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

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

P. Pages : 3 | AU - 3371

Time : Three Hours | Max. Marks : 80

Notes :
1. All question carry marks as indicated.
2. Answer **three** question from Section A and **three** question from Section B.
3. Due credit will be given to neatness and adequate dimensions.
4. Assume suitable data wherever necessary.
5. Illustrate your answer necessary with the help of neat sketches.
6. Use of slide rule logarithmic tables, Steam tables, Moller's Chart, Drawing instrument, Thermodynamic table for moist air, Psychrometric Charts and Refrigeration charts is permitted.
7. 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 200m^3/min. The coil dew point temperature is 14°C and the by-pass factor of the coil is 0.1. Determine: **8**

i) The temperature of air leaving the cooling coil.

ii) The capacity of the cooling coil in TR

iii) The amount of water vapour removed per minute and

iv) The sensible heat factor for the process.

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

Outside design conditions: 43°C DBT, 27°C WBT

Inside design conditions: 25°C DBT, 50% RH

Room sensible heat gain : 84000 kJ/h

Room latent heat gain : 21000 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.

3. a) Define the term 'effective temperature' and explain its significance in the design of air conditioning systems. **6**

b) Sketch and discuss comfort chart. Also discuss the assumptions made while constructing the same. **7**

4. An air conditioning system is to be designed for a restaurant with the following data: **13**
Outside design condition: 40°C DBT, 28°C WBT
Inside design condition : 25°C DBT, 50% RH
Solar heat gain through walls, roof, floor : 6 kW
Solar heat gain through glass : 5.52 kW
Occupants : 25
SH gain per person : 58 W
LH gain per person : 60 W
Internal lighting load : 15 lamps of 100 W and 10 fluorescent tubes of 80 W.
SH gain from other sources : 11.60 kW
Infiltration air : 15 m^3/min.

If 25% fresh air and 75% recirculated air is mixed and passed through the conditioner coil, find the following:

1) The dew point temperature of coil
2) The condition of supply air to the room.
3) The amount of total air required in m^3/h.
4) The capacity of conditioning plant.

Assume BPF = 0.2 and draw the schematic diagram.

5. a) Describe with the help of a neat sketch, the following systems. **6**
i) All air system
ii) All water system
iii) Air-water system

b) Room conditions = 26°C DBT, 19°C WBT **7**
Outside conditions = 35°C DBT, 27°C WBT
Room heat gains:
Sensible heat = 11.1 kW
Latent heat = 3.9 kW

The conditioned air supplied to the room is 50 cmm and 25% fresh, air and 75% recirculated room air. Determine the following:

i) The DBT and WBT of supply air
ii) The apparatus dew point and By-pass factor of the coil.
iii) The refrigeration load on the coil, and the moisture removed by the coil.

SECTION – B

6. a) Give the classification of air conditioning systems. Describe with the help of neat sketch central air-conditioning system. **6**

b) Discuss various types of air cleaning devices used in air conditioning systems. **7**

7. a) What are the different types of fans used in air conditioning systems? Draw the performance curves of backward curved blades centrifugal fans. Explain fan ratings. **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) Explain equal friction method of duct design for air conditioning. What are its main disadvantages? **6**

b) 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, **8**
i) The velocity of air in two ducts is same.
ii) The discharge rate through the line duct is same.

9. a) What are the different methods of air distribution? Explain the importance of each over the other. **6**

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

10. 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 the proper allowance for various bends, elbows and losses other than friction. **13**

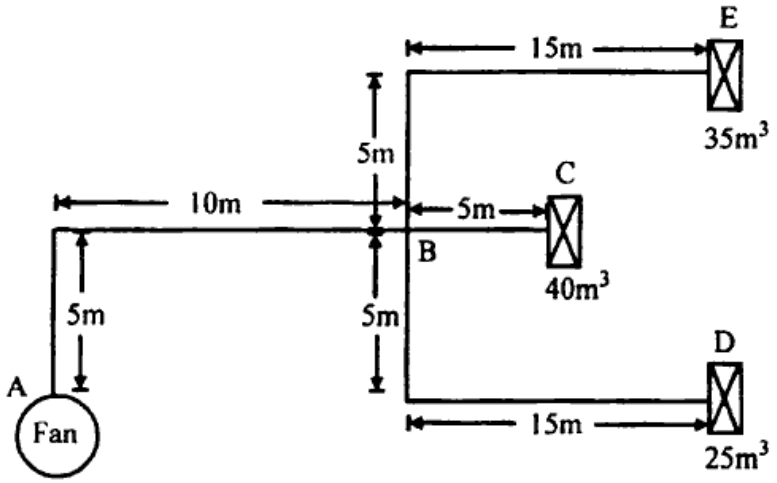

Figure : Ducting system

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