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MATRIC NO: 18/ENG09/006

DEPARTMENT: AERONAUTICAL ENGINEERING

COURSE: ENG282

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ASSIGNMENT

1a) Input rate = $(1 \text{ sint}) \frac{\text{lb}}{\text{gal}}$

Flow input rate = $50 \frac{\text{gal}}{\text{min}}$

Input concentration (m_{in}) = $50 \frac{\text{gal}}{\text{min}} \times (1 \text{ sint}) \frac{\text{lb}}{\text{gal}}$

$m_{in} = 50(1 \text{ sint})$

Output concentration (m_{out}) = $\frac{30}{1200} \times m = 2.5\% \text{ of } m$

$M_{out} = \frac{m}{40} \Rightarrow m_{out} = \frac{2.5 \times m}{100} = \frac{m}{40}$

$\frac{dm}{dt} = m_{in} - M_{out}$

$\frac{dm}{dt} = 50(1 \text{ sint}) - \frac{m}{40}$

$\frac{dm}{dt} + \frac{m}{40} = 50(1 \text{ sint})$

b.) $\frac{dm}{dt} + \frac{m}{40} = 50(1 \text{ sint})$

$\frac{dm}{dt} + (p \times m) = Q$

$I \cdot f = e^{\int p \, dt}$

$p = \frac{1}{40}, Q = 50(1 \text{ sint})$

$\int \frac{1}{40} \, dt$

$I \cdot f = e$

$I \cdot f = e^{t/40}$

$$m \times I \cdot f = \int Q \times I \cdot f \, dt$$

$$m \times e^{t/40} = \int 50(1 + \sin t) e^{t/40} \, dt$$

$$m \times e^{t/40} = 50 \int (1 + \sin t) e^{t/40} \, dt$$

$$m \times e^{t/40} = 50 \left[\int e^{t/40} \, dt + \int e^{t/40} \sin t \, dt \right]$$

$$m \times e^{t/40} = 50 \left[\int e^{t/40} \, dt + \int e^{t/40} \sin t \, dt \right]$$

but $\int e^{t/40} \, dt$

$$\text{let } u = \frac{t}{40}$$

$$du = \frac{1}{40} dt$$

$$\begin{aligned} \therefore \int e^{t/40} \, dt &= \int e^u \times 40 \, du = 40 \int e^u \, du \\ &= 40e^u \\ &= 40e^{t/40} \end{aligned}$$

$$\int e^{t/40} \sin t \, dt$$

$$\int u \, dv = uv - \int v \, du$$

$$u = e^{t/40} \quad dv = \frac{1}{40} e^{t/40} \, dt$$

$$dv = \sin t \, dt$$

$$v = \int \sin t \, dt = -\cos t$$

$$\begin{aligned} \therefore \int e^{t/40} \sin t \, dt &= -e^{t/40} \cos t - \int \frac{1}{40} e^{t/40} \cos t \, dt \\ &= -e^{t/40} \cos t + \frac{1}{40} \int e^{t/40} \cos t \, dt \end{aligned}$$

$$\therefore \int e^{\frac{t}{40}} \sin t \, dt = -e^{\frac{t}{40}} \cos t + \frac{1}{40} \int e^{\frac{t}{40}} \cos t \, dt$$

$$\int e^{\frac{t}{40}} \cos t \, dt$$

$$\text{let } u = e^{\frac{t}{40}}, \quad du = \frac{1}{40} e^{\frac{t}{40}}$$

$$dv = \cos t \, dt$$

$$v = \int \cos t \, dt \quad v = \sin t$$

$$\therefore \int e^{\frac{t}{40}} \cos t \, dt = e^{\frac{t}{40}} \sin t - \int \sin t \times \frac{1}{40} e^{\frac{t}{40}} \, dt$$

$$= e^{\frac{t}{40}} \sin t - \frac{1}{40} \int e^{\frac{t}{40}} \sin t \, dt$$

$$\therefore \int e^{\frac{t}{40}} \sin t \, dt = -e^{\frac{t}{40}} \cos t + \frac{1}{40} \left[e^{\frac{t}{40}} \sin t - \frac{1}{40} \int e^{\frac{t}{40}} \sin t \, dt \right] + k$$

$$\int e^{\frac{t}{40}} \sin t \, dt = -e^{\frac{t}{40}} \cos t + \frac{1}{40} e^{\frac{t}{40}} \sin t - \frac{1}{1600} \int e^{\frac{t}{40}} \sin t \, dt + k$$

$$\int e^{\frac{t}{40}} \sin t \, dt + \frac{1}{1600} \int e^{\frac{t}{40}} \sin t \, dt = \frac{1}{40} e^{\frac{t}{40}} \sin t - e^{\frac{t}{40}} \cos t + k$$

$$\left(1 + \frac{1}{1600}\right) \int e^{\frac{t}{40}} \sin t \, dt = e^{\frac{t}{40}} \left(\frac{1}{40} \sin t - \cos t \right) + k$$

