

18/ENC704/008

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Department: Electrical/Electronics

Course: ENC7282

Matric No: 18/ENC704/008

Question 1

a) $\frac{dm}{dt} = M_{in} - M_{out}$

$$M_{in} = 50 \frac{\text{gal}}{\text{min}} \times (1 + \sin ct) \frac{\text{lbs}}{\text{gal}}$$

$$= 50(1 + \sin ct) \frac{\text{lbs}}{\text{min}}$$

$$= 50 + 50 \sin ct \frac{\text{lbs}}{\text{min}}$$

$$M_{out} = 30 \frac{\text{M}}{1200 + 20t} \times 30 \frac{\text{gal}}{\text{min}} \left[(50 \text{gal} - 30 \text{gal}) t \right]$$

$$= \frac{30 \text{ M}}{1200 + 20t} \frac{\text{lbs}}{\text{min}} = 20t \text{ M}$$

$$= \frac{30}{120 + 2t}$$

$$\therefore \frac{dm}{dt} = 50 + 50 \sin ct - \frac{30}{120 + 2t}$$

$$\frac{dm}{dt} + \frac{30}{120 + 2t} = 50 + 50 \sin ct$$

Using integrating factor

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

$$\therefore P = \frac{3}{120 + 2t} \quad \therefore \int P dt = \int \frac{3}{120 + 2t}$$

$$= \int \frac{3}{120 + 2t} dt = \frac{3}{2} \ln(120 + 2t)$$

$$\therefore \int P dt = e^{\frac{3}{2} \ln(120 + 2t)} = e^{\frac{3}{2} \ln(120 + 2t)}$$

$$I \cdot f = (120 + 2t)^{3/2}$$

$$y \cdot If = \int Q \cdot If \, dx$$

$$\therefore M \cdot If = \int Q \cdot If \, dt$$

$$\therefore M \cdot If = \int (50 + 50 \sin ct) \cdot (120 + 2t)^{3/2} \, dt$$

$$If = (120 + 2t)^{3/2} \cdot M = \int (50 + 50 \sin ct) (120 + 2t)^{3/2} \, dt$$

$$\therefore (120 + 2t)^{3/2} \cdot M = \int (50 + 50 \sin ct) (120 + 2t)^{3/2} \, dt$$

v) solving manually

$$(120 + 2t)^{3/2} \cdot M = \int (50 + 50 \sin ct) (120 + 2t)^{3/2} \, dt$$

$$\therefore \int (50 + 50 \sin ct) (120 + 2t)^{3/2} \, dt$$

$$(120 + 2t)^{3/2} M = 4320000t - 43128000 \cos ct + 2158800 \sin ct$$

$$- 36000t^2 \cos ct - 250t^3 \cos ct + 600t^2 \sin ct$$

$$- 2158800t \cos ct + 72000t \sin ct + 1080000t^2$$

$$+ 12000t^3 + 50t^4 + C$$

$\therefore At \, t = 0$

$$\therefore M = \frac{43200000}{(120 + 2t)^{3/2}} - \frac{43128000 \cos ct}{(120 + 2t)^{3/2}} + \frac{2158800 \sin ct}{(120 + 2t)^{3/2}}$$

$$- \frac{3600t^2 \cos ct}{(120 + 2t)^{3/2}} - \frac{250t^3 \cos ct}{(120 + 2t)^{3/2}} + \frac{600t^2 \sin ct}{(120 + 2t)^{3/2}}$$

$$- \frac{2158800t \cos ct}{(120 + 2t)^{3/2}} + \frac{72000t \sin ct}{(120 + 2t)^{3/2}} + \frac{1080000t^2}{(120 + 2t)^{3/2}}$$

$$+ \frac{12000t^3}{(120 + 2t)^{3/2}} + \frac{50t^4}{(120 + 2t)^{3/2}} + \frac{C}{(120 + 2t)^{3/2}}$$

$\therefore At \, t = 0, \quad M = 150$

$$\therefore 150 = 0 - \frac{43128000 \cos(0) + 2158800 \sin(0)}{(120 + 2(0))^{3/2}} - 0$$

$$- 0 + 0 - 0 + 0 + 0 + 0 + C$$

$$(120 + 2(0))^{3/2}$$

$$150 = \frac{-43128000}{(120)^{3/2}} + \frac{C}{(120)^{3/2}}$$

$$150 = \frac{-43128000}{1314.53}$$

$$150 = -32808.5811 + 0.0007607C$$

$$0.0007607C = 150 + 32808.5811$$

$$0.0007607C = 32958.5811$$

$$C = \frac{32958.5811}{0.0007607}$$

$$C = 4332664.796$$

$$C = M_0$$

$$M = \frac{43200000t}{(120+2t)^{3/2}} - \frac{43128000 \cdot \cos(2t)}{(120+2t)^{3/2}} + \frac{2158800 \sin(2t)}{(120+2t)^{3/2}}$$

