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18/ENG02/042
Computer ENG

Accumulation Rate of Input - Output
Salt within system

$$\frac{dy}{dt} = y_{in} - y_{out} \quad --- (1)$$

since 50gal enter per minute and the gallon contains $(1+\sin t)$ lb ie the amount of salt entering tank is.

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

Since the tank contains 1200g al of water and mas out of 30gal per min

$$\frac{30gal}{1200gal} = \frac{1}{40} = 0.0251.625\% \text{ of salt per sin t}$$

the tank also leaves the tank per min

ie $y_{out} = 0.025y$ or 2.5% of y

therefore from formula (equ (1))

$$\frac{dy}{dt} = 50(1+\sin t)\frac{lb}{min} - 2.5\% \text{ of } y\frac{lb}{min}$$

$$\frac{dy}{dt} = 50(1+\sin t) - 0.025y$$

$$\frac{dy}{dt} = -0.025y + 50(1+\sin t)$$

$$\frac{dy}{dt} + 0.025y = 50(1+\sin t)$$

Using linear equation

$$\frac{dy}{dx} + Py = Q$$

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

$\int P.dt = 0.025t$ $I.f = e^{\int P dt} = e^{0.025t}$

$y \times I.f = \int Q \, I.f . dt$

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

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

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

Using integration by partial fraction

$$\int e^{0.025t}\sin t . dt$$

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

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

$$\int e^{0.025t}\sin t = e^{0.025t} - \cos t - \int \cos t \, 0.025e^{0.025} + c$$

$$= e^{0.025t}\cos t - \int \cos t \, 0.025e^{0.025} + c$$

$$= e^{0.025}\cos t + 0.025\int e^{0.025}\cos t + c$$

Using integration by partial fraction

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

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

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

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

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

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

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

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

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

$$Q + 0.000625Q = -e^{0.025t}\cos t + 0.025e^{0.025}$$

$$1.000625Q = -e^{0.025t}\cos t + 6.025e^{0.025}$$

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

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

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

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

Recall $ye^{0.025t} = 50\left[\frac{e^{0.025t}}{0.025} - \frac{e^{0.025t}}{1.000625}(\cos t - 0.025) + c\right]$

$ye^{0.025t} = 2000e^{0.025t} - \frac{50e^{0.025t}}{1.000625}(\cos t - 0.025) + 50c$

divide through by $e^{0.025t}$

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

When $y = 150$ lb and $t = 0$ mins

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

$150 = 2000 - 49.968(1) + 50c$

$150 = 1950.032 + 50c$

$\frac{18000032}{58} = \frac{50}{50}$

$c = -36.0064$ (Amount of salt instant at any time i.e y

```
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)
```

Command Window

New to MATLAB? See resources for Getting Started.

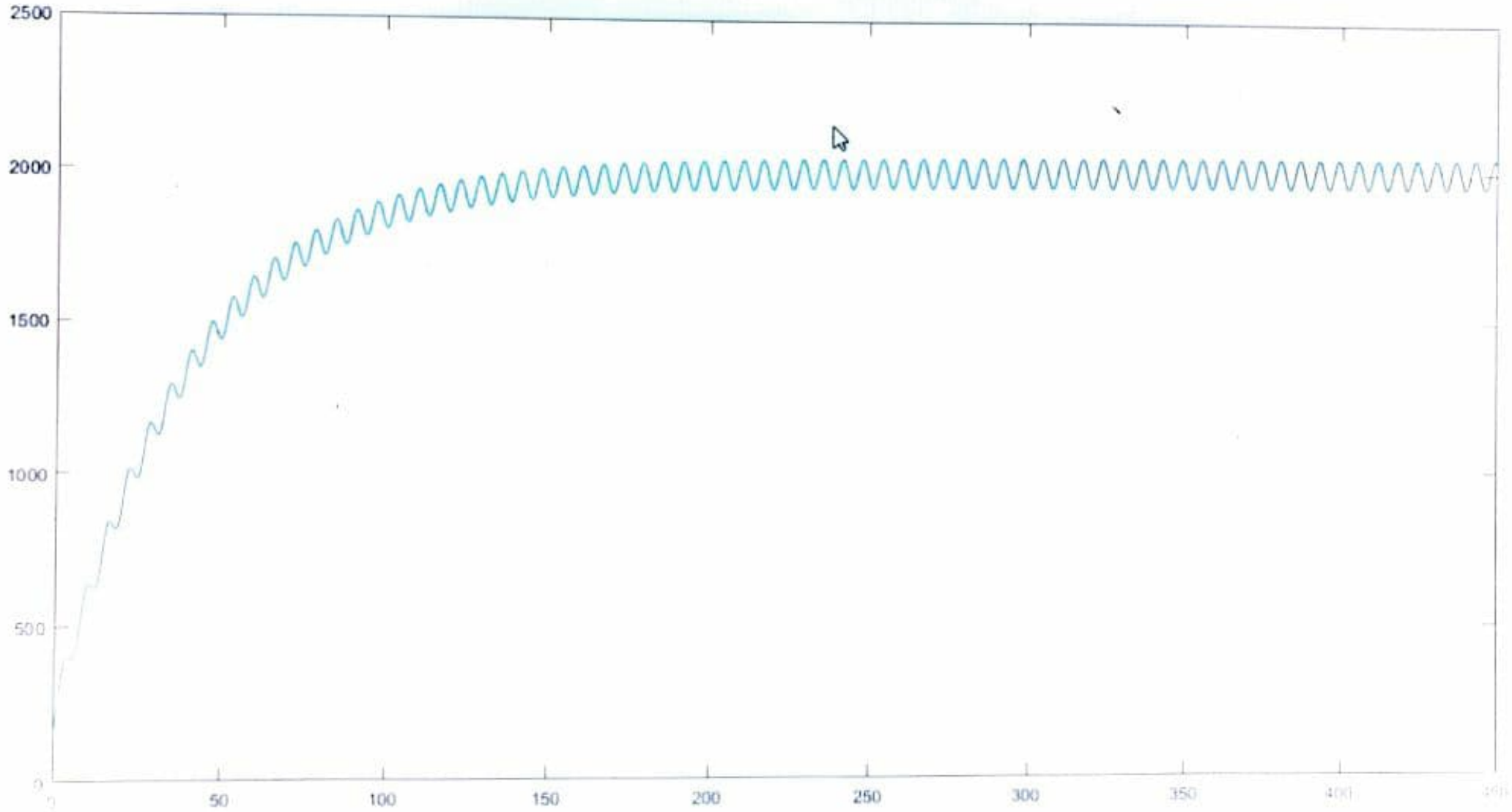
```
   445.5000   446.0000   446.5000   447.0000   447.5000   448.0000   448.5000   449.0000   449.5000   450.0

tn =

[ 150, 2000 - (2000*1601^(1/2)*cos(atan(1/40) + 1/2))/1601 - (2881850*exp(-1/80))/1601, 2000 - (20
>>
```

