|  |  |
| --- | --- |
| **Benha University** | **Air Conditioning** |
| **Faculty of Engineering at Shoubra** | **4th Year (Power)** |
| **Mechanical Engineering Department** | **Sheet: 3 A/C** |

1. A big hall is to be air conditioned to maintain an inside condition of $25℃ and 50\%$ relative humidity. The seating capacity is 600 persons. Heat gain from building is 220 kW, lighting$ 12 kW$, sensible heat from person 58 Watt and 87 Watt latent, fresh air must be$ 1{{m^{3}}/{min}}/{person}$. Fresh air is mixed with return air before entering the cooling coil. Outside air temperature is $37℃ dbt$ and$ 26℃ wbt$, air leaving the cooling coil at$ 14℃ dbt$. Find:
2. Air flow rate entering the cooling coil.
3. Relative humidity of air leaving the cooling coil.
4. Apparatus dew point.
5. Cooling coil capacity.
6. Moisture removed through cooling coil per hour.
7. Moisture added through conditioned space per hour
8. Bypass factor and contact factor of the cooling coil.
9. Ventilation load.
10. Number of cooling coil rows.
11. The air in a room is to be maintained at $22℃ dbt$ and $50\% RH$ by supplying air at a temperature of$ 12℃$, design conditions are: 6 kW sensible heat gain, 1.2 kW latent heat gain, $32℃ dbt and 24℃ wbt$ outside conditions. The ratio of circulated air to fresh air is fixed at 3:1 by weight. The plant consists of direc t expansion (DX) cooler and supply fan allowing $1℃$ rise for fan power. Determine:
12. The supply air quantity in$ kg/s$.
13. The load in refrigeration plant.
14. The cooler contact factor.
15. An air conditioned space is to be maintained at$ 25℃ dbt and 60\% RH$. The sensible and latent heat loads excluding ventilation load are $95000{kJ}/{hr}$ and $63350{kJ}/{hr}$ respectively. Air enters the cooling coil after mixing with ventilation air at$ 30℃ dbt$ and$ 23℃ wbt$. The coil face velocity is to be $7310 m/hr$, air leaving the conditioner coil $14℃ dbt$, determine:
16. The refrigerant temperature.
17. The number of rows of coil.
18. The air flow rate entering the coils$ \left({m^{3}}/{hr}\right)$.
19. The face area of the coils$ \left(m^{2}\right)$.
20. The refrigerating capacity of the conditioner$ \left(TR\right)$.
21. The cooling load calculations in theater show that at design conditions, the sensible heat load is $600000 kJ/hr$ and the latent heat load is $248000 kJ/hr$ from internal sources and transmission through the building. The indoor design conditions are $24℃ dbt$ and$ 60\% RH$, while the outside conditions are $35℃ dbt$ and$ 25℃ wbt$. The ventilation requirements are $8500 m^{3}/hr$ of outdoor air, and the conditioned air should leave the grills at$ 15℃ dbt$. Calculate:
22. The temperature at which the load ratio line intersects the saturation line.
23. DPT and WBT of the air leaving the conditioner or entering the theater.
24. The flow rate of the air handled by the conditioner$ \left({m^{3}}/{hr}\right)$.
25. The flow rate of air entering the coils.
26. The capacity of the conditioner (tons).
27. In an air conditioning plant serving a room, fresh air is cooled by means of a coil with a bypass factor of 0.15. The cooled fresh air is then mixed with equal weights of re-circulated room air and supplied to the room. Outside condition is $ 37℃ dbt$ and$ 27℃ wbt$. The room has heat gains of$ 16000 kJ/hr$ sensible and $4000 kJ/hr$ latent. If the room is to be maintained at$ 27℃ dbt$, the mass of air supplied at a rate of $1812 kJ/hr$, determine:
28. The load on the cooling coil in$ kJ/hr$.
29. The relative humidity maintained in the room.