University of Technology
Electro-mechanical Department
Systems Engineering Branch

Academic Year : 2013-2014
Class: Fourth
Subject: Air Conditioning and Refrigeration
Examiner: Ass.Prof. Dr. Saad Tami

Final Examination
Time : 3.00 hour
Data : 7/6/2014

Allowed Air-Conditioning and Refrigeration Tables and Charts

Answer on 4 questions only to be First question, including

Question No.1 (General) ***(15 Degree)***

1. Define the moisture content and prove that, $\omega = 0.662\frac{P_v}{P - P_v}$

2. What is the effect of decreasing of evaporating pressure in vapor compression refrigeration cycle on the coefficient of Performance and compression work.

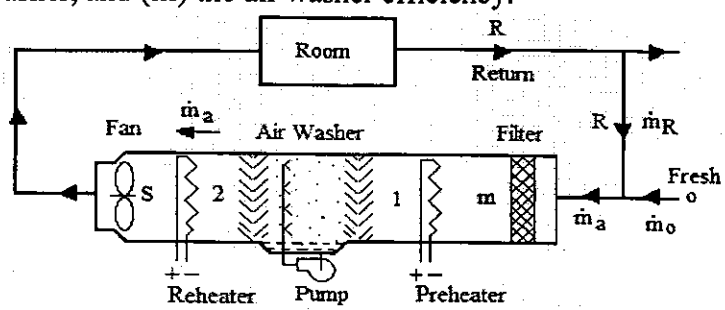
3. Based on the chart ASHARE. Draw the thermal comfort zones for human at summer and winter conditions.

4. A standard vapor compression cycle using refrigerant R- 12, if the condensing temperature is 40 ^{0}C and the evaporating temperature 0 ^{0}C . With necessity validation the compressor discharge temperature is: A: 40 ^{0}C B: 47 ^{0}C C: 55 ^{0}C

5. A South-facing wall (group B) dimension (3x2 m^2) of a building with overall heat transfer coefficient of 1.714 W/m^2.k at latitude 40^0 N on August and a solar time 16 hr. If the inside temperature is 24 ^{0}C and the average daily temperature 32 ^{0}C. With necessity validation the heat gain through the wall is: A: 160.2 Watt B: 156.3 Watt C: 152.5 Watt

Question No.2 (Air Conditioning Cycles) ***(15 Degree)***

Air of 18 m^3//min is supplied to an air conditioning room maintained at 24 ^{0}C dry bulb temperature and 50 % relative humidity. The outside air is at 10 ^{0}C dry bulb temperature and 90 % relative humidity. The return air is mixed with the fresh air before entering the primary heater in the ratio of 2 to 1 by weight. The air is first passed through a primary heater until its wet bulb temperature is equal to the room wet bulb temperature. Then, the air is passed through an adiabatic air washer and finally through a secondary heater until the air attained to 36 ^{0}C before being supplied to the room. Assume that the air is leaving the air washer at 90 % relative humidity. Show the processes on the Psychrometric chart and determine; (i) the heat added in both heaters in Kw, (ii) the mass of water evaporated in the air washer, and (iii) the air washer efficiency.

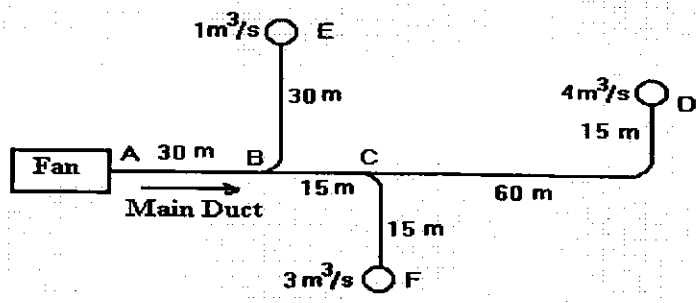


Question No. 3 (Thermal Load Calculations) *(15 Degree)*

The office work dimensions (12x6x4 m^3). Calculate the windows load and ventilation load .The office work is at latitude 32^0 N, 25 July, and a solar time 15 hr. The office work is maintained at 24 ^{0}C dbt and 50 % RH, In summer the average outside ambient condition of 32 ^{0}C dbt and 40 % RH. One window (4x2 m^2) is from glass at East direction , the U_{Glass}= 5.6 W/m^2 .k , the glass window is (single plate , clear, without shading thickness 6 mm and with inside shade).The number of person in the office work is 7 (4 person is Non smoking and 3 person is smoking), the office work is tight building .The air density is (ρ=1.181 kg/m^3), specific heat is ($C_{p,air}$ =1.005 kJ/kg) and evaporation heat for water vapor is (h_{fg} = 2570 kJ/kg).

Question No. 4 (Ducts System) *(15 Degree)*

For the air distribution system has shown below which made from galvanized iron. Assume the pressure drop in the Air Handling Unit ($\Delta p_{air-handling}$) is 550 Pa. , the air velocity in the main duct AB is 8 m/s and friction pressure drop ($\Delta p / L$) pa/m in main duct must be calculate. Estimate: the size ducts and air velocity by using equal friction method and with the duct friction chart. Also calculate the air fan power required. Air density ρ = 1.184 kg/m^3, Air dynamic viscosity μ =18.413x 10^{-6} Pa.s and roughness of galvanized iron ε = 0.00015 m.



$$Power = m^{*}\left[\left(\frac{\Delta P_{air-handling}}{\rho}\right)_{Air\ Handling} + \sum\left(\frac{\Delta P}{\rho \times L} \times L\right)_{Friction} + \sum\left(K \times \frac{V^2}{2}\right)_{Fitting} + \left(\frac{V^2_e}{2}\right)_{Exit} \right]$$

$m^{*} = V^{*} \times \rho$, **Note:** one damper and elbow 90° in each branch of (BE, CF, CD)

Question No.5 (Refrigeration) *(15 Degree)*

- Compression refrigeration system uses Freon R-134a, evaporating temperature is -20 ^{0}C, condensing temperature is 45 ^{0}C, and refrigeration capacity is 12 *TR*. Heat exchanger is used in liquid line and the vapor is superheated 8 ^{0}C before entering the compressor. Sketch the cycle on pressure-enthalpy coordinates. Estimate refrigerant mass flow rate, volumetric flow rate at the inlet to the compressor, condensing heat load, flash gas fraction, work don if the compression cycle is constant entropy and coefficient of performance of the system.

- Sketch diagram of absorption refrigeration system with brief recommend