$$- \frac{3600t^2 \cos(2t)}{(120+2t)^{3/2}} - \frac{200t^3 \cos(2t)}{(120+2t)^{3/2}} + \frac{600t^2 \sin(2t)}{(120+2t)^{3/2}}$$

$$- \frac{21558800 + \cos(2t)}{(120+2t)^{3/2}} + \frac{72000t \sin(2t)}{(120+2t)^{3/2}} + \frac{1280000t^2}{(120+2t)^{3/2}}$$

$$+ \frac{12000t^3}{(120+2t)^{3/2}} + \frac{50t}{(120+2t)^{3/2}} + \frac{332664.796}{(120+2t)^{3/2}}$$

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- lcdata.xsd
- lcdata_utf8.xml
- mathassignmenthomeone.m
- matlab.exe
- mbuild.bat
- mcc.bat
- mex.bat
- mex.pl
- mexext.bat
- mexsetup.pm
- mexutils.pm
- mw_mpiexec.bat
- worker.bat

```

1  commandwindow
2  clear all
3  clc
4  syms m(t) t
5  eqn=diff(m,t)== (50+ 50*sin(t))- 3*m/(120+(2*t));
6  cond=m(0)==150;
7  ysol =dsolve(eqn,cond);
8  Ysol=simplify(ysol);
9  figure;
10 x =0:0.5:450
11     plot(x,subs(Ysol,x))
12     grid on
13     grid minor
14     xlabel("Time (min)")
15     ylabel("Amount of salt(lb)")
16     title("DYNAMIC RESPONSE OF THE SYSTEM")
    
```

Command Window

438.0000 438.5000 439.0000 439.5000 440.0000 440.5000

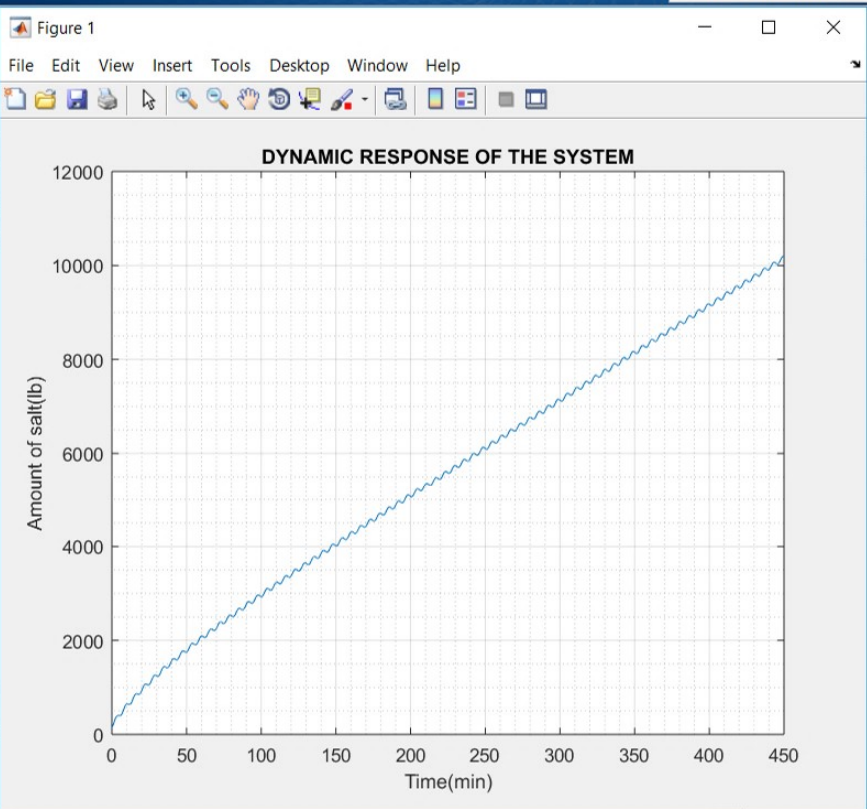
Columns 889 through 900

444.0000 444.5000 445.0000 445.5000 446.0000 446.5000 447.0000 447.5000 448.0000 448.5000 449.0000 449.5000

