M.E. Second Semester (Mechanical Engineering (Thermal Engg.)) (New-CGS)

13519 : Elective-I : Advanced Air Conditioning Systems : 2 MTE 4

P. Pages : 3

Time : Three Hours

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AW - 3540

Max. Marks : 80

Notes :
1. Answer **three** question from section "A" and **three** question from section "B".
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Illustrate your answer necessary with the help of neat sketches.
5. Use of slide rule logarithmic table, Steam table, Mollier's Chart, Drawing instrument, Thermodynamic table for moist air, Psychrometric charts and Refrigeration charts is permitted.
6. Use of pen Blue/Black ink/refill only for writing the answer book.

SECTION – A

1. a) Prove that the partial pressure of water vapour in the atmospheric air remains constant as long as the specific humidity remains constant. **6**

b) The atmospheric air at 30°C DBT and 75% Relative humidity enters a cooling coil at the rate of 200 m^3/min. The coil dew point temperature is 14°C. and the by-pass factor of the coil is 0.1. Determine **8**

1) The temperature of air leaving the cooling coil.

2) The capacity of the cooling coil in TR

3) The amount of water vapour removed per minute and

4) The sensible heat factor for the process.

2. a) Describe the different factors which must be considered evaluating cooling load on an air conditioning system. **6**

b) Explain in brief as to how human body reacts to changes in temperature of environment. Also explain the effect of activities on the heat load calculations for comfort application. **7**

3. The following data refer to summer air-conditioning of a building:- **13**

Outside design conditions:- 42°C DBT and 26°C WBT
Inside design conditions:- 25°C DBT and 50% RH.
Room Sensible heat gain - 84,000 kJ/h
Room latent heat gain - 21,000 kJ/h
By-pass factor of the cooling coil used - 0.2

The return air from the room is mixed with the outside air before entry to cooling coil in the ratio of 4:1 by mass. Determine

i) Apparatus dew point of the cooling coil

ii) Entry and exit conditions of air for cooling coil.

iii) Fresh air mass flow rate and

iv) Refrigeration load on the cooling coil.

4. a) Discuss the various types of supply air outlets. 6

b) Explain the recommended practices to avoid sound problems for equipment rooms located on upper floor. Write a brief note about sound attenuation in pipes and ducts. 7

5. The following data relates to the office air conditioning plant having maximum seating capacity of 25 occupants. 13

Outside design conditions =	34°C DBT, and 28°C WBT.
Inside design conditions =	24°C. DBT and 50% RH.
Solar heat gain =	9120 W.
Latent heat gain per occupant =	105 W
Sensible heat gain per occupant =	90 W
Lightening load =	2300 W
Sensible heat load from other sources =	11630 W
Infiltration load =	14 m^3/min.

Assuming 40% fresh air and 60% of recirculated air passing through the evaporator coil and by – pass factor of 0.15. Find the dew point temperature of the coil and capacity of the plant.

SECTION – B

6. a) Explain the effects of low section pressure and high delivery pressure on the volumetric efficiency of a reciprocating compressor. 7

b) What are the advantages of water cooled condensers over air cooled condensers? Give five examples with specific reasons. 7

7. a) What are the different types of air filters used in air conditioning systems? Explain the working of any one type with neat sketch. 6

b) What are the various types of duct arrangement systems? Explain any one of them with the help of a neat sketch. Also state its application. 7

8. a) Velocity of air chosen through a circular duct which carries standard air is 360 m/min. The size of the duct is 0.3 m diameter. If this duct is replaced by a rectangular duct of aspect ratio 1.5. Determine the size of the rectangular duct for equal friction method when. 6
   i) Velocity of air in two ducts is same.
   ii) The discharge rate through the line duct is same.

b) A rectangular duct section 500mmx350mm size carries 1.25 m^3/sec. of air having density of 1.15 kg/m^3. Determine the equivalent diameter of the circular duct if 7

   i) The quantity of air carried in both cases is same.

   ii) Velocity of air in both the cases is same

   iii) If f = 0.001 for sheet metal, find the pressure loss per 100 m length of duct.

9. a) Write short notes on **any two** of the following:- 6

   i) Split type air conditioner

   ii) Principles of piping design

   iii) Principles of duct work

b) Explain the difference between static pressure and dynamic pressure. Find the expression for the dynamic pressure loss. 7

10. a) What is the aspect ratio of a rectangular duct? What are the advantages in keeping it low? **3**

b) Find the sizes of various ducts in the system as shown in the following figure. Also find the maximum pressure loss. The velocity in AB should not exceed 400 m/min. and ducts are rectangular in section. One side of all rectangular ducts is 60 cm. Use the constant friction loss method. The quantity of air supply per minute to each grill is also shown in the figure. The lengths given in the figure include the proper allowance for various bends, elbows and losses other than friction. **10**

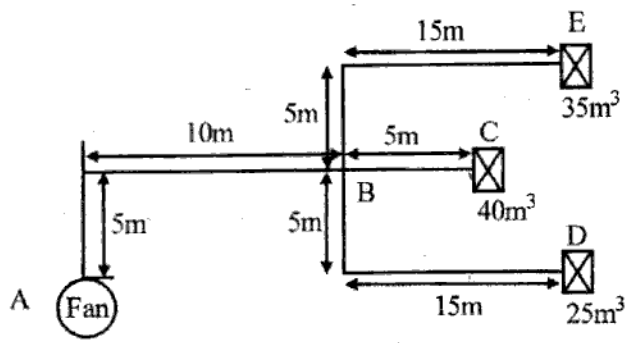

Figure : Ducting system

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