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ENG282

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Solution

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

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

Using the linear equation method,

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

$$\therefore p = 0.025, Q = 50(1 + \sin t)$$

$$\therefore \int p \cdot dt = 0.025t$$

$$I.F = e^{\int p \cdot dt}$$

$$I.f = e^{0.025t}$$

$$\therefore y \cdot I.F = \int Q \cdot I.f \cdot dt$$

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

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

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

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

Using integration by part,

$$\int e^{0.025t} \sin t \cdot dt$$

$$u = e^{0.025t} \quad dv = \sin t$$

$$du = 0.025 e^{0.025t} \quad v = -\cos t$$

$$\therefore \int e^{0.025t} \sin t = u \cdot v - \int v \cdot du = -\cos t \cdot e^{0.025t} - \int -\cos t \cdot 0.025 e^{0.025t} dt$$

$$\int e^{0.025t} \sin t = -e^{0.025t} \cos t + 0.025 \int e^{0.025t} \cos t dt + C$$

Using integration by part,

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

$$u = e^{0.025t}, \quad dv = \cos t$$

$$du = 0.025 e^{0.025t} \quad v = \sin t$$

$$= -e^{0.025t} \cos t + 0.025 \left[e^{0.025t} \sin t - \int \sin t \cdot 0.025 e^{0.025t} dt \right]$$

$$= -e^{0.025t} \cos t + 0.025 \left[e^{0.025t} \sin t - 0.025 \int \sin t e^{0.025t} dt \right]$$

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$$\text{let } Q = \int e^{0.025t} S \sin t$$

$$\therefore Q = -e^{0.025t} \cos t + 0.025 [e^{0.025t} \sin t - 0.025 Q]$$

$$Q = -e^{0.025t} \cos t + 0.025 e^{0.025t} - 6.25^{-4} Q$$

$$Q + 6.25^{-4} Q = -e^{0.025t} \cos t + 0.025 e^{0.025t}$$

$$Q + 0.000625 Q = -e^{0.025t} \cos t + 0.025 e^{0.025t}$$

$$1.000625 Q = -e^{0.025t} \cos t + 0.025 e^{0.025t}$$

$$1.000625 Q = -e^{0.025t} (\cos t - 0.025)$$

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

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

$$\therefore y e^{0.025t} = 50 \left[\frac{e^{0.025t}}{0.025} - \frac{e^{0.025t}}{1.000625} (\cos t - 0.025) + C \right]$$

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

divide through by $e^{0.025t}$

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

$$\text{When } y = 150$$

$$t = 0$$

$$150 = 2000 - \frac{50}{1.000625} (1 - 0) + \frac{50C}{1}$$

$$150 = 2000 - 49.968(1) + 50C$$

$$150 = 1950.032 + 50C$$

$$-1800.032 = 50C$$

$$C = -36.00064$$

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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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