Total No. of Questions :10] *[Total No. of Printed Pages :4*

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AU/ME - 803

B.E. VIII Semester

Examination, June, 2013

Refrigeration and Air Conditioning

Time : Three Hours

Maximum Marks : 100 ***Minimum Pass Marks :35***

Note: All parts of a question should be attempted in continuation. Use of relevant property tables and charts is permitted.

Unit 1

1. a) Explain the working of reversed Brayton refrigeration cycle. Derive the expression for COP of this cycle. 10

   b) A cold storage plant is required to store 50 tons of fish. The temperature at which fish supplied is 35°C and storage temperature of fish is - 10°C. If the cooling is achieved within 12 hours, find capacity of the refrigerating plant and the power required to run the plant if actual COP is 40% of Carnot COP. Take c_p of fish above freezing point as 2.94kJ/kg °C, c_p of fish below freezing point as 1.26 kJ/kg °C, freezing point of fish as -5°C and latent heat of fish as 250 kJ/kg. 10

OR

2. a) A bootstrap air refrigeneration system is used for an aeroplane to take 10 TR load. The ambient air conditions are 15°C and 0.9 bar. This air is rammed isentropically to a pressure of 1.1 bar. The pressure of air bled off the main compressor is 3.5 bar and this is further compressed in secondary compressor to a pressure of 4.5 bar. The isentropic efficiency of both the compressors is 90% and

its final temperature is 21°C without a change is specific humidity. Determine: 10

i) The temperature of air at the end of drying process
ii) The heat rejected during cooling process
iii) The relative humidity at the end of cooling process.

Unit 5

9. An air conditioned room is maintained at 24°C DBT and 50% RH, while the outside conditions are 35°C DBT, 27°C WBT. The air conditioned room has a sensible heat load of 12kW and latent heat load of 7.5 kW. The cooling coil has a by-pass factor of 0.1, and apparatus dew point is 8°C. Return air from the room is mixed with the outside air before entering the cooling coil in the ratio of 4:1, and return air from the room is also mixed with the air after cooling coil in the ratio 1:4. The air may be reheated, if necessary before supplying to the conditioned room.
   Determine:
   i) Supply conditions to the room
   ii) Refrigeration load
   iii) Quantity of fresh air supplied
   Also justify the need of mixing after cooling coil.
   Write clearly the procedure, draw neat diagrams and attach psycrometric chart for this problem with answer book. 20

OR

10. a) A large air conditioned building with a total internal volume of 1,00,000 m^3 is maintained at 25°C (DBT) and 50% RH, while the outside conditions are 35°C and 45% RH. It has design occupancy of 10,000 people, all non-smoking. The infiltration rate through the building is equal to 1.0 air change per hour. Estimate the heat transfer rate due to ventilation and infiltration. Assume the ventilation requirement of 3.5 l/s/person. 12

    b) Discuss the terms: grand sensible heat factor and effective room sensible heat factor. 8

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that of cooling turbine is 85%. The effectiveness of both the heat exchangers is 0.6. If the cabin is to be maintained at 25°C and the pressure in the cabin is 1 bar, find mass of air passing through the cabin, power used for the refrigeration system and COP of the system. 15

b) Discuss the working principle of vortex tube refrigeration system. 5

Unit 2

3. a) Calculate the refrigerating effect, COP, and isentropic work of compression for a vapour compression refrigeration cycle using R-717 and working between the temperature limit of 30°C and -15°C. 10

b) Explain a two stage vapour compression refrigeration cycle system with flash gas removal. 10

OR

4. a) Why the throttling process is preferred over the isentropic expansion process in vapour compression cycle? 5

b) In a 15 TR ammonia refrigeration plant, the condensing temperature is 25°C and evaporating temperature is -10°C. The refrigerant ammonia is sub-cooled by 5°C before passing through the throttle valve. The vapour leaving the evaporator is 0.99 dry. Calculate COP and power required. Use the following properties of ammonia: 15

Saturation temperature (°C)	Enthalpy (kJ/kg)		Entropy (kJ/kg K)		Specific heat (kJ/kg K)	
	Liquid	Vapour	Liquid	Vapour	Liquid	Vapour
25	298.8	1465.84	1.1242	5.0391	4.6	2.8
-10	135.37	1433.05	0.5443	5.4770	--	--

Unit 3

5. a) The operating temperatures of a single stage vapour absorption refrigeration system are: generator: 90°C; condenser and absorber: 40°C; evaporator: 0°C. The system has a refrigeration capacity of 100kW and the heat input to the system is 160kW. The solution pump work is negligible. 14

i) Find the COP of the system and the total heat rejection rate from the system.

ii) An inventor claims that by improving the design of all the components of the system he could reduce the heat input to the system to 80 kW while keeping the refrigeration capacity and operating temperatures same as before. Examine the validity of the claim.

b) Discus the designation of the refrigerants and write the chemical formula of R11, R134a, and R718. 6

OR

6. a) Explain the working of steam jet rejector refrigeration system. 10

b) Write note on refrigerants, desirable properties, and their designation. 10

Unit 4

7. a) Prove that the state of mixture of mixing of two streams of air lines on the straight line joining the states of streams and position of mixture state divides this straight line in inverse ratio of the masses of two dry air streams. 10

b) On a particular day the weather forecast states that the dry bulb temperature is 37°C, while the relative humidity is 50% and the barometric pressure is 101.325 kPa. Without using psychrometric chart, find the specific humidity, dew point temperature and enthalpy of moist air on this day. Will the moisture in the above air condense when it comes in contact with a cold surface whose surface temperature is 24°C? 10

OR

8. a) Define DBT, WBT, DPT, and specific humidity. Prove that the partial pressure of water vapour in the atmospheric air remains constant as long as specific humidity remains constant. 10

b) Saturated air at 21°C is passed through a drier so that its final relative humidity is 20%. The drier uses silica gel absorbent. The air is then passed through a cooler until