EBONG PRINCE VINCENT
18IENG04028
ELECTRICAL ELECTRONICS
MATHS ENG282 ASSIGNMENT

1. Tank holds
- Input rate → 50gal of brine/min [1gal has (1+sint) lb of salt]
- Output rate → 30gal of brine/min

m => amount of salt of any time t

Using the blance Law

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

So gal of water enter per minute and a gallon has [(1+sint)]lb of salt

$\therefore m_2 = 50gal/min \times (1+sint) = 50(1+sint)\ lb/min$

If the tank contains 1200gal of water and 30gal of water leaves per minute. That means $\frac{30}{1200} = \frac{1}{40} = 0.025$

=> 2.5% of water in the tank leaves per minute. This also means that 2.5% of salt will also leave the tank per minute

$m_{out} => 2.5\%$ of m

$\frac{dm}{dt} = 50(1+sint) - 0.025m \longrightarrow (i)$

b. differentiating using integration factor method

$\frac{dm}{dt} + 0.025m = 50(sint + 1) \longrightarrow (ii)$

$\frac{dy}{dx} + Py = Q \left(\frac{dm}{dt} + Pm = Q \right)$

$P = 0.025, \quad Q = 50(sint + 1)$

$e^{\int p\,dt}$ = Integrating factor

$\int p\,dt = \int 0.025\,dt = 0.025t$

$IF \Rightarrow e^{0.025t}$

from $y \cdot IF = \int Q \cdot IF\,dx$

$m \cdot IF = \int Q \cdot IF\,dt$

$m \cdot e^{0.025t} = \int 50(\sin t + D)e^{0.025t}\,dt$

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

let $u = t/40 \Rightarrow \frac{du}{dt} = \frac{1}{40}$, $dt = 40\,du$

$= 40\int e^{u}(\sin 40u + 1)\,du$

$= \int e^{u}(\sin 40u + 1)\,du$

$q = \sin 40u + 1 \qquad dp = e^{u}\,du$

$dq = 40\cos 40u \qquad \int df = \int e^{v}\,dv$

$dq = 40(\cos 400)\,du \qquad p = e^{v}$

from $\int q\,dp = qp - \int p\,dq$

$\int 40e^{u}(\cos 40u)\,du = \int 40e^{v}(\cos 40u)\,dv$

$\int e^{u}\cos 40u\,du \Rightarrow$ let $q = \cos 400$ $dp = e^{v}du$

$\int e^{u}\cos 40u\,du = e^{u}\cos 400 - \int 40e^{u}(\sin 400)\,du$ — (iii)

integrating by

Integration by part

$q = -40\sin 40u$ $dp = e^{u}$

$dq = -1600(\cos 40u)\,du \qquad p = e^{u}$

$\int e^{u}\cos 40u\,du = e^{u}\cos 40u - (-40e^{u}\sin 40u - \int -1600e^{u}(\cos 40u\,du$

$1601\int e^{u}\cos 40u\,du = e^{u}\cos 40 + 40e^{u}\sin 40u$

$\int e^{u}\cos 40u\,du = \frac{e\cos 40 + 40e^{u}\sin 40u}{1601}$

$40\int e^{u}\cos 40u\,du = 40(40e^{v}\sin 40u + e^{v}\cos 40u)$ ——> iv

$\Rightarrow \int e^{u}(\sin 400 + 1)\,dx = e^{u}\sin 40u + 1 - \int 40e^{u}(\cos 40v\,du$

$\int e^{u}(\sin 40u + 1) \Rightarrow e^{u}\sin 40u + 1 - \frac{40(40e^{u}\sin 40v + ev\cos 40)}{1601}$

$$\int 40e^{u}\sin 40u\,du = \frac{40e^{u}(\sin 40u + 1) - 1600(40e^{u}\sin 40u + e^{u}(\cos 40u)}{1601}$$

Put $u = t/40$

$$\frac{40e^{t/40}(\sin t + 1) - 1600(40e^{t/40} + e^{t/40}(\cos t)(\cos t))}{1601}$$

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

$$\int 50 e^{t/40}(\sin t + 1)\,dt \Rightarrow \frac{2000e^{t/40}(\sin t - 40(\cos t + 1601) + c}{1601} \quad -(v)$$

Recall the original integration factor

$$m \cdot if = \int Q \cdot if\,dt$$

$$m \cdot e^{0.025} = \int 150(\sin t + 1)\cdot e^{0.025t}\,dt$$

$$m \cdot e^{0.025t} = \frac{2000e^{0.025}(\sin t - 40(\cos t + 1601) + c}{1601}$$

$$m = \frac{2000(\sin t - 40(\cos t + 1601) + m_0 \cdot e^{-0.025t}}{1601} \longrightarrow (vi)$$