Column 901

450.0000

fx >>



Value

- 1x1 sym
- 1x1 symfun
- 1x1 symfun
- 1x1 sym
- 1x901 double
- 1x1 sym
- 1x1 sym

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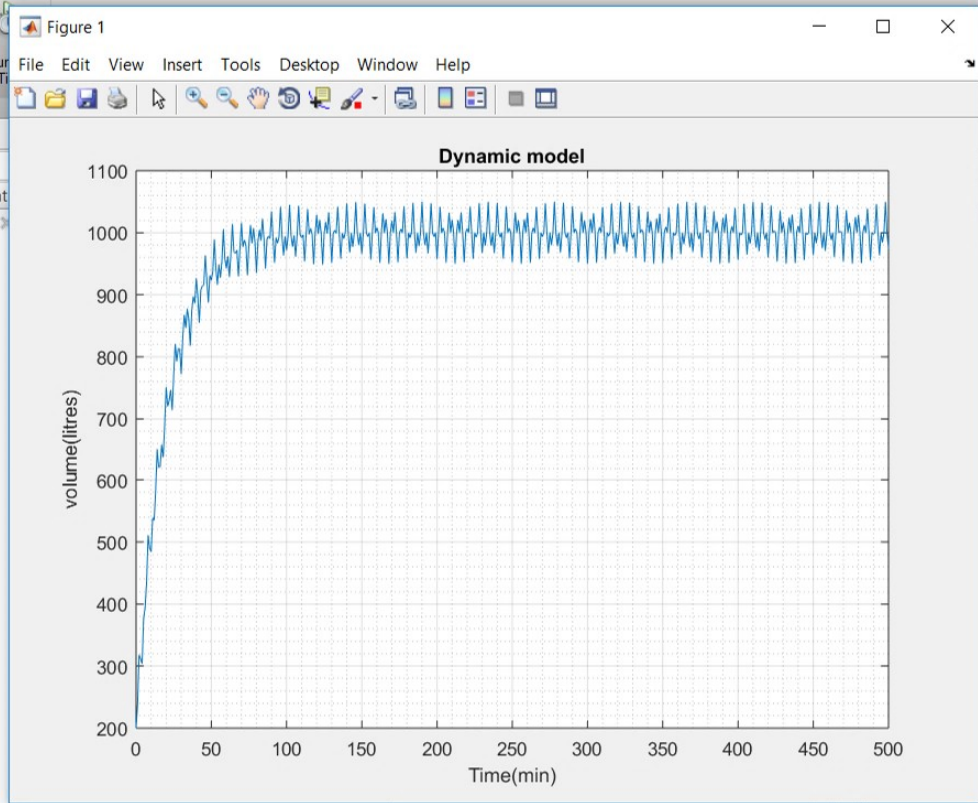
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Current Folder: C:\Program Files\MATLAB\R2017a\bin

```

1  commandwindow
2  clear
3  clc
4  x=[0:1:500];
5  z=[];
6  for i=x
7      if(mod(i,2)==0)
8          z=[z Y(i)];
9      else
10         z=[z Ym(i)];
11     end
12 end
13 plot(x,z)
14 z=z';
15 x=x';
16 a=[x z];
17 grid on
18 grid minor
19 xlabel("Time (min)")
20 ylabel("volume (litres)")
21 title("Dynamic model")
22 mdata1='odevbesdata.xlsx';
23 mdata2='veriler';
24 xlswrite(mdata1,'t (min)',mdata2,'A1')
25 xlswrite(mdata1,'v (litre)',mdata2,'B1')
26 xlswrite(mdata1,A,mdata2,'A1')
27 function Yo=Y(t)
28 Yo=50/0.05 + (50/1.0025)*sin(t) + 50*(0.05*cos(t))/1.0025 - 802.49*exp(-0.05*t);

```



Value
 501x2 double
 500
 'odevbesdata.xlsx'
 'veriler'
 501x1 double
 501x1 double

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Insert fx
 Comment %
 Indent

Breakpoints Run Run and Advance Advance Run and Time

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- mexutils.pm
- mw_mpiexec.bat
- worker.bat

mathassignmenthomeone.m (Script)

```

7   if(mod(i,2)==0)
8       z=[z Y(i)];
9   else
10      z=[z Ym(i)];
11  end
12  end
13  plot(x,z)
14  z=z';
15  x=x';
16  a=[x z];
17  grid on
18  grid minor
19  xlabel("Time (min)")
20  ylabel("volume (litres)")
21  title("Dynamic model")
22  mdata1='odevbesdata.xlsx';
23  mdata2='veriler';
24  xlswrite(mdata1,'t(min)',mdata2,'A1')
25  xlswrite(mdata1,'v(litre)',mdata2,'B1')
26  xlswrite(mdata1,A,mdata2,'A1')
27  function Yo=Y(t)
28  Yo=50/0.05 + (50/1.0025)*sin(t) + 50*(0.05*cos(t))/1.0025 - 802.49*exp(-0.05*t);
29  end
30  function Ymo=Ym(t)
31  Ymo=1000-800*exp(-0.05*t);
32  end
33
34

```

