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18/ENG02/066
Computer Eng

1)(a) Amount of salt = m
Time = t

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

Input => 50gal/min
1gal => $(1 + \sin t)$

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

~~$= 50(1 + 50$~~

$= 50(1 + \sin t) \frac{lb}{min}$

* Tank contains 1200gal of water
30gal leave per minute

$\frac{30}{1200} = \frac{1}{40} = 0.025$
$= 2.5\%$

* That means 2.5% of the salt in tank will also leave the tank per minute
m_{out} = 2.5% of m

$\therefore \frac{dm}{dt} \frac{lb}{min} = 50(1 + \sin t) \frac{lb}{min} - 2.5\% m \frac{lb}{min}$

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

$\frac{dm}{dt} + 0.025m = 50(1 + \sin t)$ ——— (i)

* Using integrating factor to solve differential equation

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

$IF = e^{\int P dt}$
$= e^{\int 0.025 dt}$
$= e^{0.025t}$

$m \cdot e^{0.025t} = 50 \int (1 + \sin t)(e^{0.025t})$ ——— (ii)

R.H.S
Using integration by parts

$u = \sin t$ $\quad du = \cos t$
$dv = e^{0.025t}$ $\quad \int dv = \int e^{0.025t}$
$v = \frac{1}{0.025} e^{0.025t} = 40 e^{0.025t}$

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

$$= (\sin t \cdot 40e^{0.025t}) - \int (40e^{0.025t})(\cos t)$$

$$= 40\sin t\, e^{0.025t} - 40\left[(\cos t \cdot 40^{0.025t}) + \int (40e^{0.025t} \cdot \sin t)\right]$$