at $t = 0$ min

and $m = 150$ lb of salt

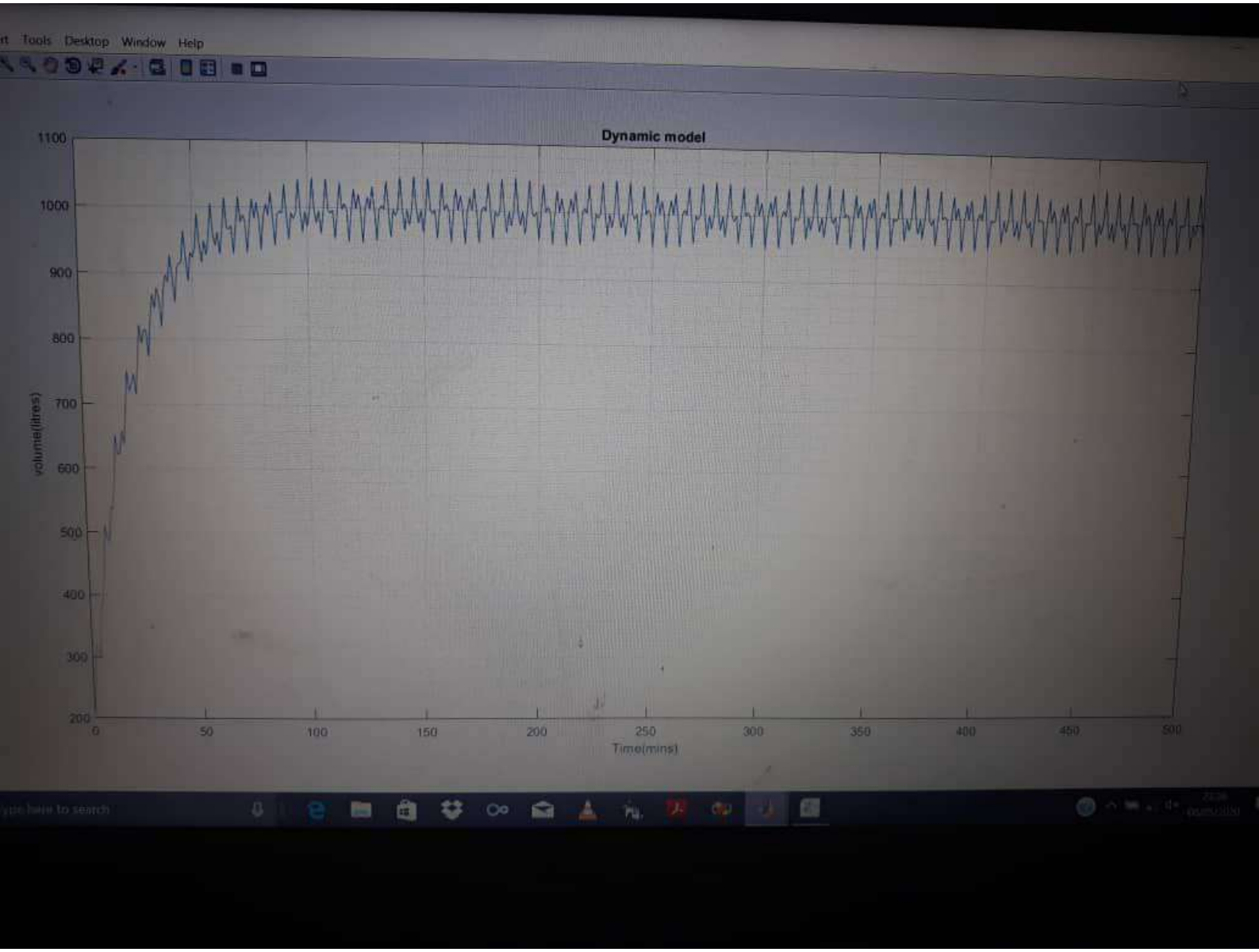
$$150 = \frac{2000(\sin 0 - 40(\cos(0) + 1601) + m_0 \cdot 1}{1601}$$

