c) -Command window
-Clear
-Clc
-Close all
Note 360mins = 6hr.
- t = 0 : 5 : 360
- y = 20000 - (20000 . $e^{-0.03t}$)
- plot (t, y)
- Grid on
- Grid minor
- xlabel ('time')
- ylabel ('volume').

d) The steady value is 2×10^4 ft^3 at 180 mins.

e) At time t = 180 mins, the room is filled with 20000 ft^3 of fresh air and it is maintained till the 360th min (6th hr).

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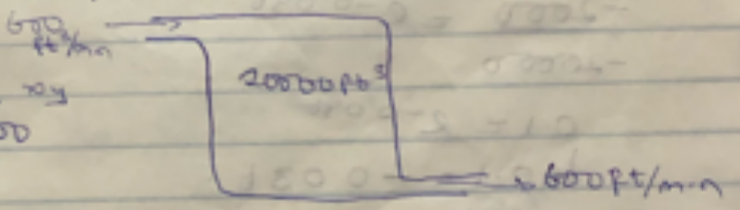
ENG 282 Assignment.
Assignment 4.

- It is discovered that 600 ft^3/min of fresh air flows into a room containing 20000 ft^3 of air. The mixture, which is made practically uniform by circulating fans, is exhausted at a rate of 600 cubic feet per minute (cfm). If the room contains no fresh air initially,

a) develop a model for the amount of fresh air in the room at any time t
b) Calculate the time at which 90% of the air in the room will become fresh.
c) with the aid of MATLAB, plot the dynamic response of the amount of fresh air in the room for t = 0 to t = 6hr using a step time of 5 min.
d) determine the steady-state value of the amount of fresh air in the room, and
e) comment on the result obtained in (d)

Solution.

a) dy/dt = Air inflow rate − Air outflow rate



$dy/dt = y_{in} - y_{out}$

$dy/dt = 600 ft^3/min - \frac{600}{20000} \times y$

$dy/dt = 600 - 0.03y$.

$= -0.03(-20000 + y)$

$dy/dt = -0.03(y - 20000)$

$\frac{dy}{y - 20000} = (-0.03)dt$

Integrating both sides.

$\int \frac{1}{y - 20000} dy = \int (-0.03) dt$.

$\ln(y - 20000) = -0.03t + C$.

Dividing by ln.

$(y - 20000) = e^{-0.03t + C}$.

$y - 20000 = e^{-0.03t} \cdot e^{c}$

$y - 20000 = e^{0.03t} \cdot y_0$

$y - 20000 = y_0 e^{-0.03t}$

At time $t = 0$, $y_0 = 0$.

$0 - 20000 = y_0 \cdot e^{0.03(0)}$

$y_0 - 20000 = y_0 \cdot 1$

$y_0 = -20000 \text{ ft}^3/\text{min}$.

$\therefore y - 20000 = -20000 \cdot e^{-0.03t}$.

$y = 20000 - (20000 \cdot e^{-0.03t})$

b) ~~90~~
~~100~~

b) 90% of 20000 cm^3 of fresh air

$= \frac{90}{100} \times 20000$

$= 18000 \text{ cm}^3$ of fresh air.

when $y = 18000$ ~~(20000cm)~~ find $t = ?$

~~$y = 18000$~~

$18000 = 20000 - (20000 \cdot e^{-0.03t})$

$18000 - 20000 = -(20000 \cdot e^{-0.03t})$

$-2000 = -(20000 \cdot e^{-0.03t})$

$\frac{-2000}{-20000} = e^{-0.03t}$

$0.1 = e^{-0.03t}$

$\ln 0.1 = -0.03t$

$-2.3 = -0.03t$

$t = \frac{-2.3}{-0.03}$

$t = 76.6 \text{ mins}$.