$$A = (\sin t)(40e^{0.025t}) - 40\left[\cos t\,(40e^{0.025t})\right] - 1600$$

$$= (\sin t)(40e^{0.025t}) - 1600\, e^{0.025t}\cos t$$

$$50\int e^{0.025t} = 2000e^{0.025t}$$

$$m \cdot e^{0.025t} = 2000e^{0.025t} + 50A$$

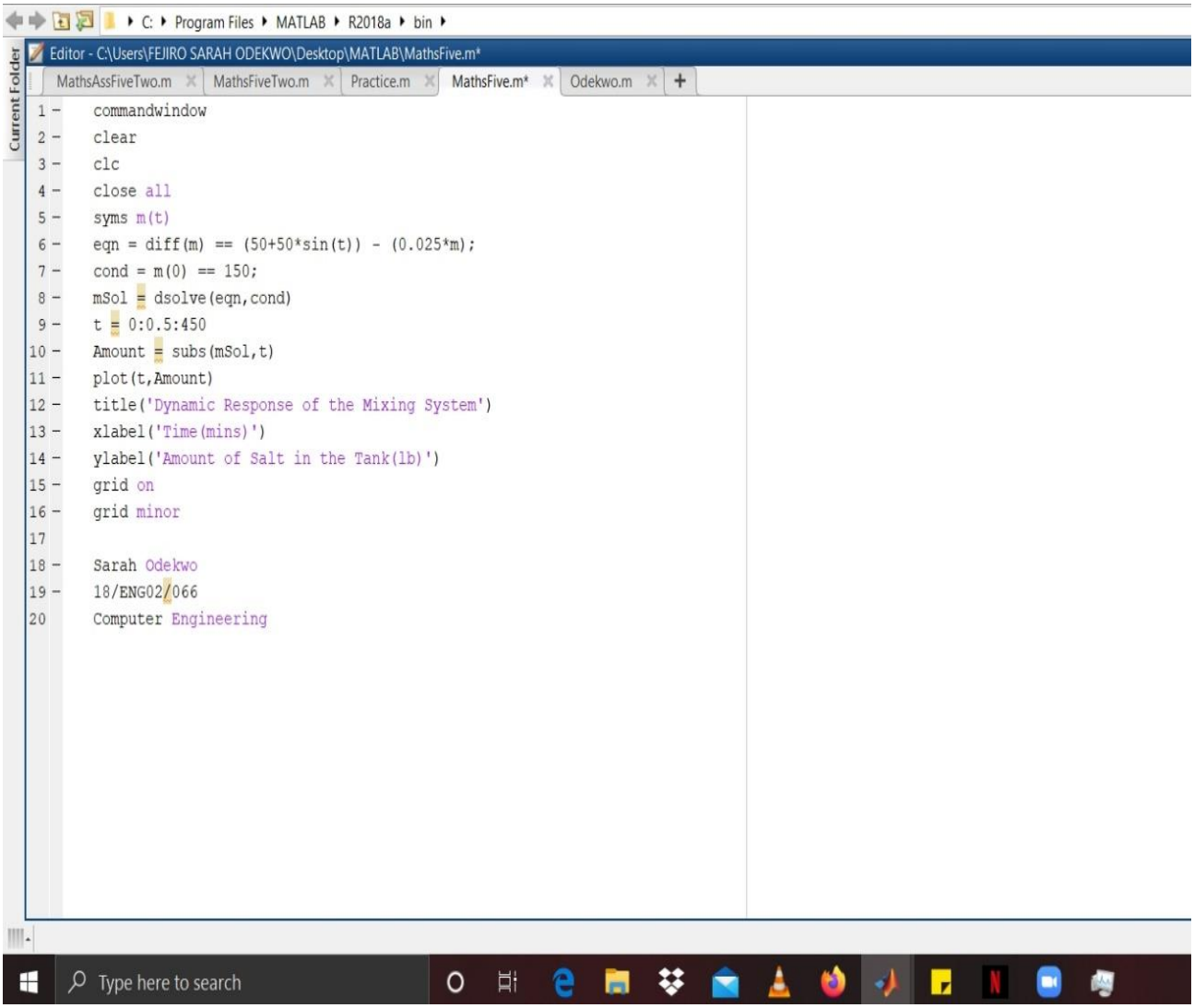
$$m = \frac{2000 - 80000}{1601} + C$$

when $t = 0$;

