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Course: Engineering Mathematics II (ENG282)

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a) $\frac{dy}{dt} = y_{in} - y_{out}$

b) $\frac{dy}{dt} = y_{in} - y_{out}$

$$y_{in} = 50 \frac{\text{gal}}{\text{min}} \times (1 + \sin t) \frac{\text{lb}}{\text{gal}}$$

$$= 50 + 50 \sin(t) \frac{\text{lb}}{\text{min}}$$

$$y_{out} = \frac{30 \text{ gal}}{400 \text{ gal}} = 0.025$$

$$y_{out} = 2.5\% \text{ of } y$$

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

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

$$= -0.025 \left(\frac{-0.025y + 50 + 50 \sin t}{-0.025} \right)$$

$$= -0.025 \left(y - \frac{50 + 50 \sin t}{0.025} \right)$$

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

$$\int \frac{dy}{y - 50 + 50 \sin t} = \int -0.025 dt$$

$$\int \frac{dy}{y - 50 + 50 \sin t} = -0.025 \int dt$$

$$\ln \frac{y - 50 + 50 \sin t}{0.025} = 0.025t + C$$

$$\ln \frac{y - 50 + 50 \sin t}{0.025} = 0.025t + C$$

$$\frac{y - 50 + 50 \sin t}{0.025} = e^{-0.025t + C}$$

$$\frac{y - 50 + 50 \sin t}{0.025} = e^{-0.025t} e^C$$

$$\frac{y - 50 + 50 \sin t}{0.025} = e^{-0.025t} y_0$$

$$\frac{y - 50 + 50 \sin t}{0.025} = y_0 e^{-0.025t}$$

$$y = y_0 e^{-0.025t} + \frac{50 + 50 \sin t}{0.025}$$

when $t = 0 \text{ min}$, $y = 150 \text{ lb}$

$$150 = y_0 e^{-0.025t} + \frac{50 + 50 \sin t}{0.025}$$

$$150 = y_0 e^{-0.025(0)} + \frac{50 + 50 \sin(0)}{0.025}$$

$$150 = y_0 + \frac{50}{0.025}$$

$$150 = y_0 + 2000$$

$$y_0 = 150 - 2000$$

$$y_0 = -1850$$

So,

$$y = \frac{50 + 50 \sin t}{0.025} - 1850 e^{-0.025(t)}$$

(Above) Question 1 (a) and (b)

Question 1(C)i

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1 - commandwindow
2 - clear
3 - clc
4 - close all
5 - syms yin yout t y
6 - %t = 0:0.5:450;
7 - %y = 50+50*sin(t)/0.025 - 1850*exp(-0.025*t);
8 - yin = 50+50*sin(t);
9 - yout = 0.025*y;
10 - Dy= 50+50*sin(t)-0.025*y;
11 - %eqn = diff1 == yin -yout;
12 - %S = dsolve(eqn);
13 - int(Dy)
14

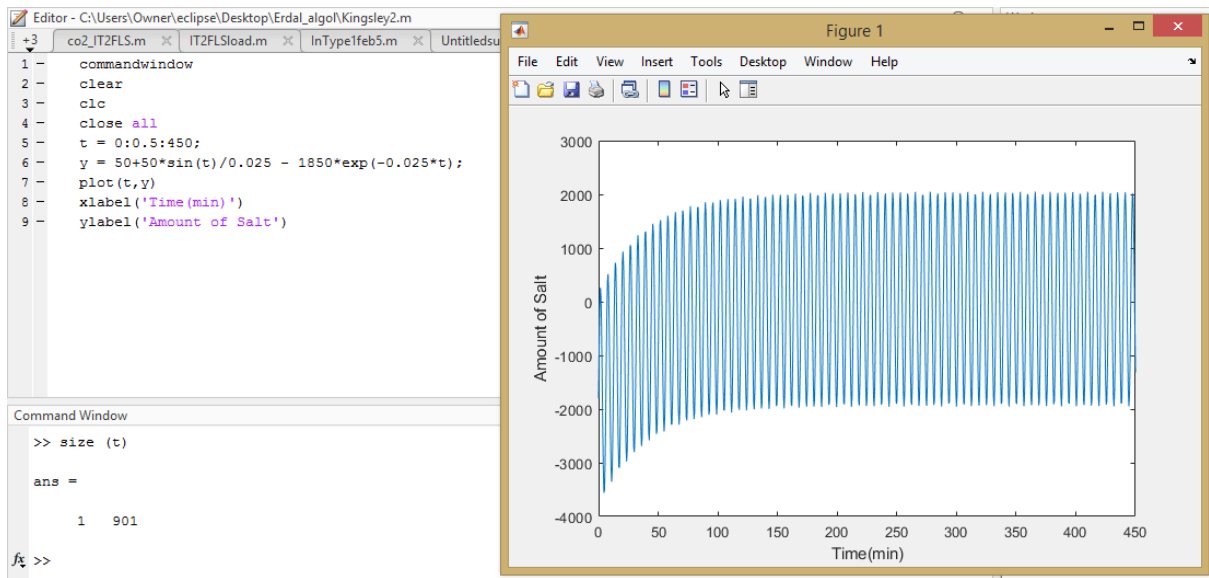
Command Window

ans =

- y^2/80 + (50*sin(t) + 50)*y

fx >> |
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Question 1 c (ii)



Question 2 a,b,c

