Code : 021720

B.Tech. 7th Semester Special Examination, 2016

Refrigeration and Air Conditioning

Time : 3 hours   Full Marks : 70

Instructions :

(i) There are **Nine** questions in this paper.

(ii) Attempt **Five** questions in all.

(iii) **Questions No.1 is Compulsory.**

(iv) The marks are indicated in the right hand margin.

(v) Use of refrigerant table and psychrometric chart is allowed.

---

1. Choose the correct answer any Seven of the following:

$2 \times = 7 = 14$

(a) The COP of reversed Carnot cycle refrigerator is 4. The ratio of higher temperature to low temperature is

    (i)   2·5

    (ii)   2

    (iii)   1·5

    (iv)   1·25

(b) The Common air cooling system used in air-craft is

    (i)   Simple air-cooling

    (ii)   Boot-Strap

    (iii)   Simple air Cooling with evaporator

    (iv)   None of the above

(c) The COP of a window air conditioner compared to the COP of domestic refrigerator is

    (i)   Same

    (ii)   Lower

    (iii)   Higher

    (iv)   Unpredictable

(d) In Electrolux refrigerator

    (i) NH_3 evaporates in H_2

    (ii) NH_3 is absorbed by H_2

    (iii) NH_3 is absorbed in water

    (iv) H_2 evaporates in NH_3

(e) The COP of steam jet refrigeration system lies between

    (i)   1 to 2

    (ii)   0·4 to 0·6

    (iii)   0·1 to 0·3

    (iv)   3 to 5

(f) Low boiling point refrigerant is suited for

    (i)   Centrifugal Compressor

    (ii)   Axial flow compressor

    (iii)   Reciprocating Compressor

    (iv)   Screw type compressor

P.T.O.

Code : 021720   2

(g) The domestic refrigerator uses

    (i) Shell and coil type condenser

    (ii) Double pipe condenser

    (iii) Forced convection air-cooled condenser

    (iv) Natural convection air cooled condenser

(h) The Condition of the refrigerant leaving the evaporator is

    (i) Dry-Saturated vapour

    (ii) Superheated vapour

    (iii) High dryness fraction

    (iv) Low dryness fraction

(i) The process used for winter air-conditioning is

    (i) Dehumidification

    (ii) Cooling and dehumidification

    (iii) Humidification

    (iv) Heating and humidification

(j) If the specific humidity of air remains same but its DBT increase, then DPT.

    (i) Remains Same

    (ii) Increases

    (iii) Decrease

    (iv) May increase or decrease

2. (a) What are the advantages of air refrigeration system, using aeroplane ?   6

(b) An air-refrigerator used for food storage provides 50 tons of refrigeration. The temperature of air entering he compressor is 7°C and the temperature before entering into expander is 27°C, Assuming 30% more power is required then theoretical find (a) Actual COP of the cycle, (b) kW-Capacity required to run the compressor. The quantity of air circulated in the system is 100 kg/min. The compression and expansion follow the law $pv^{1.3}$ = constant. Take $\gamma = 1.4$ and $C_p = 1 kJ / kg\,°c$ for air.

3. A boot-strap cooling system of 20 tons capacity is required for an aeroplane cabin. The temperature and pressure conditions of the atmosphere are 20°C and 0·8 bar. The pressure of air is increased fro 0·8 bar to 0·96 bar by ramming action. The pressure of the air leaving the main-compressor and auxiliary compressor are 3·5 bar and 5·25 bar respectively. The isentropic efficiency of both compressor is 85% and of turbine is 80%, 60% of the total heat of the air leaving the main compressor is removed in the first heat exchanger and 35% of the total heat of the leaving the auxiliary compressor is removed in the second heat exchanger.

Assuming that ramming is isentropic and cabin pressure is 1·03 bar, find the followings: 14

(a) kW required to take the load in the cabin

(b) COP of the system

Temperature of air leaving the cabin should not exceed 27°C.

4. Refrigerant 134a is the working fluid is an ideal vapour compression refrigeration cycle, that operated between a cold region at 0°C and a warm region at 26°C. The saturated vapour enters the compressor at- 10°C and the saturated liquid leaves the condenser at a pressure of q bar. Determine for mass flow rate (in)= 0·8kg/s (a) compression power in kW, (b) refrigeration capacity in tonnes and (c) Co-efficient of performance. 14

5. (a) Explain the different methods of improving the COP of a simple compression refrigeration cycle. 7

(b) Explain the working of refrigeration cycle with two stage compression. What are its merits and demerits? 7

6. (a) What are the advantages of absorption refrigeration system over compression refrigeration system? 6

(b) In an absorption type refrigeration, the heat is supplied to NH_3 generator by condensing steam at 2 bar and 90% dry. The temperature to be maintained is the refrigerator,

is -5°C. The temperature of the atmosphere is 30°C. Find the maximum COP possible of the refrigerator. If the refrigeration load is 20 tons and actual COP is 70% of maximum COP, Find the mass of steam required per hour. 8

7. (a) Explain the basic components of steam ejector. What are advantages of steam jet system. 8

(b) Under which circumstanges, the cascade refrigeration system is preferable? 6

8. 100 m³ of air per minute at 30°C DBT and 60% RH is cooled to 20°C DBT by passing through a cooling coil. Find the followings: 14

(i) Capacity of cooling coil is tons of refrigeration.

(ii) Relative humidity of coming out air and its wet-bulb temperature. Take atmospheric pressure=1·033 bar.

9. A library hall is to be maintained at 24°C DBT and 50% RH when ambient conditions are 38°C DBT and 40% RH. The room sensible and latent heat gains are 125000 kJ/hr and 68000 kJ/hr respectively. The ventilation is 65 m³/min. Find the following:

(i)   Grand total heat

(ii)   Effective sensible heat factor

(iii) ADP temperature

(iv)   Dehumidified air quantity Take B.F (for coil)= 0.1

***