

NAME: APENA ADEOULUWASEMIPE KAREEM

DEPT: MECHATRONICS

MATRIC NO.: 18/ENG05/010

Apena Adeouluwasemipe Kareem
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Mechatronics

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

using the linear equation method
 $\frac{dy}{dx} + Py = Q$
 $\therefore P = 0.025, Q = 50(1 + \sin t)$
 $\therefore S.P.H = 0.025t$
Integrating factor = $e^{SP.H}$
 $I = e^{0.025t}$
 $\Rightarrow y = I.F. \int Q I.F. dt$

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

using Integration by part:
 $\int e^{0.025t} \sin t dt$
 $u = e^{0.025t} \quad dv = \sin t$
 $du = 0.025 e^{0.025t} \quad v = -\cos t$
 $\therefore \int e^{0.025t} \sin t dt = e^{0.025t} \cdot -\cos t - \int -\cos t \cdot 0.025 e^{0.025t} dt$
 $\int e^{0.025t} \sin t dt = -e^{0.025t} \cos t - \int -\cos t \cdot 0.025 e^{0.025t} dt + C$
 $\int e^{0.025t} \sin t dt = -e^{0.025t} \cos t + 0.025 \int e^{0.025t} \cos t dt + C$

Using Integration by part
 $\int u dv = uv - \int v du$

$$\begin{aligned}
 W &= e^{-0.025t} \frac{d}{dt} (e^{0.025t} y) \\
 &= -0.025 e^{-0.025t} y + e^{-0.025t} y' \\
 &= -e^{-0.025t} \cos t + 0.025 \int e^{-0.025t} \sin t - \int \sin t \cdot e^{-0.025t} e^{0.025t} \\
 &= -e^{-0.025t} \cos t + 0.025 \int e^{-0.025t} \sin t - e^{-0.025t} \sin t + e^{-0.025t} \cos t \\
 &\quad \text{Let } Q = \int e^{-0.025t} \sin t
 \end{aligned}$$

$$\begin{aligned}
 \Rightarrow Q &= -e^{-0.025t} \cos t + 0.025 \int e^{-0.025t} \sin t - 0.025 Q \\
 Q &= -e^{-0.025t} \cos t + 0.025 e^{-0.025t} \sin t - 6.25^{-1} Q \\
 Q + 6.25^{-1} Q &= -e^{-0.025t} \cos t + 0.025 e^{-0.025t} \sin t \\
 Q + 0.000625 Q &= -e^{-0.025t} \cos t + 0.025 e^{-0.025t} \sin t \\
 1.000625 Q &= -e^{-0.025t} \cos t + 0.025 e^{-0.025t} \sin t \\
 1.000625 Q &= e^{-0.025t} (\cos t - 0.025 \sin t) \\
 Q &= \frac{-e^{-0.025t} (\cos t - 0.025 \sin t) + C}{1.000625}
 \end{aligned}$$

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

$$\text{since } \int e^{-0.025t} \sin t = \frac{-e^{-0.025t} (\cos t - 0.025 \sin t) + C}{1.000625}$$

$$\Rightarrow y e^{0.025t} = 50 \int \frac{-e^{-0.025t} (\cos t - 0.025 \sin t) + C}{1.000625}$$

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

$$\text{divide through by } e^{0.025t} \\
 y = \frac{2000 - 50 (\cos t - 0.025 \sin t) + \frac{50C}{e^{0.025t}}}{1.000625}$$

$$\text{when } y = 150 \\
 t = 0$$

$$150 = \frac{2000 - 50 (1 - 0) + 50C}{1.000625} \quad \Rightarrow 150 \cdot 0.99937 = 50C \\
 C = -36.00064$$

$$150 = 2000 - 49.468(1) + 50C$$

$$150 = 1950.532 + 50C$$

```

1 - Commandwindow
2 - clear
3 - close all
4
5 - syms m(t)
6
7 - in = 50*(1 + sin(t))
8 - out = (30/1200)*m
9 - rate = diff(m, t)
10 - m = dsolve(rate == in - out, m(0) == 150)
11
12 - t = 0:0.5:450
13 - x = subs(m, t)
14
15 - plot(t, x)
16 - grid on
17 - grid minor
18 - xlabel('time(hours)')
19 - ylabel('amount of salt(lb)')

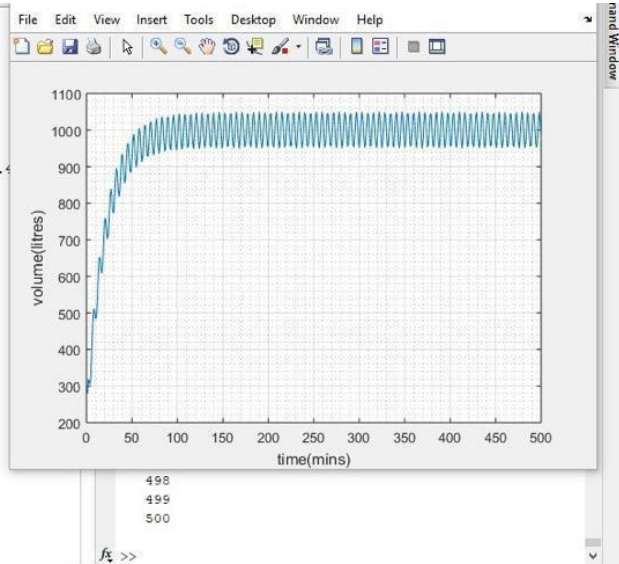
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Command Window

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1 - commandwindow
2 - clear
3 - clc
4 - close all
5 - syms t
6 - values=[]
7 - t=1:1:500
8 - mean=1000-((exp(-0.05*t))*800)
9 - y=1000+(50/1.0025)*sin(t)+(2.5/1.0025)*cos(t)-((exp(-0.05*t))*802.4
10
11 - if rem(t,2) ==0
12 -     values=[values,mean]
13 - else
14 -     values=[values,y]
15 - end
16 - excelvalues=transpose(values)
17 - mins=transpose(t)
18 - plot(t,values)
19 - grid on
20 - grid minor
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',excelvalues,'veriler','B2')
27

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From

$$\frac{dy}{dt} = y - y \sin t$$

$$\frac{dy}{dt} = 50(1 + \sin t) - 2.5y$$

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

\therefore by separating the variables

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

Multiply both sides by dt

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

$$\frac{0.025y^2}{2} = \int 50 + 50 \sin t dt$$

$$\frac{0.025y^2}{2} = 50t - 50 \cos t + C$$

$$0.0125y^2 = 50t - 50 \cos t + C$$

MUS by 0.0125

$$y^2 = 4000t - 4000 \cos t + 80C$$

$$y^2 = 4000(t - \cos t) + 80C$$

$$y = \sqrt{4000(t - \cos t) + 80C}$$