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18/ENG03/003
Civil Engineering Math 202 Assignment

Using the balance law, i.e

Accumulation rate = Input rate - Output rate

amount of salt at any time t = y

i.e $dy/dt = y_{in} - y_{out}$

$y_{in} = 50 \frac{gal}{min} \times (1+\sin t) \frac{lb}{gal}$

This is because, 50 gal of brine water goes through the tank per minute at $(1 + \sin t)$ lbs of salt per gallon

$\therefore$ at $t = 1$, $(1 + \sin t) \Rightarrow$
$1 + \sin(1) = 1.02 lb$

$\therefore y_{in} = 50 gal/min \times 1.02 lb/gal =$
$51 lb/min$

The tank has 1200 gal of water with the dissolved salt and 30 gallons of the solution leaves the tank per minute. That is

$\frac{30}{1200} = 0.025 = 2.5\%$ of the content of the tank.

Therefore 2.5% of the salt present in the tank will leave the tank per minute

i.e $y_{out} = 2.5\%$ of the salt (y)

a) $\frac{dy}{dt}\frac{lb}{min} = 5\frac{lb}{min} - 2.5\%\text{ of } y\frac{lb}{min}$

b) $\frac{dy}{dt} = 51 - 0.025y \Rightarrow \frac{dy}{dt} = -0.025y + 51$

$$\frac{dy}{dt} = 0.025\left[\frac{-0.025y + 51}{-0.025y - 0.025}\right] \Rightarrow$$