$$\frac{1601}{1600} \int e^{\frac{t}{40}} \sin t \, dt = e^{\frac{t}{40}} \left(\frac{1}{40} \sin t - \cos t \right) + k$$

$$\int e^{\frac{t}{40}} \sin t \, dt = \frac{1600}{1601} \left[e^{\frac{t}{40}} \left(\frac{1}{40} \sin t - \cos t \right) + k \right]$$

$$\therefore m \times e^{\frac{t}{40}} = \frac{1600}{1601} \left[e^{\frac{t}{40}} \left(\frac{1}{40} \sin t - \cos t \right) + k \right]$$

$$m = \frac{1600}{1601} \left[\frac{e^{\frac{t}{40}}}{e^{\frac{t}{40}}} \left(\frac{1}{40} \sin t - \cos t \right) + k e^{\frac{t}{40}} \right]$$

$$m = \frac{1600}{1601} \left[\frac{1}{40} \sin t - \cos t + k e^{-\frac{t}{40}} \right]$$

$$\text{but } \frac{1600}{1601} \approx 1$$

$$\therefore m = \frac{1}{40} \sin t - \cos t + k e^{-t/40}$$

at $t=0$

$$m = \frac{150}{1200} \quad m = 150/6$$

$$\therefore 150 = \frac{1}{40} \sin(0) - \cos(0) + k e^{-0/40}$$

$$150 = -1 + k$$

$$k = 150 + 1$$

$$k = 151$$

$$\therefore m = \frac{1}{40} \sin t - \cos t + 151 e^{-t/40}$$

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```

1 - commandwindow
2 - clear
3 - clc
4 - close all
5 - syms m(t)
6 - N=diff(m,t)==50*(1+sin(t))-(m/40)
7 - mSol(t)=dsolve(N)
8 - cond=m(0)==150
9 - mSol(t)=dsolve(N,cond)
10

```

script Ln 6 Col 33

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Command Window

```

N(t) =

diff(m(t), t) == 50*sin(t) - m(t)/40 + 50

mSol(t) =

C1*exp(-t/40) - (2000*1601^(1/2)*cos(t + atan(1/40)))/1601 + 2000

cond =

m(0) == 150

mSol(t) =

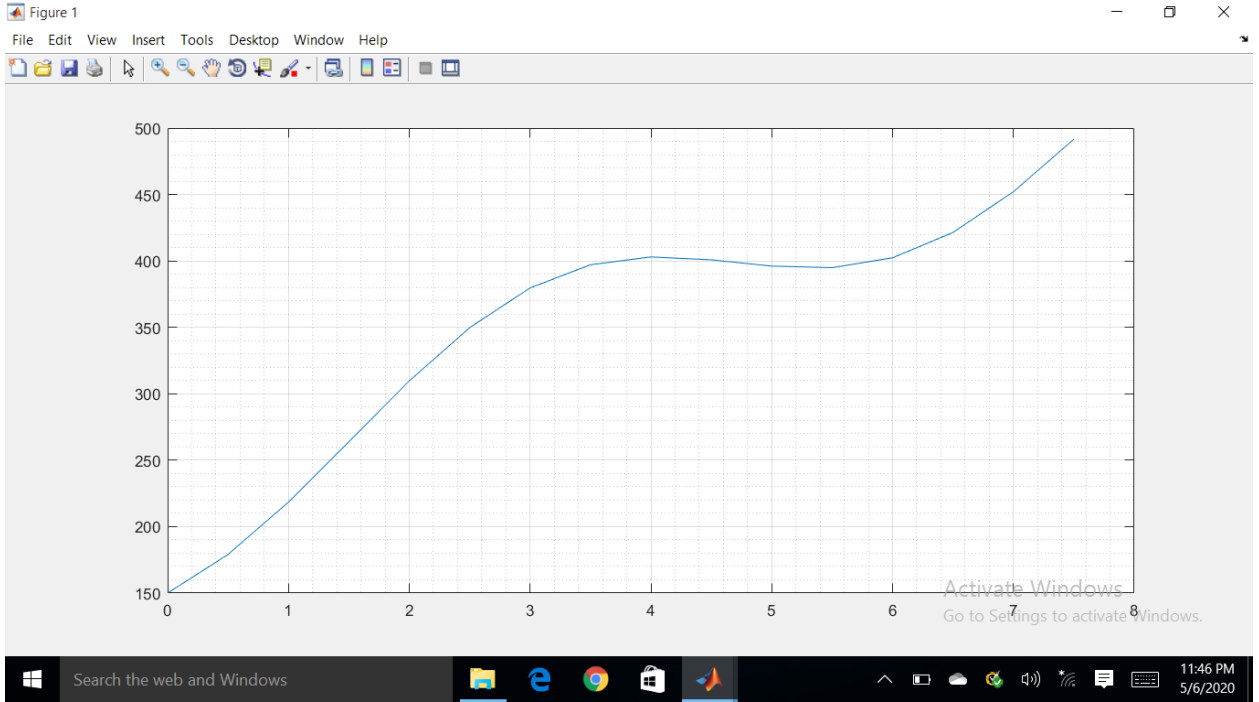
2000 - (2000*1601^(1/2)*cos(t + atan(1/40)))/1601 - (2881850*exp(-t/40))/1601