$m = 1501b$

$C = 1800.03$

$$m = 2000 - \frac{2000(\sin t)}{1601} - \frac{80000e^{0.025}}{1601}$$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MathsAssFiveTwo.m
MathsFiveTwo.m
Practice.m
MathsFive.m*
Odekwo.m
1 commandwindow
2 clear
3 clc
4 close all
5 syms m(t)
6 eqn = diff(m) == (50+50*sin(t)) - (0.025*m);
7 cond = m(0) == 150;
8 mSol = dsolve(eqn,cond)
9 t = 0:0.5:450
10 Amount = subs(mSol,t)
11 plot(t,Amount)
12 title('Dynamic Response of the Mixing System')
13 xlabel('Time(mins)')
14 ylabel('Amount of Salt in the Tank(lb)')
15 grid on
16 grid minor
17
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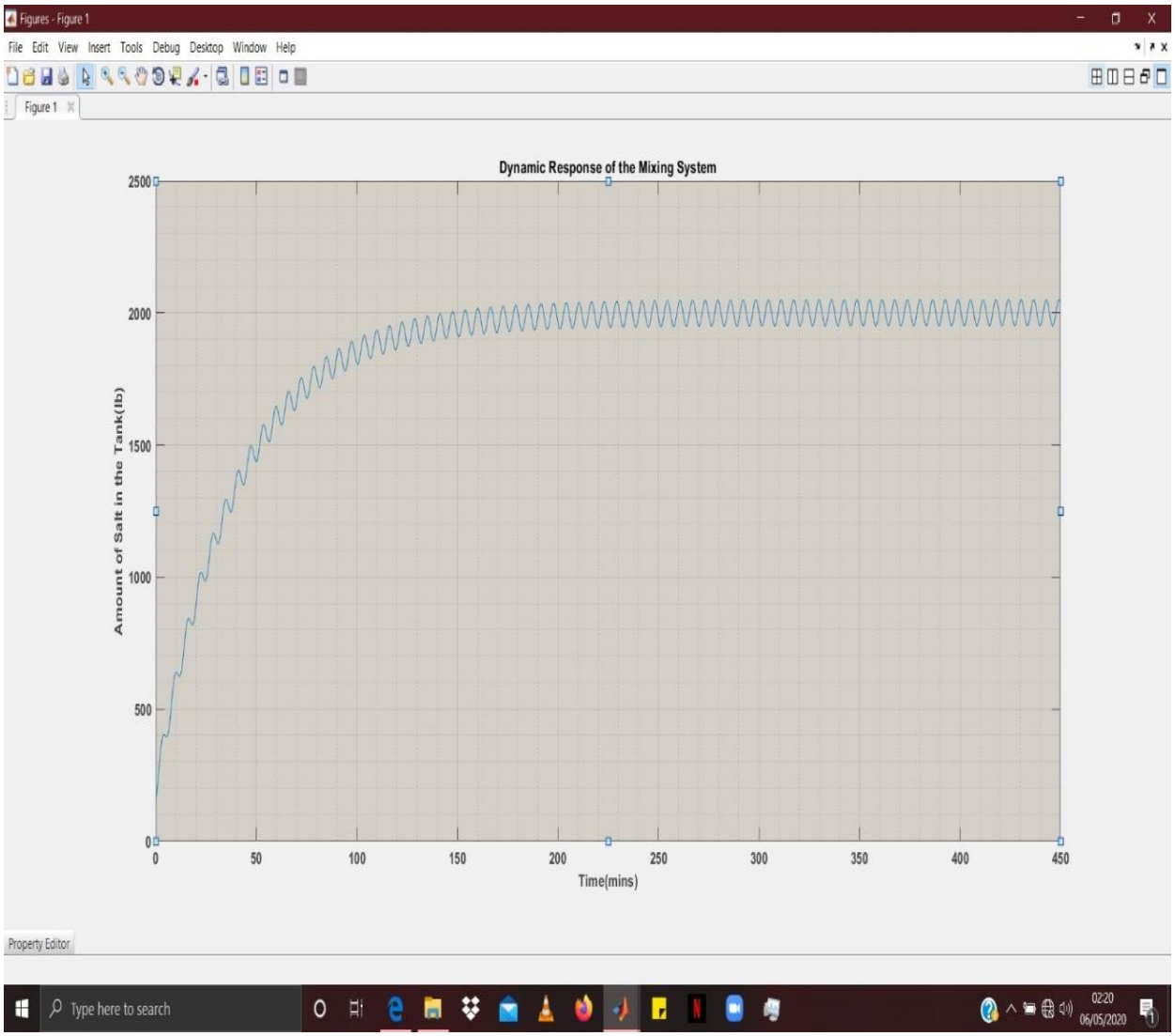
Figures - Figure 1