$$\frac{dy}{dt} = -0.025(y - 2040)$$

$$\frac{dy}{(y-2040)} = -0.025\,dt$$

$$\int \frac{dy}{(y-2040)} = \int -0.025\,dt$$

$$\int \frac{dy}{(y-2040)} = -0.025 \int$$

$$\ln(y - 2040) = -0.025t + C$$

$$y - 2040 = e^{-0.025t}\,C$$

$$y - 2040 = e^{-0.025t}\,e^{C}$$

$$y - 2040 = e^{-0.025t}\,y_0$$

$$y - 2040 = y_0 e^{-0.025t}$$

$$y = y_0 e^{-0.025t} + 2040$$

Given that when $t = 0$ min (initially), $y = 150$ lb

$$\therefore 150 = y_0 e^{-0.025(0)} + 2040$$

$$150 = y_0 e^{0} + 2040$$

$$150 - 2040 = y_0 (1)$$

$$-1890 = y_0$$

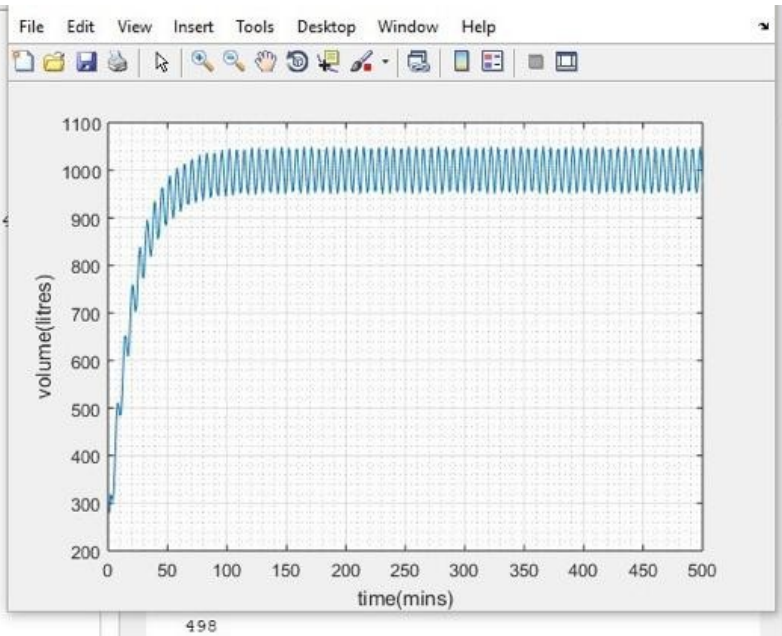
$$y = -1890 e^{-0.025t} + 2040$$

Therefore, $y = 2040 - 1890e^{-0.025t}$

```
commandwindow
clear
clc
close all
syms t
values=[]
t=1:1:500
mean=1000-((exp(-0.05*t))*800)
y=1000+(50/1.0025)*sin(t)+(2.5/1.0025)*cos(t)-((exp(-0.05*t))*802.4

if rem(t,2) ==0
    values=[values,mean]
else
    values=[values,y]
end
excelvalues=transpose(values)
mins=transpose(t)
plot(t,values)
grid on
grid minor
xlabel ('time(mins)')
ylabel('volume(litres)')
xlswrite('odevbesdata.xlsx',{'t(min)'},'veriler','A1')
xlswrite('odevbesdata.xlsx',mins,'veriler','A2')
xlswrite('odevbesdata.xlsx',{'V(Litre)'},'veriler','B1')
xlswrite('odevbesdata.xlsx',excelvalues,'veriler','B2')

```

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498
499
500
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fx >>

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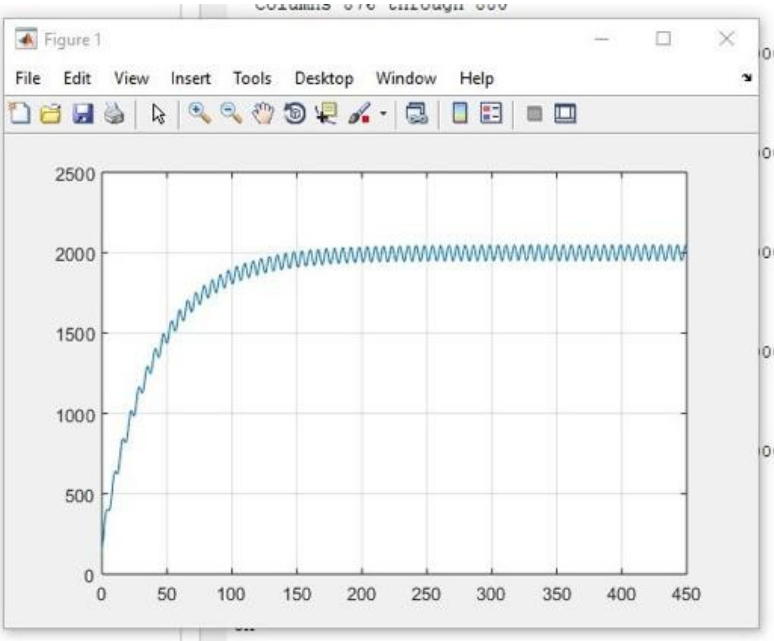
B2 279.963914100068

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	t(min)	V(Litre)																			
2	1	279.9639																			
3	2	318.1907																			
4	3	313.8601																			
5	4	303.601																			
6	5	327.9009																			
7	6	393.9593																			
8	7	469.1423																			
9	8	511.0566																			
10	9	506.5922																			
11	10	484.0395																			
12	11	487.1398																			
13	12	534.9268																			
14	13	604.2824																			
15	14	651.2431																			
16	15	651.4694																			
17	16	622.6706																			
18	17	608.3676																			
19	18	637.9229																			
20	19	699.585																			
21	20	751.3315																			
22	21	759.541																			
23	22	729.9392																			
24	23	702.3679																			
25	24	714.1865																			
26	25	765.9535																			
27	26	820.9421																			
28	27	838.9333																			
29	28	813.2194																			
30	29	776.7953																			

```
commandwindow
clear
clc
close all
syms m t
ans=dsolve('Dm+0.025*m=50+50*sin(t)','m(0)=150')
t=0:0.5:450
tn=subs(ans,t)
plot(t,tn)
grid on
```




```
[ 150, 2000 - (2000*1601^(1/2)*cos(atan(1/40) + 1/2))/1
>>
```