MEBS6008 Environmental Services II

http://me.hku.hk/msc-courses/MEBS6008/index.html

Self-evaluation Exercises

(* If possible, please try to answer the questions without referring to the lecture notes.)

1. Briefly describe the terms in the generalised Bernoulli equation and their physical meanings in fluid dynamics.

2. Suggest two methods to control flow separation in air diffusers and three ways to avoid cavitation.

3. Using the Darcy-Weisbach equation and other related formulae, calculate the frictional loss for 2 m long of an air duct with D = 0.2 m, surface roughness ε = 0.003 m, mean air velocity inside the air duct v = 5 m/s. Assume air density ρ = 1.2 kg/m^3, absolute viscosity μ = 0.00002 Pa•s and gravitational constant g = 9.81 m/s^2. The frictional factor may be determined using the following empirical equation.

$$f = \frac{0.25}{\left\{\log\left[\frac{\varepsilon}{3.7D} + \frac{5.74}{0.9\,\mathrm{Re}_D}\right]\right\}^2}$$

4. What are the important design considerations for chilled water systems? Briefly explain the principles for analysis of pipe network in a water distribution system.

5. Draw a diagram to show typical design of a variable flow chilled water system with plant-building loop. Explain the pump affinity laws that can be used to evaluate pump performance and characteristics. What precaution shall be taken to minimise the risk of cavitation at the pump impeller?

6. Briefly describe the five common methods for fan modulation and capacity control. With the help of suitable diagrams, explain the likely unstable regions for centrifugal and axial fans.

7. Briefly explain the following terms for space air diffusion.

   (a) Age of air
   (b) Air change effectiveness
   (c) Air diffusion performance index
   (d) Characteristic length

8. Draw a diagram to show the four zones of a free, isothermal, axial air jet. What are the typical terminal air velocities used for design of space air jet?

9. Briefly explain the characteristics of stratified mixing flow that can be found in a large indoor sport stadium. What type of supply air outlet can be used in such a situation?

10. What are the advantages and disadvantages of using underfloor air distribution in office buildings? Draw a diagram to show the stratified displacement flow in a typical room.