File Edit View Insert Tools Debug Desktop Window Help
Figure 1
Dynamic Response of the Mixing System
Amount of Salt in the Tank(lb)
Time(mins)
0
500
1000
1500
2000
2500
0
50
100
150
200
250
300
350
400
450
Property Editor
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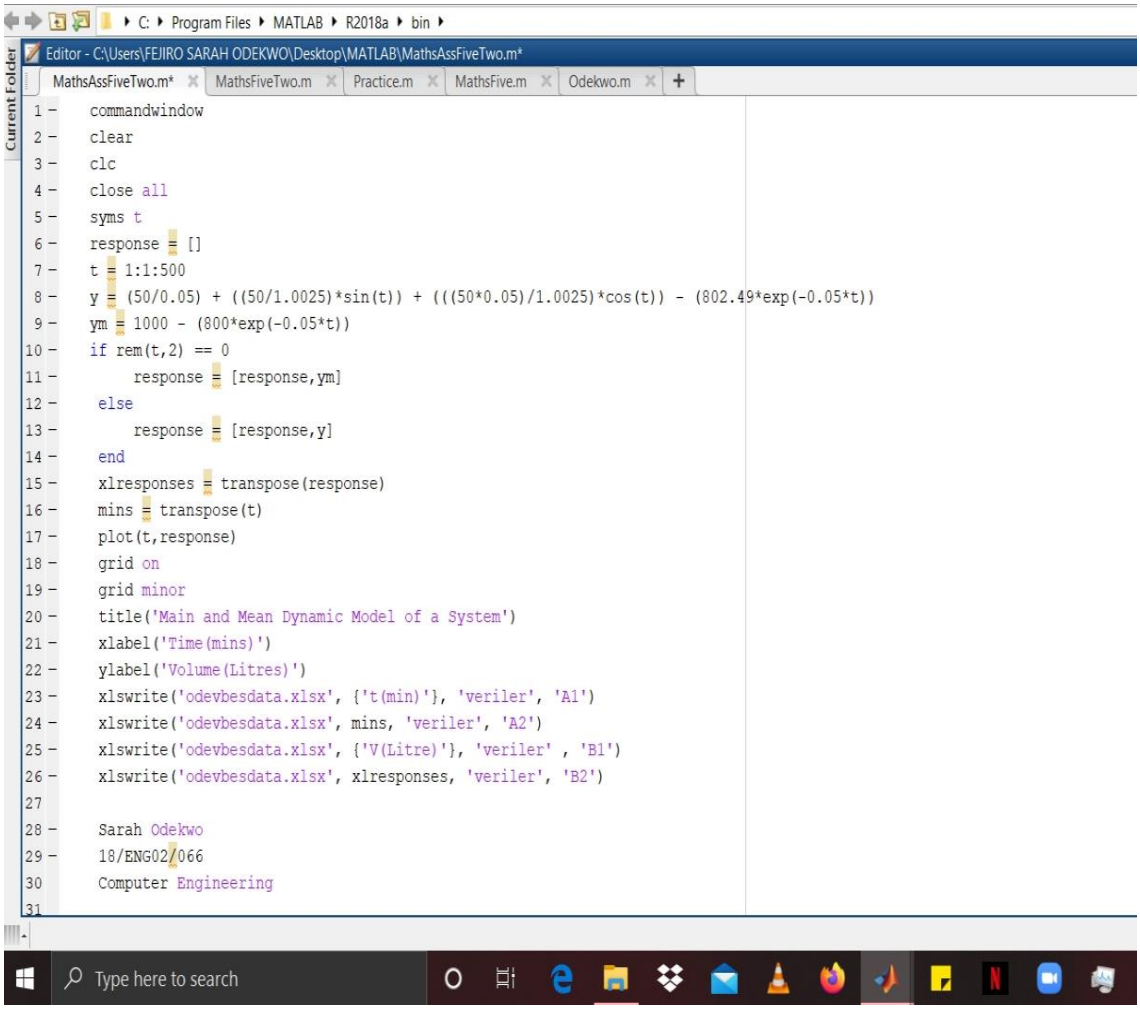
02:20
06/05/2020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MathsAssFiveTwo.m*
MathsFiveTwo.m
Practice.m
MathsFive.m
Odekwo.m
Current Folder
1 – commandwindow
2 – clear
3 – clc
4 – close all
5 – syms t
6 – response = []
7 – t = 1:1:500
8 – y = (50/0.05) + ((50/1.0025)*sin(t)) + (((50*0.05)/1.0025)*cos(t)) - (802.49*exp(-0.05*t))
9 – ym = 1000 - (800*exp(-0.05*t))
10 – if rem(t,2) == 0