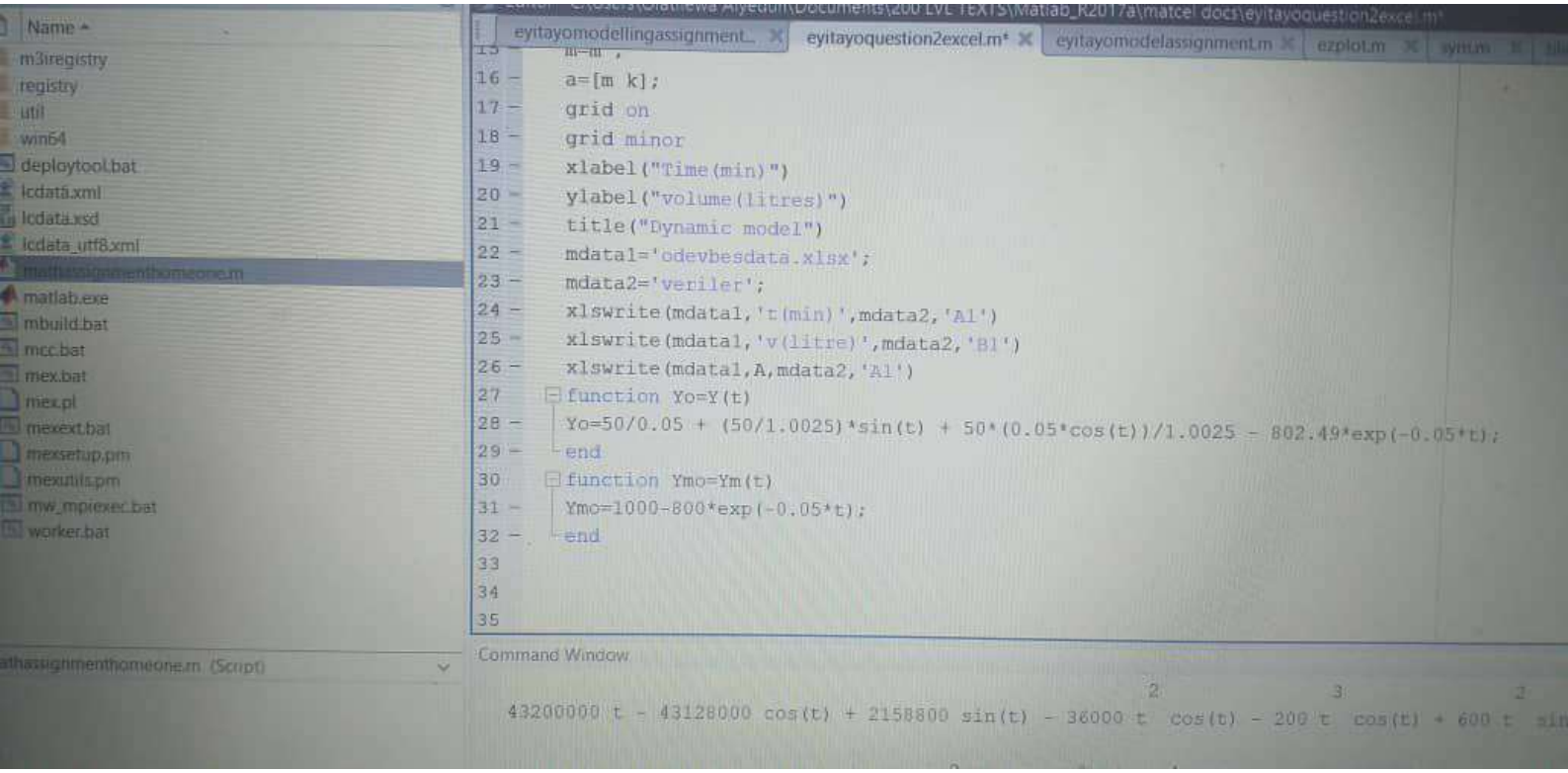
$$150 = 1950.03 + m_0$$

$$m_0 = -1800.03$$

put m_0 in equation (vi)

$$m = \frac{2000(\sin t - 40\cos t + 1601)}{1601} - \frac{1800.03}{e^{0.025t}}$$


Tools Desktop Window Help
Dynamic model
volume(litres)
Time(mins)
1100
1000
900
800
700
600
500
400
300
200
0
50
100
150
200
250
300
350
400
450
500


Name
m3iregistry
registry
util
win64
deploytool.bat
lcdata.xml
lcdata.xsd
lcdata_utf8.xml
matlab.exe
mbuild.bat
mcc.bat
mex.bat
mex.pl
mexext.bat
mexsetup.pm
mexutils.pm
mw_mpiexec.bat
worker.bat
eyitayomodellingassignment...
eyitayoquestion2excel.m*
eyitayomodelassignment.m
ezplot.m
a=[m k];
grid on
grid minor
xlabel("Time(min)")
ylabel("volume(litres)")
title("Dynamic model")
mdata1='odevbesdata.xlsx';
mdata2='veriler';
xlswrite(mdata1,'t(min)',mdata2,'A1')
xlswrite(mdata1,'v(litre)',mdata2,'B1')
xlswrite(mdata1,A,mdata2,'A1')
function Yo=Y(t)
Yo=50/0.05 + (50/1.0025)*sin(t) + 50*(0.05*cos(t))/1.0025 - 802.49*exp(-0.05*t);
end
function Ymo=Ym(t)
Ymo=1000-800*exp(-0.05*t);
end
Command Window
43200000 t - 43128000 cos(t) + 2158800 sin(t) - 36000 t cos(t) - 200 t cos(t) + 600 t sin

eyitayomodellingassignment... | eyitayoquestion2excel.m*

```
1 -  commandwindow
2 -  clear
3 -  clc
4 -  m=[0:1:500];
5 -  k=[];
6 -  for i=m
7 -      if(mod(i,2)==0)
8 -          k=[k Y(i)];
9 -      else
10 -         k=[k Ym(i)];
11 -     end
12 - end
13 - plot(m,k)
14 - k=k';
15 - m=m';
16 - a=[m k];
17 - grid on
18 - grid minor
19 - xlabel("Time(min)")
20 - ylabel("volume(litres)")
```

Command Window

$$43200000\,t - 43128000\cos(t) + 2158800\sin(t) -$$

$$\cos(t) + 72000\,t\sin(t) + 1080000\,t^{2} + 12000$$

fx >>