Menoufia University
Faculty of Engineering
Shebin El-Kom
second Semester Examination
Academic Year: 2013-2014

Department: Mechanical Power Engineering
Year: Master Exam
Subject: Basics of Air Conditioning
Code: [MPE 603]
Time Allowed: 3 hours
Date: 15 /6/2014

Allowed Tables and Charts: Air Conditioning Tables and Charts

Answer all the following Questions [100 Marks]

Question (1) (26 marks)

1-a)) Is it possible to obtain saturated air from unsaturated air without adding any moisture? Explain. ***(4 marks)***

1-b) Why is cooled air sometimes reheated in summer before it is discharged to a room? ***(4 marks)***

1-c) What is the importance of return air in summer air conditioning units? ***(4 marks)***

1-d) A summer air conditioning systems consists of water chiller and air re-heater. The return air is mixed partially before the water chiller and by passed after it with equal masses. The inside conditions are 25 °C dry bulb temperature and 50 % relative humidity and outside conditions are 38 °C dry bulb temperature and 26 °C wet bulb temperature. Fresh air for ventilation is 0.5 m^3/s. The internal sensible heat gain is 21 kW and internal latent heat gain is 7 kW. The air leaving water chiller saturated at 10 °C and the temperature difference between inside and supply air is 8 °C dry bulb temperature. Determine: ***(14 marks)***

a) The refrigeration capacity of the water chiller,
b) The heating capacity of the air re-heater,
c) The cooling coil efficiency, and
d) The rate of water removed from the air.

Question (2) (24 marks)

2-a) At what states on the psychrometric chart are the dry-bulb, wet-bulb, and dew-point temperatures identical? ***(4 marks)***

2-b) What is sensible heat? How is the sensible heat loss from a human body affected by the

a) Skin temperature,
b) Environment temperature, and
c) Air motion? ***(6 marks)***

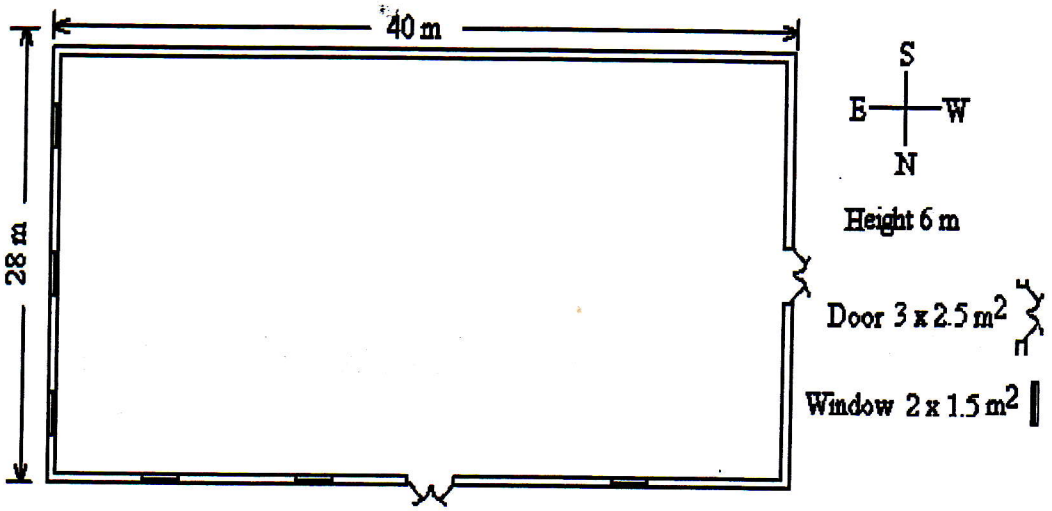
2-c) A winter air conditioning unit consists of preheating coil, adiabatic air washer and reheating coil is used to maintain the conditions inside a room at 25 °C dry bulb temperature and 50 % relative humidity. The re-circulated air is mixed with fresh air at equal parts by weight before the preheating coil. An amount of 56.6 m^3/min fresh air is supplied to the unit at 5 °C dry bulb temperature and 90 % relative humidity. The air leaves the humidifier at 85 % relative humidity and leaves the reheating coil at 30 °C dry bulb temperature and 45 % relative humidity. Draw a sketch for this unit and its representation on the Psychrometric chart. Then calculate: ***(14 marks)***

a) The heating capacity of each heating coil,
b) The rate of water to be consumed in the humidifier,
c) The humidifier efficiency, and
d) Internal heating load.

Question (3) (30 marks)

3-a) Distinguish between infiltration and ventilation loads. ***(5 marks)***

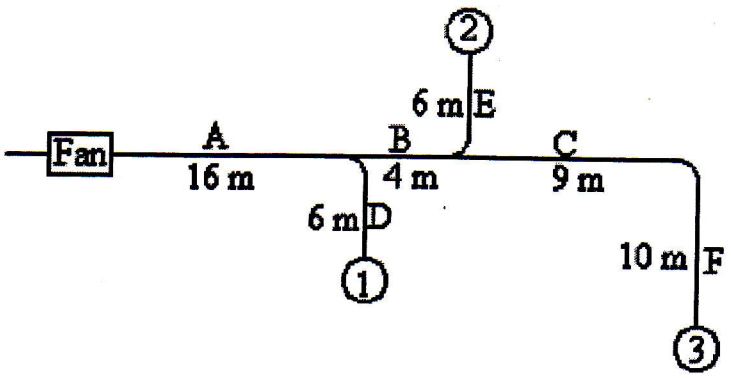
3-b) For the room shown below, calculate the total cooling load and room sensible heat factor. The room is at latitude of 30° N, 21 of July and solar time of 15 hr. The room is maintained at 25 °C dry bulb temperature and 50 % relative humidity, the ambient conditions are 38 °C dry bulb temperature and 25 °C wet bulb temperature. The ceiling from heavy concert which the conduction overall heat transfer coefficient of U = 0.51 $W/m^2.K$ and the walls from hole bricks of U = 1.36 $W/m^2.K$. The floor from cement and covered with ceramic layer of U = 1.02 $W/m^2.K$. The windows and doors are from glass of U = 5.6 $W/m^2.K$. The light density is 15 W/m^2 of the floor area and the lambs are fluorescent. The number of persons is 60. There are 8 kW of appliances load. For any data you need use the ASHRAE tables. The infiltration is 0.11 from the room volume per hour and each person needs 5 lit/s of fresh air. The air density is 1.181 kg/m^3 and specific heat of 1.005 kJ/kg.K. The water evaporation heat is 2454 kJ/kg. ***(25 marks)***



Question (4) (20 marks)

4-a) list the various methods of air duct design? ***(5 marks)***

4-b) In the duct layout shown blow, the outlets are deliver 25 m^3/min at 1, 15 m^3/min at 2 and 30 m^3/min at 3. Also, select air velocity of 8 m/s in the section A. Determine the size of duct system using Duct friction chart and determine the static pressure required for the air fan. ***(15 marks)***



With my best wishes