# R 8458

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2006.

Sixth Semester

Mechanical Engineering

ME 034 — REFERIGERATION AND AIRCONDITIONING

Time : Three hours Maximum : 100 marks

Answer ALL questions.

Use of approved data book is permitted.

Assume missing data suitably.

PART A — (10 × 2 = 20 marks)

1. What is the influence of superheat horn in the VCR cycle in respect of system COP?

2. What is the OD? & GWP of :

   (a) HC 290

   (b) HCFC 22.

3. In a TEV what are all the balancing forces on the diaphragm?

4. Mention two differences between Flooded type chillers and D-X coil units.

5. Distinguish between Range and Differential settings in cycling controls of Refrigeration systems.

6. What do you mean by system balancing?

7. In a Skeleton Psychrometric chart, represent the following processes :

   (a) Heating and Dehumidification.

   (b) Adiabatic Saturation.

8. Two air streams one at 25°C DBT and 20°C WBT mixes with another stream at 40°C DBT and 70% RH in the ratio 4:1 respectively. Find the condition of the stream after mixing.

9. A conditioned room has 20 kW of sensible heat and 5 kw of Latent heat. Find the RSHF of the room.

10. Diagrammatically represent the Air Distribution patterns of a high side wall diffuser for heating and cooling applications.

PART B — (5 × 16 = 80 marks)

11. (a) A refrigeration machine using R-12 as refrigerant operates between the pressures 2.5 bar and 9 bar. The compression is isentropic and there is no subcooling in the condenser.

The vapour is in dry saturated condition at the beginning of the compression. Estimate the theoretical coefficient of performance. If the actual coefficient of performance is 0.65 of theoretical value, calculate the net cooling produced per hour. The refrigerant flow is 5 kg per minute. Properties of refrigerant are :

| Pressure, bar | Saturation temperature, °C | Enthalpy, kJ/kg | | Entropy of saturated vapour, kJ/kg K |
|---|---|---|---|---|
| | | Liquid | Vapour | |
| 9.0 | 36 | 70.55 | 201.8 | 0.6836 |
| 2.5 | –7 | 29.62 | 184.5 | 0.7001 |

Take $C_p$ for superheated vapour as 9 bar as 0.64 kJ/kg K.

Or

(b) A water cooler using CFC -12 works between condensing temperature of 46°C and evaporator temperature of 2°C. The vapour leaves the evaporator saturated and dry. The average output of cold water is 100 kg/hr, cooled from 26°C to 6°C. Assuming 20% of the load to be taken extra and Volumetric efficiency of Compressor to be 80%, Mechanical Efficiency of Compressor and Motor to be 85% and 95% respectively find.

(i) the Volumetric displacement of the Compressor,

(ii) the power of the motor

(iii) C.O.P of the Water Cooler. (6 + 5 + 5)

12. (a) With a neat sketch explain the working of a TXV and explain how it maintains constant degree of superheat.

Or

(b) With a simple sketch explain the working of a scroll compressor and compare its performance with a Reciprocating compressor.

13. (a) A walk-in cooler, having a calculated cooling load of 13.9 kW, is to be maintained at 2°C. The desired evaporator TD is 5 K and the available water temperature is 24°C. Allowing 0.5°C for the pressure drop in the suction line, select a water-cooled, R-12 condensing unit and a cooling coil to meet the system design conditions.

Or

(b) Discuss the salient features of pressure actuated cycling controls and Temperature actuated cycling controls in a Refrigeration systems.

14. (a) Four kilograms of air, having initial DB and WB temperatures of 30°C and 21°C, respectively, are passed across a cooling coil whose mean effective surface temperature is 10°C. Assuming that all parts of the air contact the cooling surface so that the air leaves the coil saturated at the temperature of the coil surface, plot the path of the process on the Psychrometric chart and determine :

(i) the total heat removed per kilogram of dry air,

(ii) the sensible heat removed per kilogram of dry air,

(iii) the latent heat removed per kilogram of dry air,

(iv) the mass of water vapour condensed from the air in kilograms per second.

Or

(b) What are all the various Psychrometric processes that are achievable in an air washer system? Discuss how they are realized.

15. (a) Room conditions : 26°C DBT, 20°C WBT

Out side conditions : 38°C DBT, 27°C WBT

Room heat gains : Sensible heat = 10 kW, Latent heat = 4 kW.

The conditioned air supplied to the room is 50 cm and contains 15 per cent freshair and 85 per cent recirculated room air. Determine :

(i) The DBT and WBT of supply air.

(ii) The DBT and WBT of mixed air before the cooling coil.

(iii) The apparatus dew point and bypass factor of the coil.

(iv) The refrigeration load on the cooling coil and the moisture removed by the coil.

Or

(b) A space to be conditioned has the following data :

| | |
|---|---|
| Size of space | 30 m × 30 m × 4 m high |
| West glass | 15 $m^2$ |
| South glass | 15 $m^2$ |
| Solar gain through west glass | 508 $W/m^2$ at 4 p.m. |
| Solar gain through south glass | 38 $W/m^2$ at 4 p.m. |
| Overall heat-transfer Coefficient of roof | 2.5 $W/m^2 K$ |
| Overall heat-transfer Coefficient of wall | 3.5 $W/m^2 K$ |
| Overall heat-transfer Coefficient of glass | 6 $W/m^2 K$ |
| Door in E–wall | 3 m × 25 m |
| Overall heat-transfer Coefficient of door: | 1.5 $W/m^2 K$ |

**Equivalent temperature differentials at 4 p.m.**

E-wall : 15°C, W-wall : 10.5°C, N-wall : 6. 1°C, S-wall : 10.5°C

Roof : 17.8°C

Infiltration through window cracks : 5.3 $m^3/h$ /m.

Infiltration through door openings : 3 $cmm/m^2$

Occupancy : 100

Sensible heat gain per occupant : 75 W

Latent heat gain per occupant : 55 W

Lighting : 33.5 $W/m^2$ fluorescent

Outside design conditions : 43°C DE, 27°C WB

Inside design condition : 25° C DB, 50% RH

Ventilation air : 0.24 cmm/person

Bypass factor of the air-conditioning apparatus : 0.1

Calculate :

(i) Room sensible & latent heat gain

(ii) Outside air sensible, latent and total heat gains

(iii) Grand total cooling load on apparatus

(iv) Effective sensible heat factor and apparatus dew point

(v) Dehumidified and recirculated room air quantities.

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