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EME053

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 140853

Roll No.

B. Tech.

(SEM. VIII) THEORY EXAMINATION, 2014-15
DESIGN OF THERMAL SYSTEMS

Time : **3** Hours]   [Total Marks : **100**

Note :- Attempt **All** Questions.

P-H Charts, Steam Table and Psychometric Charts are allowed in examination. Assume suitable data if missing.

1   Attempt any Two of following :   10×2=20

a.   108 m^3 of air per minute at 5°C DBT and 2.5°C WBT is passed through a heating coil which gives 48.85. kW energy to the air. Saturated steam at I 10°C and with a rate of 48 kg/hr is mixed with the air leaving the heater.
Determine the DBT and WBT of the air after mixing.
Enthalpy of saturated steam at 110"C = 2691 kJ/Kg.

b.   Derive an expression for specific humidity and show that it is function of vapour pressure and barometric pressure of air.

140853]   **1**   **[Contd...**

c. The following data relate to a conference room for seating 80 persons.

Inside design conditions.........22°C DBT, 55% RH

Outside design conditions...38°C DBT ,28°C WBT

Sensible and latent heat loads per person ...75 kW and 45 kW respectively

Lights and fan loads...............................12000 W

Sensible heat gain through glass walls, ceiling etc..12000W

Air infiltration ....18m³/min.

Fresh air supply......................................80m³/min.

By-pass factors of supply of the coil...........0.1

If two-third of recirculated room air and one-third of fresh air are mixed before entering the cooling coils, determine :

(i)   Apparatus dew point,

(ii) Grand total heat load, and

(iii) Effective room sensible heat factor.

2 Attempt any Two of following :   10×2=20

a. Following results were obtained in a test conducted on a vapour compression refrigerant : Evaporator temperature = -28.5°C, Condenser pressure = 2.75 bar; Refrigerant entering the condenser is 3°C superheat, Refrigerant leaving the condenser is at 12.8°C. Determine the C.O.P., The following properties are given :

Pressure (bar)	Saturation Temp. (°C)	Enthalpy (kJ/kg)		Entropy Vapour (kJ/kg K)	Specific heat (kJ/kg K) At constant pressure	
		Liquid	Vapour		Liquid	Vapour
2.75	14	438.48	802.9	5.5287	1.381	0.669
0.412	-28.5	381.58	783.24	5.6852	--	--

b. What are the desirable properties of an ideal refrigerant ?

c. Discuss the performance characteristics of refrigerant reciprocating compressor i.e.

(i) Effect of suction temp.

(ii) Effect of condenser temp.

3   Attempt any Two of following :   10×2=20

a. What is the principle of design of turbo machines

b. Deduce the formulae for optimum pressure ratio during two stage compression for reciprocating compressor.

c. What are the advantages and disadvantages of Axial flow compressor and centrifugal compressor in refrigeration machine ?

4   Attempt any two form the following :   10×2=20

a. What is the overall heat transfer coefficient. Explain the phenomenon of rust formation and the deposition of fluid Impurities.

b. Dry saturated steam at 10 bar enters a counter-flow heat exchanger at the rate of 15 kg/s and leaves at 300°C. The entry of gas at 600°C is with mass flow rate of 25 kg/s. If the condenser tubes are of 30 mm diameter and 3 m long, make calculations for the heating surface area and the number of tubes required. Neglect the resistance offered by the metallic tubes

Take the following properties for steam and gas :

For steam : t_{sat} 180°C (at 10 bar) ; cps = 2.7 kJ/kg/K ; hs = 600 W/m^2 -deg

For gas : cpg = 1 kJ/kgK ; hg = 250 W/m^2 - deg.

c. When the NTU approach is required for analysis of heat exchanger ? Derive the formulae

$NTU = UA / C_{min}$

5 **Attempt any Two of following :**   **10×2=20**

a. What are the factors used for minimization of cost and maximization of performance for cooling tower ?

b. Develop the computer program to design an evaporator assuming the standard design data.

c. Write the procedure for analysis of thermal systems using FEM.

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