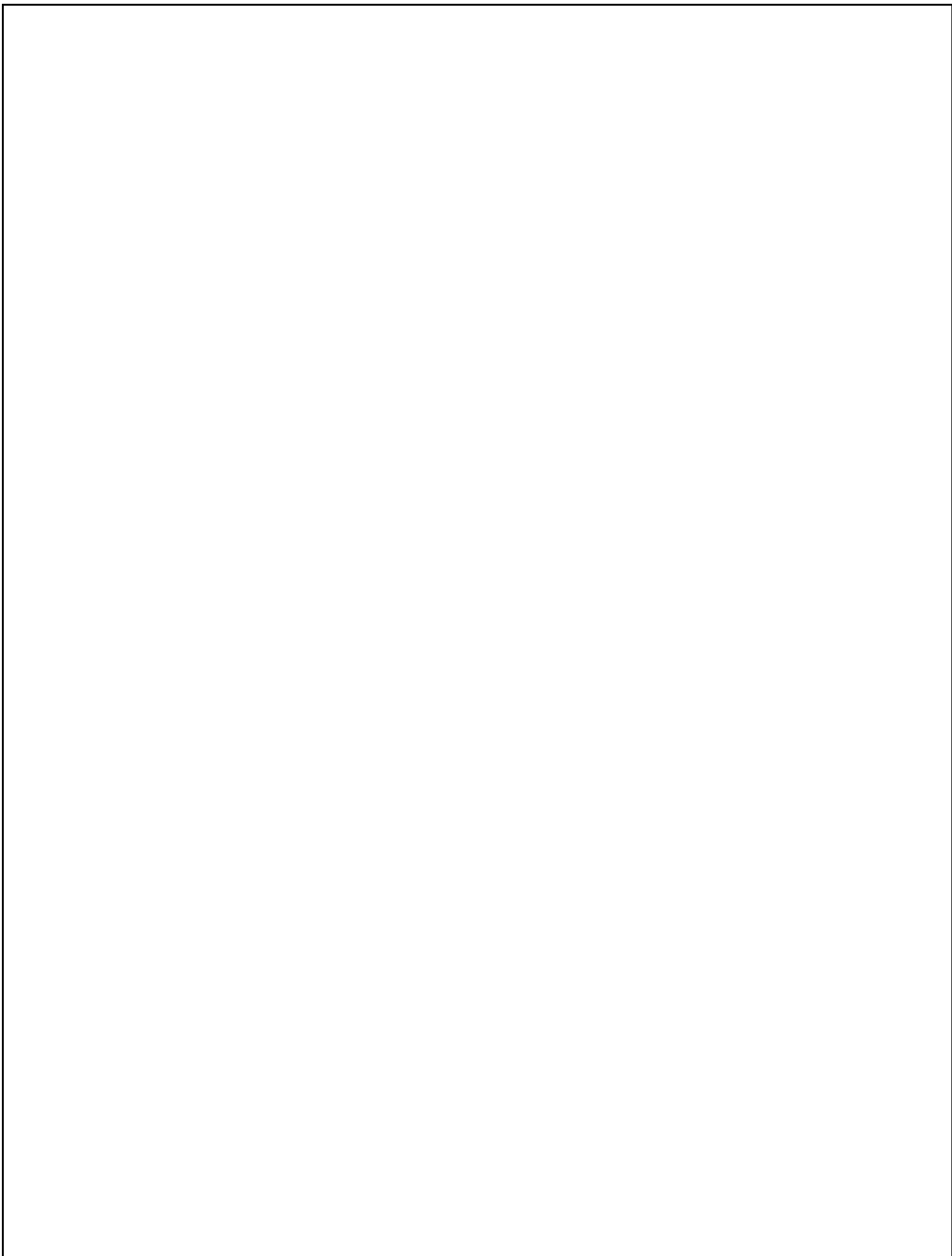
```

fx 2000 - (2000*1601^(1/2)*cos(t + atan(1/40)))/1601 - (2881850*exp(-t/40))/1601

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```
Editor - C:\Users\HP\Documents\MATLAB\bin\STCHIIJOKE.m
1 - commandwindow
2 - clear
3 - clc
4 - close all
5 - format short g
6 - syms t
7 - y=(50/0.05)+((50/1.0025)*sin(t))+((50*0.05/1.0025)*cos(t))-(802.49*exp(-0.05*t))
8 - ym=1000-(800*exp(-0.05*t))
9 - t=0:1:500
10 - t1=t(2:2:500)
11 - t2=t(1:2:500)
12 - Y=subs(y,t1)
13 - Ym=subs(ym,t2)
14 - mdata={'t(min)', 'V(litres)'; Y, Ym}
15 - plot(t1, Y, t2, Ym)
16 - grid on
17 - grid minor
18
19
```

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2.

