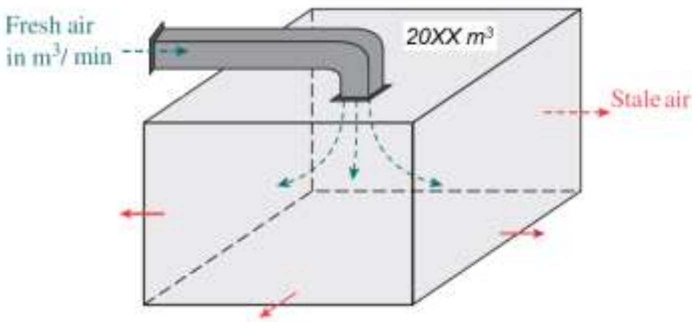
KIX1001 *Engineering Mathematics 1*
Assignment 1
Academic Session 2021/2022 Semester 1

Date of submission: Week 13 to Tutor *[10 marks]*

Figure 1 shows the air exchange process in a room.



Note: Given the room size, R is 20XX m^3 where XX is the last two-digit constant of your metric number before slash. For example, 20XX = 2004 if the metric number is 173505804/01.

Figure 1

It can be governed by the following equation:

$$\frac{dV}{dt} = \dot{V}_{fresh\ air} - \dot{V}_{stale\ air} = \frac{0.04}{100}F - \frac{V}{R}F$$ *(Note: F and R are constants)*

Where,

(i) $V(t)$ *is the volume of* CO_2 *(in* m^3*) in the room at time* t *(in min), i.e.* $\frac{CO_2 \text{ in } \%}{100} x\ room\ size, R.$

(ii) $\dot{V}_{fresh\ air}$ *is the input rate of fresh air that is circulated into the room at a constant F (in* m^3*/min) with 0.04%* CO_2*. Assume the stale air and fresh air mix immediately in the room.*

(iii) $\dot{V}_{stale\ air}$ *is the output rate of stale air that leave the room at a constant F* m^3*/min with* CO_2 *concentration of* $\{V(t) \div room\ size\}$*.*

(1) *Initially, the room contains 0.30% by volume of CO_2. Design the required flow rate of the fresh air, F (in m^3/min) if you wish to reduce the level of CO_2 in the room to 0.05% in 5 minutes.*

(5 markah/*marks*)

(2) *Continue from (Q1), plot the table and graph for the change of level of CO_2 (in m^3) over time for 1 hour duration with 5 minutes interval by using Excel or any other software.*

(2 markah/*marks*)

(3) *Continue from (Q2), estimate the steady state level of CO_2 (in m^3) within 4 significant figures and the time taken to reach the steady state level.*

(1 markah/*mark*)

(4) *Assume the room has no ventilation system initially, calculate and comment on the CO_2 level (in m^3) in the room over the time.*

(1 markah/*mark*)

(5) *After the installation of the ventilation system as you design in (Q1-Q3), calculate the reduction percentage (%) of the steady state CO_2 level (in m^3). If the safety level of CO_2 in an indoor space is less than 0.1% (or 1000 ppm) according to standard, comment if the proposed ventilation system is useful to achieve this requirement.*

(1 markah/*mark*)

TAMAT / *END*