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

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

P. Pages : 2 **AW - 3811**

Time : Three Hours * 1 0 8 1 * 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 tables, Steam tables, 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) Explain the concept of effective temperature. What are the factors governing optimum effective temperature? Describe briefly. **6**

b) A sample of moist air has a dry bulb temp. of 43°C and a wet bulb temperature of 29°C. Calculate the following properties of moist air without using psychrometric chart. **8**

i) Partial pressure of water vapour. ii) Specific humidity
iii) Relative humidity iv) Dew point temperature.
v) Humid specific heat vi) Enthalpy

2. a) Write short note on the factors affecting comfort air-conditioning. **6**

b) An air-conditioning plant is to be designed for a small office for winter conditions. **7**
Outdoor conditions = 10 °C DBT, 8 °C WBT
Required indoor conditions = 20 °C DBT, 60% RH
Amount of air circulation = $0.3 m^3$/min per person.
Seating capacity of the office = 50 persons
The required condition is achieved first by heating and then by adiabatic humidifying
Find
i) Heating capacity of the coil in kW and the surface temperature if the BPF of the coil is 0.32 and
ii) Capacity of the humidifier

3. A retail shop located in a city of 30 °N latitude has the following loads:- **13**
Room sensible heat load = 58.15 kW
Room latent heat load = 14.54 kW
The summer outside and inside design conditions are:-
Outside conditions – 40 °C DBT and 27 °C WBT
Inside conditions – 25 °C DBT and 50% RH
70 cmm of ventilation air is used.
Determine the following:-
i) Ventilation load ii) Grand total load
iii) Effective sensible heat factor iv) Apparatus dew point
v) Dehumidified air quantity
iv) Condition of air entering and leaving apparatus
Assume a suitable by pass factor for the cooling coil.

4. a) Define: **3**
i) Room sensible heat factor.
ii) Grand sensible heat factor
iii) Effective room sensible heat factor.

b) The following data refers to summer air conditioning of a building **10**
Outside design conditions -- 43°C DBT and 27 °C WBT
Inside design conditions -- 25°C DBT and 50% RH
RSH = 84 MJ/h,
RLH = 21 MJ/h,
BPF = 0.2
The room air from the room is mixed with fresh air before entering the coil in the ratio of 4:1 by mass.
Determine:-
i) Coil ADP
ii) Condition of air entering and leaving the coil.
iii) Fresh air rate in cmm.
iv) Capacity of the coil in TR.

5. a) Define the term by -pass factor used for cooling or heating coil and find the expression for finding the by -pass factor. **6**

b) Draw a neat diagram of air conditioning system required in winter season. Explain the working of different components used in the system. Is it possible to use the steam for such air conditioning systems? **7**

SECTION - B

6. a) Explain the working of window air conditioner. Compare it's performance with the split air conditioner. **7**

b) Explain air washer type humidifier with the help of neat sketch. **7**

7. a) What are the various types of duct arrangement systems? Explain any one of them with the help of a neat sketch. Also state it's application. **6**

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

8. a) A rectangular section 60cm × 40cm size made of sheet metal is used to carry 100 cmm of air having a density of 1.2 kg/m^3. Find the equivalent diameter of circular duct if. **7**
i) Quantity of air carried is same in both cases and.
ii) If the velocity of air in both cases is same.
Also find the pressure loss per 100m length of duct. Take the friction factor. f = 0.015 for sheet metal.

b) Explain the principle of working of the following motors:- **6**
i) Capacitor start motor ii) Slip ring motor

9. a) What is the function of a fan in an air conditioning system? Write in brief on the comparative study of the characteristics of backward and forward curved blade fans. **6**

b) Briefly describe the different types of heating and cooling used in air – conditioning systems. **7**

10. Discuss **any three** of the following:- **13**
i) Variable volume, constant temperature system.
ii) Cooling coil selection
iii) Location of supply and return air outlets.
iv) Air – water air conditioning system.

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