Datiabasi Ibanga Gains

17/ENG02/029

COMPUTER ENGINEERING

Initial condition; no fresh air = $0 ft^3$ of air

let $y(t)$ be the amount of fresh air inside in ft^3

Air in $= 600 \frac{ft^3}{min}$

Air out $= \frac{y(t) ft^3}{20,000 ft^3} \times 600 \frac{ft^3}{min} = 0.03 y(t) \frac{ft^3}{min}$

$$\frac{dy(t)}{dt} = 600 - 0.03y(t)$$

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

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

$$y' = -0.03(y - 20000)$$

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

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

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

Let $e^C = B$

$$\frac{dy(t)}{dt} = 600 - 0.03y(t)$$

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

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

$$y' = -0.03(y - 20000)$$

$$\int \frac{dy}{y-20000} = \int 0.03\,dt$$

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

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

Let $e^{C} = B$

$$y - 20000 = Be^{-0.03t}$$

$$y(t) = 20000 + Be^{-0.03t}$$

When $y(t) = 0$

$$yt = 0 = 20000 + Be^{-0.05t}$$

b) When 90% of air will be fresh

$= y = \frac{90}{100} \times 20000 = 18000$

$18000 = 20000 - 20000e^{-0.03t}$

$18000 - 20000 = -20000e^{-0.03t}$

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

Divide both sides by -20000

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

$= 0.1 = e^{-0.03t}$

$\ln 0.1 = \ln(e^{-0.03t})$

$-2.30 = -0.03t$

$t = \frac{-2.30}{-0.03}$

$t = 76.6 \approx 77$ mins

6 hours = 360 mins

(d) The steady state value of the amount of fresh air in the room is 20000 ft.

(e) From results, at the 200m meter y is tending to infinity giving a steady state value

e Command window

```
clear
close all
syms t
t = [0:5:360]
y = 20000 - 20000 exp^-(0.03t)
plot(t,y)
```