11 – response = [response,ym]
12 – else
13 – response = [response,y]
14 – end
15 – xlresponses = transpose(response)
16 – mins = transpose(t)
17 – plot(t,response)
18 – grid on
19 – grid minor
20 – title('Main and Mean Dynamic Model of a System')
21 – xlabel('Time(mins)')
22 – ylabel('Volume(Litres)')
23 – xlswrite('odevbesdata.xlsx', {'t(min)'}, 'veriler', 'A1')
24 – xlswrite('odevbesdata.xlsx', mins, 'veriler', 'A2')
25 – xlswrite('odevbesdata.xlsx', {'V(Litre)'}, 'veriler' , 'B1')
26 – xlswrite('odevbesdata.xlsx', xlresponses, 'veriler', 'B2')
27
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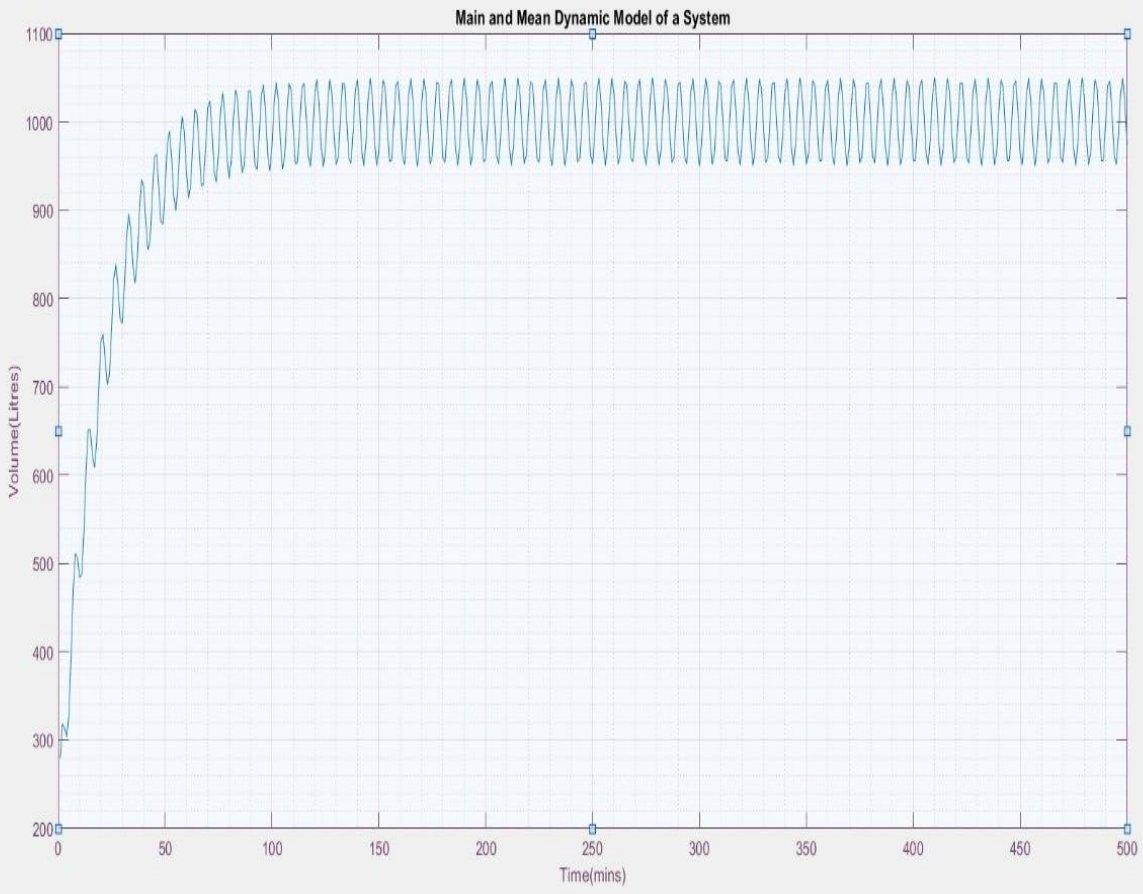

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