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The University of Jordan – Faculty of Engineering and Technology
Mechanical Engineering Department
ME 0934445: HVAC - Mid exam: 2nd semester, 2014/2015
Instructor: Dr. Osama Ayadi

الاسم : لؤي عصام العفيشن الرقم الجامعي: 0110524 الرقم التسلسلي: 15

	Statement	
1	The most suitable solution for the year round heating and cooling of a hotel room is a split unit.	F ✓
2	The outside air design temperature for calculating the heating load for a given application is selected to be the minimum outdoor temperature of the total hours during winter season.	F ✓
3	The wind chill temperature expresses the combined effect of outdoor temperature and wind speed on human comfort.	T ✓
4	Underfloor heating system is characterized by its high cost and fast dynamic response.	T ✗
5	The higher the depth of the wall below grade, the higher its overall heat transfer coefficient.	F ✓
6	Fan coil units are direct expansion dx systems.	F ✓
7	If the return air is treated to the rech the supply conditions without entering fresh air, then the cooling coil and the cooling load of the building are the same.	T ✓
8	The latent load due to occupants can be detected by using temperature sensors.	F ✓
9	When the occupant number is large, such as theater, then the $CLF_{occ.}$ Is taken as 1.	T ✓
10	In the calculation of the heating load, the heat gains due to occupants, lights, applicances and solar effect are subtracted from the calculated heating load.	F ✓

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Question 1. [6 points]
Fifty employees at a telecomunictions center are working in an open space,
The space is maintained at 20 °C dry bulb temperature and 50% RH.
The office is open from 8:00 am till 1:00 pm when employees leave for a lunch break.
Calculate the following:

a. Total heat gain rate due to occupants at 10:00 am.
b. Total and latent heating loads due to ventilation if the outside fresh air is available at 5 °C dry bulb temperature and 60% RH.

Question 2. [4 points] A solid wall consists of firm stone of 30 mm thickness, concrete of 100 mm thickness (ρ = 2300 kg/m^3), polysteren layer of unkown thickness, cement bricks with air gaps of 70 mm thickness (k= 0.90 W/m.K), cement plaster of 20 mm thickness (k=1.25 W/m.K). if the wall is to satisfy the Jordanian code with an overall heat transfer coefficient of 0.57 W/m^2.K, how much should be the insulation thikness?

Question 3. [3 points]
A Jordanian family of six members with low hot water consumption at 50 °C, assume that the supply cold water temperature is 15 °C, and the boiler is required to heat the water in two hours, the boiler capacity is?

Question 4. [7 points]
Outside air at 38 °C dry bulb temperature and 60% relative humidity eneters a cooling and dehumidifying device at a volumetric flow rate of 3800 m^3/h. The air leaves the device at 90% relative humidity. The inside design condition is 26 °C and 45% relative humidity. The sensible heat ratio is 0.75 (assume 100% fresh air)

a. Sketch the process on the psychrometric chart, and calculate the following
b. Apparatus dew point.
c. Dry bulb and wet bulb temperatures of the supply air.
d. Cooling capacity of the air conditioner.
e. Amount of moisture removed.
f. Mass of chilled water for the cooling coil, if the supply and return temperatures from the chiller are 7°C / 12°C respectiveley

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الجامعة الأردنية
عمان

اسم الطالب لؤي عصام العفيف رقمه الجامعي 0110524

المستوى الكلية

القسم المادة تكييف 1

التاريخ 6

$20 + 4.5 = \boxed{24.5}$

العلامات

Q1) 50 employees (office open space), $T_i = 20°C$, RH = 50%, 8 am – 1 pm

a) $\dot{Q}_{occ} = n(\dot{q}_{sen} * CLF + \dot{q}_{lat})$

$= 50(70 * 0.595 + 45)$

$= 4332.5$ W

b) $\dot{V} = 10 * 50 = 500$ L/s $= 0.5$ m³/s

$v_o = 0.79$ m³/kg dry air

$\dot{m}_{o.a} = \frac{0.5}{0.79} = 0.633$ kg/s

$\dot{Q}_{tot} = \dot{m}_{o.A} \Delta h$, $h_i = 38$ kJ/kg

$= 0.633(38 - 13)$, $h_o = 13$ kJ/kg

$= 15.825$ kW

$\dot{Q}_s = \dot{m}_{o.A} c_p \Delta T$

$= (0.633)(1)(20 - 5) = 9.495$ kW

$\dot{Q}_{lat} = 6.33$ kW $(\dot{Q}_{tot} - \dot{Q}_s)$

Q2) Firm ston ; $X = 0.03\,m$, $K = 1.7$
concreat ; $X = 0.1\,m$, $K = 1.75$
polysteren ; $X = ?$, $K = 0.03$
cement Brick with A.G , $X = 0.07\,m$, $K = 0.9$
cement plaster ; $X = 0.02\,m$, $K = 1.25$
} W/m.K

