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Matric No: 18/ENG02/096

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

$\frac{dm}{dt}$

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

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

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

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

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

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

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

$$= e^{0.025t}$$

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

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

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

$$\Rightarrow m e^{0.025t} = 50 x \frac{e^{0.025t}}{0.025} + C$$

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

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

$$\Rightarrow u = \sin t, du = \cos t, dv = e^{0.025t} \quad v = \frac{e^{0.025t}}{0.025}$$



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

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

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

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

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

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

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

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

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

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

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

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

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

$$= 40e^{t/40}$$

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



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

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

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

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

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

$$\text{at } t=0, m=150$$

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

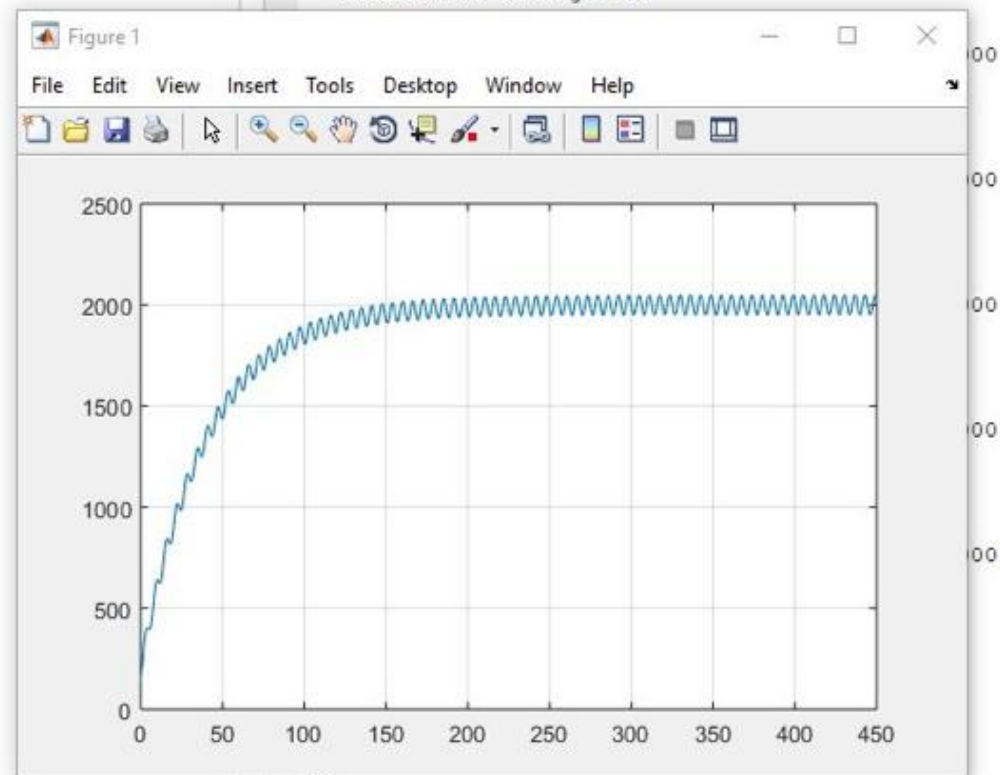
$$c = 150 - 1950.03 \\ = -1800.03 = m$$

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

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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 - t=0:0.5:450
8 - tn=subs(ans,t)
9 - plot(t,tn)
10 - grid on

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[ 150, 2000 - (2000*1601^(1/2))*cos(atan(1/40) + 1/2)]/14
fx >>

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