MEBS6006 Environmental Services I

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Assignment 01: Fundamentals of HVAC

1. An operating theatre is maintained at an inside temperature of 26°C dry-bulb when the outside air is at 45°C dry-bulb, 32°C wet-bulb (sling) and the sensible and latent heat gains are 9 kW and 3 kW, respectively. Determine the cooling load if 100 per cent fresh air is handled, the air temperature leaving the cooler coil being 14°C and the apparatus dew point 12°C. Assume a rise of 1.5°C across the supply fan (which is located after the cooler coil) and a further rise of 2°C because of heat gains to the supply duct. Also, determine the percentage saturation maintained in the theatre under these conditions.
   [Answers: 72.67 kW, 50.9 per cent.]

2. Explain the two important conditions for ensuring thermal comfort in a space and the four situations where local thermal discomfort may happen.

3. List the factors in the environment which affect the body's feeling of comfort and describe how they influence the rate of heat loss from the body.

4. Write down an equation expressing the thermal balance between the human body and its environment. Under what conditions is the temperature of the deep tissues of the human body going to change? Discuss the physiological mechanisms which the body employs to adjust such an imbalance.

5. Briefly discuss the influence of clothing on human comfort. How is the effect of clothing expressed? Why would you expect a mixed group of people in an air conditioned room to have different attitudes to thermal comfort?

6. Briefly explain the principle of adaptive thermal comfort. What is its main effect on naturally ventilated buildings?

7. A room measures 20 m x 10 m x 3 m high and is to be maintained at a state of 20°C dry-bulb and 50 per cent saturation. The sensible and latent heat gains to the room are 7.3 kW and 1.4 kW, respectively. Calculate from first principles, the mass and volume of dry air that must be supplied at 16°C to the room each second. Also calculate its moisture content. Take the specific heats of dry air and superheated steam as 1.012 and 1.890 kJ kg^{-1} K^{-1}, respectively, the density of air as 1.208 kg m^{-3} at 16°C and the latent heat of evaporation as 2454 kJ kg^{-1} of water.
   [Answers: 1.779 kg dry air per second, 1.473 m^3 s^{-1} at 16°C, moisture content= 7.055 g per kg dry air]

8. Explain the meaning of sol-air temperature and describe its equation.

9. Draw a diagram to show the basic principles and conversion process of heat gain into cooling load. Indicate clearly the components of transfer function method (TFM).

10. Briefly explain the principles of the following energy calculation methods: heat balance (HB) method and radiant time series (RTS) method.