C 28964 (Pages : 3) Name.....

Reg. No.....

SEVENTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION JUNE 2012

ME 04 703—REFRIGERATION AND AIRCONDITIONING

(2004 Admissions)

Time : Three Hours Maximum : 100 Marks

Part A

Each question carries 5 *marks*

1. Represent heat engine heat pump and refrigerator on a common platform and compare.
2. A machine works on Carnot cycle between temperature limit –10°C and 27°C. Find its efficiency / COP working as (a) Heat Engine ; (b) Heat pump ; and (c) Refrigerator.
3. Explain dry and wet compression with the help of T–S and P–H diagram of vapour compression system. What are the effects of (a) Subcooling the refrigerant after the condensor ; and (b) Super Heating after the evaporator on refrigeration effect and COP ?
4. Explain with a neat sketch the working of vortex tube refrigeration system.
5. Explain dry bulb temperature, wet bulb temperature and dew point temperature with the help of a T–S diagram.
6. What are the desirable properties of ideal refrigerant ?
7. With a neat sketch, explain the working of constant pressure expansion valve.
8. What is meant by flash gas ? Draw a neat sketch of simple saturation cycle with a flash chamber and briefly explain ?

(8 × 5 = 40 marks)

Part B

Each question carries 15 *marks.*

9. A reversible heat engine operates between 600°C and 40°C. The engine drives a reversible refrigerator operates between 40°C and –20°C. The heat transfer to the engine is 2000 kJ and the network output of the combined system is 360 kJ. Determine the net heat transfer to the reservoir at 40°C. What will be the heat transfer if the efficiency of the heat engine and COP of refrigerator are 40 % of the maximum value ?

Or

10. An air refrigerator system used for food storage is 25TR. The temperature of air entering the compressor is 27°C. The quantity of air circulated in the system is 3000 kg/hr. The compression and expansion both follow the law $PV^{1.3}$ = constant. Find (a) COP of the cycle and (b) power per ton of refrigerator required by the compressor ? Take $\gamma = 1.4$, and $C_p = 1$ kJ/kg-K ?

Turn over

11. A vapour compression refrigerator uses R – 12 as refrigerant and the liquid evaporates at –15°C. The temperature of this refrigerant at the delivery from the compressor is 15°C when the vapour is condensed at 10°C. Find COP if (i) There is no undercooling and (ii) The liquid is undercooled by 5°C before expansion by throttling. Take specific heat at constant pressure for the superheated vapour as 0.64 kJ/kg-K and that for liquid as 0.94 kg/kg-K. The other properties of the refrigerant are as follows :

Temperature °C	*Entropy in kJ/kgK*		*Specific entropy in kJ/kgK*	
	Liquid	*Vapour*	*Liquid*	*Vapour*
–15	22.3	180.88	0.0904	·7051
10	45.4	191.76	0.1750	0.6921

Or

12 30 tonnes of ice from and 0°C is produced in an ammonia refrigerator. The temperature range in the compressor is –15°C to 25°C. The vapour is dry and saturated at the end of compression. There is no liquid sub-cooling. Assuming actual COP of 65 % of theoretical, calculate the power required to drive the compressor. Following properties of ammonia are given :

Temperature °C	*Enthalpy kJ/kgK*		*Entropy kJ/kgK*	
	Liquid	*Vapour*	*Liquid*	*Vapour*
25	298.9	1465.84	1.1242	5.0391
–15	112.34	1426.54	0.4572	5.5490

13. Draw a neat sketch of ammonia vapour absorption system incorporating generator, absorber, rectifier, analyser and heat exchanger for improving performance. Explain the working in details. Also explain the advantage and disadvantage compared to vapour compression system.

Or

14. Draw a neat sketch of lithium bromide absorption system and explain the working in detail. Also explain the advantage and disadvantage compared to ammonia vapour absorption system.

15. 300 m^3 of air is supplied per minute from outdoor conditions of 40°C dry bulb temperature and 26°C WBT to an airconditioned room. The air is dehumidified first by a cooling coil having bypass factor 0.4 and dew point temperature at 12°C and then by a chemical dehumidifier. Air leaves the chemical dehumidifier at 30°C DBT. Air is then passed over a cooling coil whose surface temperature is 12°C and bypass factor 0.3. Calculate the capacities of the two cooling coils and dehumidifier. Use Psychrometric chart.

Or

16. The following datas are given for a space to be airconditioned :

(a) Inside design conditions = 25°C DBT, 50 % RH.

(b) Outside design condition = 43°C DBT, 27°C WBT.

(c) Room sensible heat = 46.6 kW.

(d) Room latent heat = 11.4 kW.

(e) By-pass factor of cooling coil = 0.2.

The return air from the room is mixed with outside air before entering to cooling coil in the ratio 4 : 1 by weight. Determine entry and exit condition of air for cooling coil and the refrigerating load on the cooling coil.

(4 × 15 = 60 marks)