DALMOP WENG
18/ENG01/008
Chemical Engineering
ENG 282

1a) From $dy/dt = y_{in} - y_{out}$

$dy/dt = 50(1+\sin t) - 2.5\%$ of y

$y_{out} = \frac{30}{1200} = 0.025 = 2.5\%$

$y_{out} = 2.5\%$ of $y = 1/40y$

$dy/dt = 50(1+\sin t) - 0.025y$

By Seperating the variable

$dy/dt + 0.025y = 50(1+\sin t)$

$\Rightarrow 1 + 0.25y\, dy = 50(1+\sin t)dt$

1b) $dy/dt = 50(1+\sin t) - 0.025y$

$dy/dt + 0.025y = 50(1+\sin t)$

Using linear equation method;

$dy/dx + Py = Q$

$P = 0.025$, $Q = 50(1+\sin t)$

$\int P.dt = 0.025t$

$I.F = e^{\int P dt}$

$I.F = e^{0.025t}$

$y.e^{0.025t} = \int 50(1+\sin t)\, e^{0.025t}.dt$

$y.e^{0.025t} = 50\int (1+\sin t)\, e^{0.025t}.dt$

$y.e^{0.025t} = 50\int e^{0.025t}.dt + \int e^{0.025t}\sin t.dt$

$y.e^{0.025t} = 50\left[\frac{e^{0.025t}}{0.025} + \int e^{0.025t}\sin t.dt\right]$

Integration by Part

$\int e^{0.025t}\sin t.dt \qquad \int u\,dv = uv - \int v\,du$

$u = e^{0.025t} \qquad dv = \sin t$

$du = 0.025\, e^{0.025t} \qquad v = -\cos t$

$\therefore \int e^{0.025t}\sin t = e^{0.025t}(-\cos t) - \int -\cos t \cdot 0.025 e^{0.025t}$

$+ C$

$\int e^{0.02t} \sin t = -e^{0.02t} \cos t + 0.025 \int e^{0.025t} \cos t$
$+ C$

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

$u = e^{0.025t}$, $dv = \cos t$

$du = 0.025 e^{0.025t}$ $v = \sin t$

$= -e^{0.025t} \cos t + 0.025 \left[e^{0.025t} \cdot \sin t - \int \sin t \cdot 0.025 e^{0.025t} \right]$

$= -e^{0.025t} \cos t + 0.025 \left[e^{0.025t} \sin t - 0.025 \int \sin t\, e^{0.025t} \right]$

Let $Q = \int e^{0.025t} \sin t$

$Q = -e^{0.025t} \cos t + 0.025 \left[e^{0.025t} \sin t - 0.025 Q \right]$

$Q = -e^{0.025t} \cos t + 0.025 e^{0.025t} - 0.25^{-4} Q$

$Q + 6.25^{-4} Q = -e^{0.025t} \cos t + 0.025 e^{0.025t}$

$1.0006250 Q = -e^{0.025t} (\cos t - 0.025)$

$Q = \frac{-e^{0.025t}}{1.000625} (\cos t - 0.025) + C$

$y = 2000 - \frac{50}{1.000625} (\cos t - 0.025 \sin t) + \frac{50C}{e^{0.025t}}$

