

## MEBS6008 Environmental Services II

<http://www.hku.hk/bse/MEBS6008/>

### Exercise 02 – Fans and Pumps

(\* For self-evaluation, no need to submit.)

1. 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?
2. 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.
3. Briefly explain the five major issues causing energy losses to a centrifugal fan.
4. 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  $\varepsilon = 0.003$  m, mean air velocity inside the air duct  $v = 5$  m/s. Assume air density  $\rho = 1.2$  kg/m<sup>3</sup>, absolute viscosity  $\mu = 0.00002$  Pa•s and gravitational constant  $g = 9.81$  m/s<sup>2</sup>. The frictional factor may be determined using the following empirical equation.

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