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18/ENG02/1098
Computer Engineering
ENG 282 (Engineering Maths II)

(i) The rate of accumulation of salt within a system is equal to the input rate of salt into the system minus output rate of salt from the system (Balance law).
The accelerating rate of salt within a system = Input rate of salt − output rate of salt from it.
Let the amount of salt present in the tank at any time be y
The rate of change of $y = \frac{dy}{dt} = y_{in} - y_{out}$

If 50g of brine enters the tank per minute of 50 gallons containing $(1 + \sin t)$ lb of salt then

at $t = 1$, $(1 + \sin t) = (1 + \sin(1)) = 1.0215$

Hence the amount of salt entering the tank is
$50\,gal/min \times 1.0215\,lb/gal = 51\,lb/min$

(ii) $\frac{dy}{dt}$ lb/min $= 51$ lb/min $- 2.5\%$ of y lb/min

(iii) $\frac{dy}{dt} = 51 - 0.025y$; $\frac{dy}{dt} = -0.025y + 51$

$\frac{dy}{dt} = -0.025\left(\frac{-0.025y}{0.025} + \frac{51}{0.025}\right)$

$= 0.02(y - 2040)$

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

$\int \frac{dy}{(y-2040)} = -0.025 \int dt$; $\ln(y - 2040) = -0.025t + c$

$y - 2040 = e^{-0.025t + c}$; $\therefore y - 2040 = e^{-0.025t + c}$

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

$y = y_0 e^{-0.025t} + 2040$; Initially, when $t = 1$, $y = 150$ lb

$150 = y_0 e^{-0.025t} + 2040$; $150 - 2040 = y_0 \times 1$

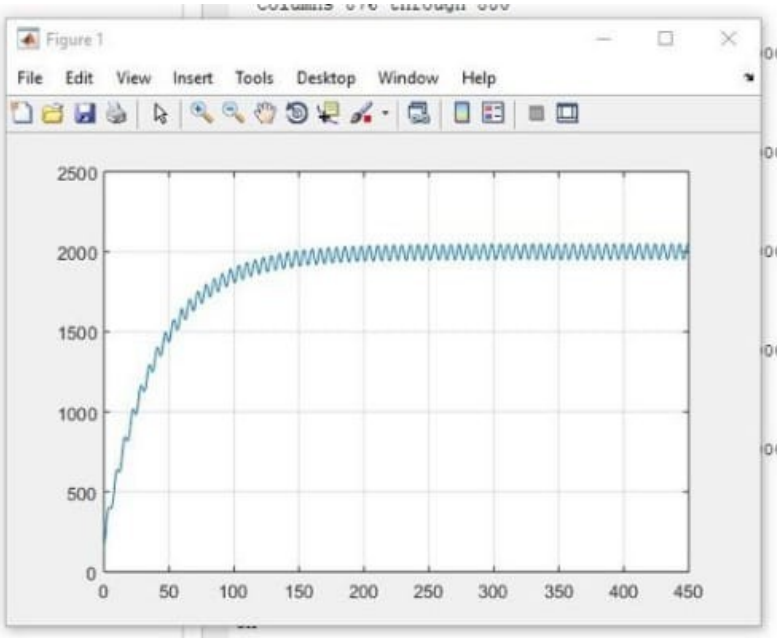
$y_0 = -1890$

So;

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

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

```
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
```




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

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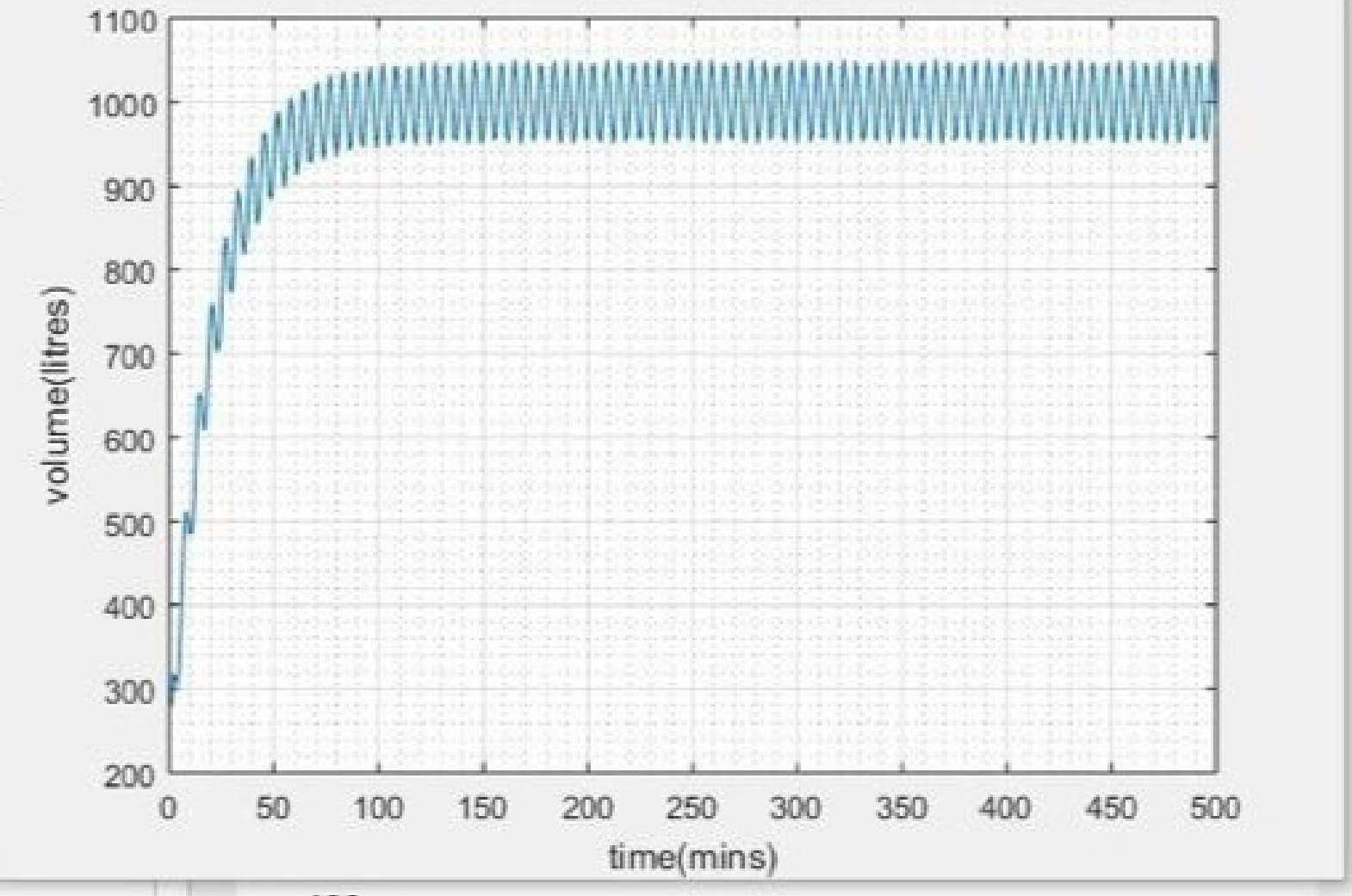

498
499
500

fx >>

```
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.

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')

```