~~Uoverall~~ $U_w = 0.57\ W/m^2.K$

$$U_w = \frac{1}{R_i + R_o + R_{FS} + R_C + R_P + R_{CB} + R_{CP}}$$

(Assume in Amman to obtain R_i, R_o)

$$0.57 = \frac{1}{0.12 + 0.06 + \frac{0.03}{1.7} + \frac{0.1}{1.75} + \frac{X}{0.03} + \frac{0.07}{0.9} + \frac{0.02}{1.25}}$$

$X_{pol} = 0.0422\ m$ ✓ (4)

Q3) family $n = 6$, low hot water consum. @ 50°C
$T_{sup} = 15°$, Time to heat = 2 hours

$V_w/day = (50)(2) + 4(30) = 220\ L/day$ ✓

$\dot{Q}_{boiler} = \dot{m}_w\, C_{p_w}\, \Delta T$

$$= \frac{220}{2*60*60}(4.186)(50-15) = 4.48\ KW$$ ✓ (3)

(Q4) **O.A, M**

$T_d = 38°C$

$RH = 60\%$

$\dot{V} = 3800\ m^3/h = 1.056\ m^3/s$

$h = 104\ kJ/kg$

$W = 0.0256\ kg_{H_2O}/kg_d$

$v = 0.92\ m^3/kg_d$

$\dot{m}_s = 1.148\ kg/s$

S

$RH = 90\%$

$SHR = 0.75$

$T_{db} = 11°C$

$h = 30\ kJ/kg$

$W = 0.0074$

$T_{wb} = 10°C$

i

$T_d = 26$

$RH = 45\%$

$W = 0.0097\ kg_{H_2O}/kg_d$

$h = 50.5\ kJ/kg$

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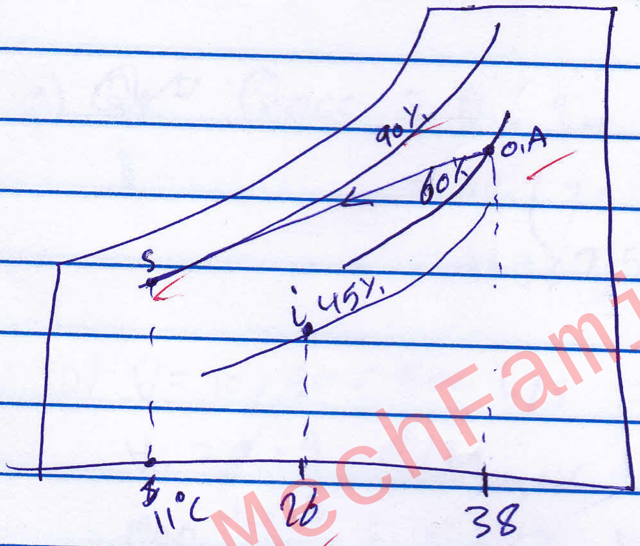

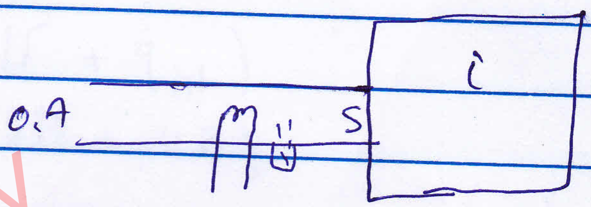

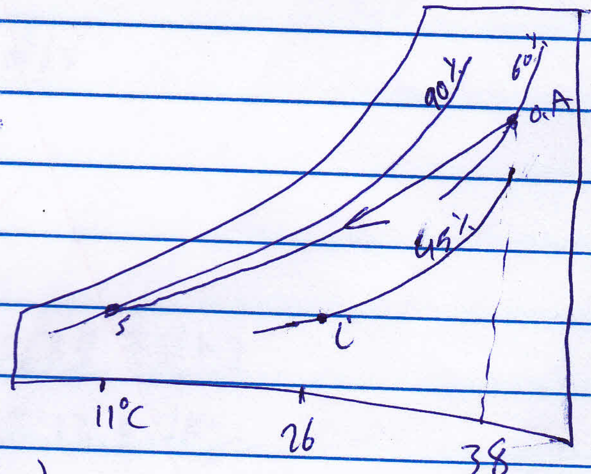

dew point = 13°C

$\dot{Q}_{cool} = \dot{m}_s \Delta h = \dot{m}_s (h_{O.A} - h_s)$

$= (1.148)(104 - 30) = 84.939\ kW$

$\dot{m}_{moist} = \dot{m}_s (W_{OA} - W_s)$

$= (1.148)(0.0256 - 0.0074) = 0.02089\ kg_{H_2O}$

$\dot{m}_{CW} = \dfrac{\dot{Q}_{cool}}{c_p \Delta T} = \dfrac{84.939}{(4.186)(12-7)} = 4.058\ kg/s$