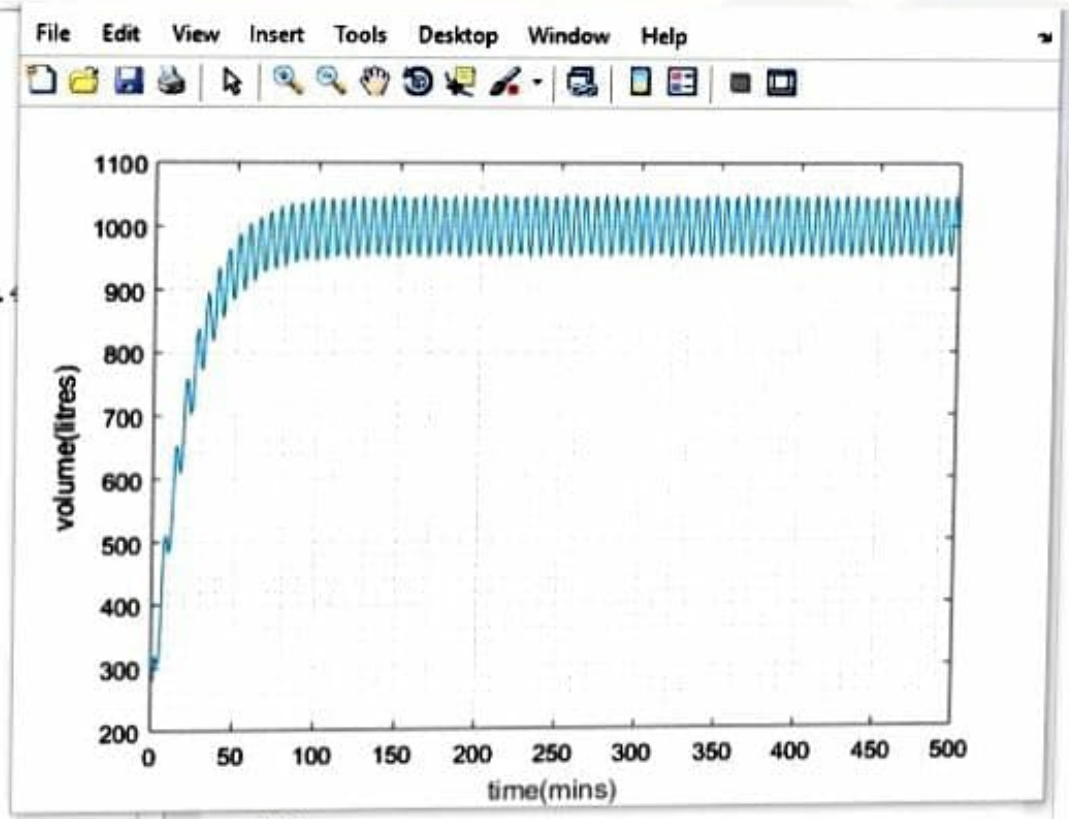
script

Insert Tools Desktop Window Help



```
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')
```




```
498
499
500
>>
```