When $y = 150$, $t = 0$

$150 = 2000 - \frac{50}{1.000625} (1 - 0) + \frac{50C}{1}$

$150 = 2000 - 49.968(1) + \frac{50C}{1}$

$150 = 1950.032 + 50C$

$\frac{50C}{50} = \frac{-1800.032}{50}$

$C = -36.00064$

$Q = \frac{-e^{0.025t}}{1.00025} (\cos t - 0.025) + C$

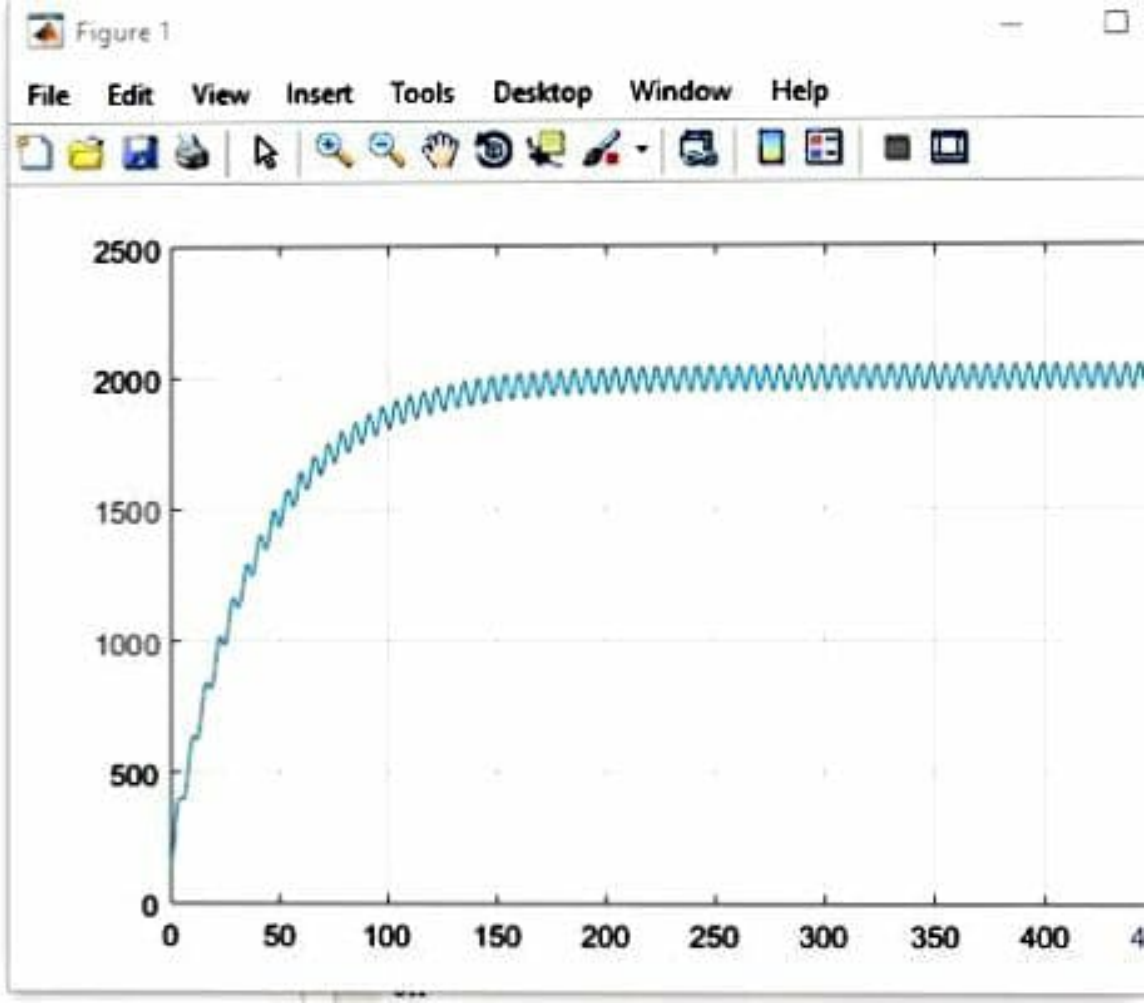
$\int e^{0.025t} \sin t = \frac{-e^{0.025t}}{1.000625} (\cos t - 0.025) +$

$y \cdot e^{0.025t} = 50 \left[\frac{e^{0.02t}}{0.2} - \frac{e^{0.02t}}{1.000625} ((\cos t - 0.025) + C \right]$

$y \cdot e^{0.02t} = 2000 e^{0.02t} - \frac{e^{0.025t}}{1.000625} (\cos t - 0.025) +$

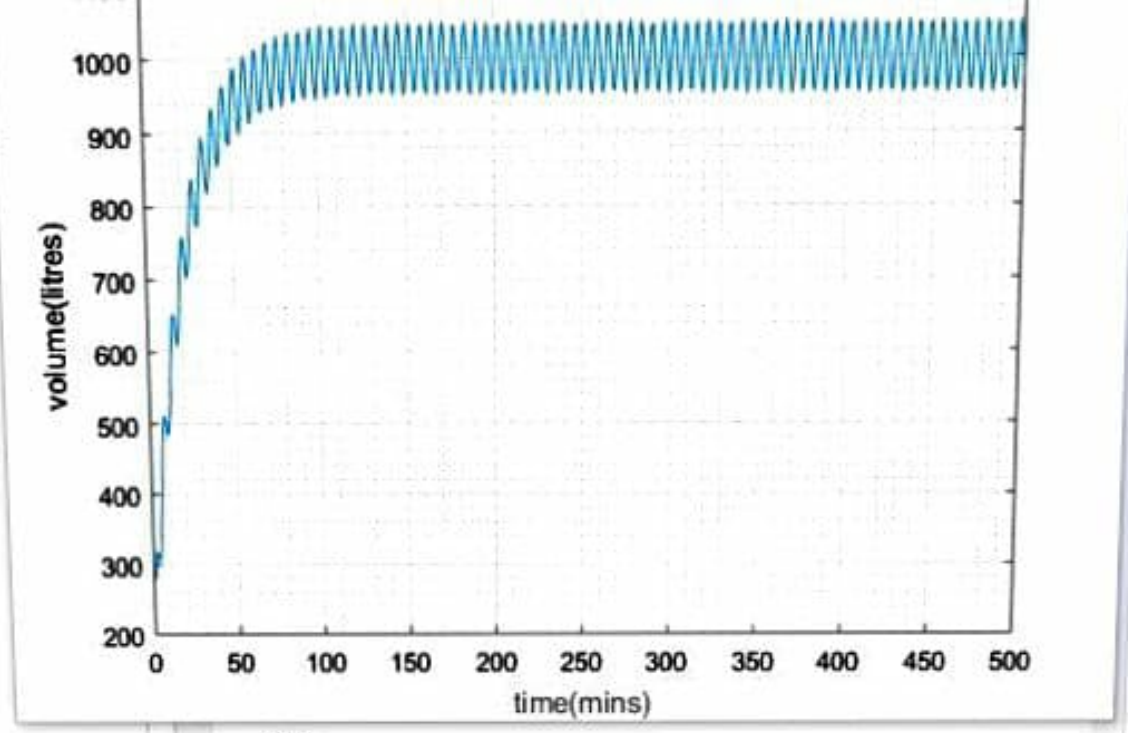
$$y = 2000 = \frac{50}{1.000625}\left(\cos t - 0.025\right) + \frac{50C}{e^{0.025t}}$$

```
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
```



```
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')
```




```
498
499
500
```

fx >>

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW Sign in

B2 279.963914100068

	A	B
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