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Chemical Engineering
14/EK401/019

4e^{3x}
12e^{3x}

$$1a) \frac{dm}{dt} = M_{in} - M_{out}$$

$$\frac{dm}{dt} = 50(1 + \sin t) - 2.5\% \text{ of } m$$

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

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

$$50(1 + \sin t) \times dt = \frac{dm}{dt}$$

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

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

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

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

$$\Rightarrow m \times I.F = \int Q \cdot I.F dt$$

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

$$\Rightarrow m e^{0.025t} = 50 \int e^{0.025t} + \sin t e^{0.025t} dt + C$$

$$\Rightarrow m e^{0.025t} = 50 \times \frac{e^{0.025t}}{0.025} \text{ or } 50e^{t/40}$$

$$\int \sin t e^{0.025t} dt \rightarrow \text{Integration by Part}$$

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

$$\Rightarrow u = \sin t, du = \cos t, dv = e^{0.025t}, v = \frac{e^{0.025t}}{0.025} \text{ or } 40e^{t/40}$$

$$\Rightarrow 40e^{t/40} \sin t - \int 40e^{t/40} \cos t$$

$$\Rightarrow 40e^{t/40} \sin t - \int 40e^{t/40} \cos t$$

$\frac{1}{40}$
 $40 \times \frac{1}{40}$

$$\int 40e^{t/40} \cos t$$

$$u = \cos t \quad dv = 40e^{t/40}$$

$$du = -\sin t \quad v = 1600e^{t/40}$$

$$\Rightarrow \cos t 1600e^{t/40} - \int 1600e^{t/40} \times -\sin t$$

$$\Rightarrow \cos t 1600e^{t/40} + \int 1600e^{t/40} \sin t$$

$$\Rightarrow 40e^{t/40} \sin t - \left[\cos t 1600e^{t/40} + \int 1600e^{t/40} \sin t dt \right]$$

$$\Rightarrow 40e^{t/40} \sin t - \left[\cos t 1600e^{t/40} + 1600 \int e^{t/40} \sin t dt \right]$$

$$\Rightarrow \int e^{t/40} \sin t = \frac{40e^{t/40} \sin t}{40} - 1600e^{t/40} \cos t - 1600 \int e^{t/40} \sin t dt$$

$$\Rightarrow 1601 \int e^{t/40} \sin t = 40e^{t/40} \sin t - 1600e^{t/40} \cos t$$

$$\Rightarrow \int e^{t/40} \sin t = \frac{40e^{t/40} \sin t - 1600e^{t/40} \cos t}{1601}$$

$$\int e^{t/40} dt$$

$$u = \frac{t}{40} \quad \frac{du}{dt} = \frac{1}{40} \Rightarrow \frac{dt}{du} = 40 du = 40 \int e^u du$$

$$= 40e^u$$

$$\therefore \Rightarrow 50 \left(\frac{40e^{t/40} \sin t - 1600e^{t/40} \cos t}{1601} + 40e^{t/40} \right) + C$$

$$\Rightarrow \frac{2000e^{t/40} \sin t - 80000e^{t/40} \cos t + 2000e^{t/40}}{1601} + C$$

~~$\Rightarrow 80000f$~~

$$\Rightarrow \frac{80000(e^{\frac{t}{40} \sin t} / 40 - e^{\frac{t}{40} \cos t})}{1601} + 2000e^{\frac{t}{40}} + C$$

$$\Rightarrow 2000e^{\frac{t}{40}} \frac{(\sin t - 40 \cos t + 1601)}{1601} + C$$

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

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

at $t = 0$, $m = 150$

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

$$C = 150 - 1950.03$$

$$= -1800.03 = m$$

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

MATLAB R2017a

HOME PLOTS APPS EDITOR PUBLISH VIEW

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FILE NAVIGATE EDIT BREAKPOINTS RUN

C:\Users\odina\Desktop

Current Folder: C:\Users\odina\Desktop\odinaks22.m

```

1  commandwindow
2  clear
3  clc
4  close all
5  syms m t
6  ans=dsolve('Dm+0.025*m=50+50*sin(t)', 'm(0)=150')
7
8  t=0:0.5:450
9  tn=subs(ans,t)
10 plot(t,tn)
    grid on
  
```

Workspace

Name	Value
ans	1x1 sym
m	1x1 sym
t	1x501 d
tn	1x501 s

Command Window: Columns 876 through 880

Figure 1

Command Window: [150, 2000 - (2000*1601^(1/2)*cos(atan(1/40) + 1/2))/1601]

Command Window: f> >>

Taskbar: ENG 6:33 PM

odevbesdata - Microsoft Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW

B2 : 279.963914100068

t(min)	V(Litre)
1	279.9639
2	318.1907
3	313.8601
4	303.601
5	327.9009
6	393.9593
7	469.1423
8	511.0566
9	506.5922
10	484.0395
11	487.1398
12	534.9268
13	604.2824
14	651.2431
15	651.4694
16	622.6706
17	608.3676
18	637.9229
19	699.585
20	751.3315
21	759.541
22	729.9392
23	702.3679
24	714.1865
25	765.9535
26	820.9421
27	838.9333
28	813.2194
29	776.7953

veriler Sheet2

READY AVERAGE: 968.8380276 COUNT: 500 SUM: 484419.0138 100%

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FILE NAVIGATE EDIT BREAKPOINTS RUN

```

C:\Users\odina\Desktop\odina33.m
1 clear
2 clc
3 close all
4 syms t
5 values=[]
6 t=1:500
7 mean=1000-(exp(-0.05*t))*800
8 y=1000+(50/1.0025)*sin(t)+(2.5/1.0025)*cos(t)-(exp(-0.05*t))*802.4
9
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

```

Workspace

Name	Value
excelvalues	500x1 d
mean	1x500 d
mins	500x1 d
t	1x500 d
values	1x500 d
y	1x500 d

