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BIME-015

B.Tech. MECHANICAL ENGINEERING

Term-End Examination

June, 2014

BIME-015 : REFRIGERATION AND AIR CONDITIONING

Time : 3 hours *Maximum Marks : 70*

Note : *(i)* *Attempt **any five** questions.*

(ii) *Non-programmable **scientific** calculator is **permitted**.*

(iii) *Use of psychometric charts, steam tables, mollier diagrams, refrigeration and air conditioning tables and charts is **permitted**.*

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1. (a) Brief about Engine, Refrigerator and Heat Pump. Also mention about unit of Refrigeration and Coefficient of Performance (C.O.P.). 7

(b) A reversed Carnot cycle is used to deliver 24000 kcal/min. to heat the conditioned space. The heat is taken from atmosphere at 10°C and supplied to the conditioned space at 25°C. Find the following : 7

(i) H.P. required to run the system.

(ii) If the same quantity of heat is supplied by electric heaters find the consumption of the electric energy in kW and H.P.

2. (a) Differentiate between vortex tube refrigeration and thermo-electric refrigeration. 5

(b) A reversed Carnot cycle is used for cooling in summer maintained at 5°C when the ambient temperature is 40°C. The same cycle is used for heating in winter at 55°C, when the ambient temperature is 15°C. Assuming 5°C temperature difference in the heat exchanger that exchanges heat with the surrounding, find : 9

(i) The C.O.P. for cooling and heating cycles.

(ii) If the water at 30°C is used as cooling medium with 3°C temp. difference for summer air conditioning, what will be the Carnot C.O.P.

(iii) The power consumption per ton of refrigeration in each case.

Assume, the air and water temperature remain constant during heat transfer.

3. A food storage requires a refrigeration system of 12 tons capacity at an evaporator temperature of 10°C and condenser temp. of 25°C. The refrigerant NH_3 is sub cooled by 5°C before passing through throttle valve. The vapour leaving the evaporator coil is 0.97 dry. Find the co-efficient of performance and H.P. required. 14

The properties of NH_3 are given below :

Temperature	Liquid			Vapour		
	h_f	s_f	c_p	h_g	s_g	c_p
25	128.1	1.0975	1.1	406.8	2.0334	0.67
−10	89.6	0.9593	-	398.7	2.4362	-

4. Draw the refrigeration cycle on T-S diagram when the refrigerant is dry and saturated at the end of compression and find an expression for the C.O.P. in terms of : 14

(a) Temperature and entropies

(b) Enthalpy

5. Data for an absorber of an Ammonia Absorption Refrigeration System is given below : 14

(a) Evaporator Pressure = 2.5 kgf/cm^2.

(b) Temperator Ammonia leaving the evaporator and entering the absorber is $-10°C$.

(c) Absorber Pressure = 2.5 kg/cm^2.

(d) Weak aqua enters the absorber at 50°C with weight concentration of 0.25.

(e) Strong aqua leaves the absorber at 35°C with weight concentration of 0.33.

(f) Anhydrous ammonia circulated through system = 8.5 kg/min.

Neglect the water vapour returning from evaporator and assume specific heat of solution as 1.5 kcal/kg $-$ °C and liquid heat at 0°C as 100 kcal/kg.

Calculate the amount of heat to be removed per minute from the absorber in kcal.

6. (a) Define relative humidity, specific humidity and dew point temperature and describe a theoretical method for determining their values. 5

(b) 100 cu. m. of air per minute at 30°C DBT and 60% Relative Humidity is cooled to 20°C DBT by passing through a cooling coil. Find : 9

(i) The capacity of cooling coil in tons of refrigeration and

(ii) Relative humidity of air coming out air and its wet bulb temperature

7. (a) What are requirements of Comfort Air Conditioning ? 5

(b) A spray cooling coil is chosen to operate under the following conditions : 9

(i) Air inlet conditions $\rightarrow$ 28°C DBT and 21°C WBT

(ii) Air outlet conditions $\rightarrow$ 10°C DBT and 6°C WBT

(iii) Total amount of airflow = 2000 m^3/min

(iv) The chilled water inlet and outlet temperatures are 7°C and 12°C respectively.

Find the following :

(A) The cooling load on the coil.

(B) Water flow rate through the coil.