship with COP.
- (c) Define the following :
- (i) Relative humidity
 - (ii) Degree of saturation.
- (d) Define the following :
- (i) Dew point temperature
 - (ii) Wet point temperature.
- (e) What are the components of vapour compression refrigeration cycle ?
- (f) Explain ASHRAE numbering system for refrigerants with example.
- (g) What is the function of absorber and rectifier ?
- (h) Classify different types of refrigerants.
- (i) Write a note on designation of refrigerants.
- (j) Differentiate between ventilation load and infiltration load.

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