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18/ENG06/008

CHEMICAL ENGINEERING

ENG 282

The salt in the tank at any time t as m

$$\frac{dm}{dt} = m_{in} - m_{out} = m = 150 \text{ lb}$$

50 gal of brine, containing 1 lb of dissolved salt, runs into the tank per minute

$$m_{in} = 50 \times (1 \times \sin t)$$

The tank contains 1200 gal of water and 30 gal of solution runs out of the tank per minute.

$$\frac{30 \text{ gal}}{1200 \text{ gal}} = 0.025 = 2.5\%$$

$$m_{out} = 2.5\% m$$

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

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

Eqn (1) with $\frac{dy}{dx} + (P_y) = Q$

$$Q = 50(1 + \sin t) = (50 + 50 \sin t)$$

$$P_y = 0.025m$$

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

$$I.F = \int P dt = \int 0.025 dt$$

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

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

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

Using the BODAS

$$\int (1 + \sin t) e^{t/2} dt = \int (1 + \sin t) e^{t/2} dt$$

$$= \int e^{t/2} (1 + \sin t) dt = \int e^{t/2} (1 + \sin t) dt \quad \text{--- (2)}$$

Using again (2)

$$\text{Let } u = \frac{t}{2}$$

$$= t = 2u$$

$$\text{Let } du = \frac{1}{2} dt$$

$$\text{Let } \frac{dt}{2} = \frac{1}{2}$$

$$= \int e^u (1 + \sin 2u) 2 du$$

$$= 2 \int e^u (1 + \sin 2u) du$$

~~Using the BODAS~~

$$\text{Using } \int gh' = gh - \int g'h$$

$$\text{Let } g = 1 + \sin 2u$$

$$h = e^u$$

$$g' = 2 \cos 2u$$

$$h' = e^u$$

$$(1 + \sin 2u) e^u - \int (2 \cos 2u) e^u du$$

$$e^u (1 + \sin 2u) - \int 2 e^u \cos 2u du \quad \text{--- (3)}$$

$$e^u (1 + \sin 2u) - (2 \int e^u \cos 2u du)$$

$$2 \int e^u \cos 2u du \quad \text{--- (4)}$$

$$\int gh' = gh - \int g'h$$

$$\text{Let } g = \cos 2u$$

$$g' = -2 \sin 2u$$

$$h = e^u$$

$$h' = e^u$$

$$\therefore = (\cos 2u) e^u - \int (-2 \sin 2u) e^u du$$

$$= e^u (\cos 2u) - \int -2 e^u \sin 2u du$$

Using $\int -40e^r \sin 40r \, dr$

$$\int gh' = gh - \int g'h$$

$$g = -40 \sin 40r$$

$$g' = -1600 \cos 40r$$

$$h = e^r$$

$$h' = e^r$$

$$= (-40 \sin 40r) e^r - \int -1600 \cos 40r e^r \, dr$$

$$e^r (\cos 40r - (-40e^r \sin 40r)) - \int -1600 e^r \cos 40r \, dr$$

$$e^r \cos 40r - (40e^r \sin 40r) + 1600 \int e^r \cos 40r \, dr$$

$$= 40e^r \sin 40r + e^r \cos 40r / 1601$$

Using equation (4)

$$= \frac{40(40e^r \sin 40r + e^r \cos 40r)}{1601}$$

Using eqn (3)

$$e^r (1 + \sin 40r) - \int 40e^r \cos 40r \, dr$$

$$= e^r (1 + \sin 40r) - \frac{40(40e^r \sin 40r) + (e^r \cos 40r)}{1601}$$

Then multiply it by 40

$$40e^r (1 + \sin 40r) - \frac{1600(40e^r \sin 40r + e^r \cos 40r)}{1601} \quad (5)$$

xxxx

Recall that ~~xxxx~~ $r = \frac{t}{40}$

Apply the value of r into eqn (5)

$$40e^{t/40} (1 + \sin 40t/40) - \frac{1600(40e^{t/40} \sin 40t/40 + e^{t/40} \cos 40t/40)}{1601}$$

$$40e^{t/40} (1 + \sin t) - \frac{1600(40e^{t/40} \sin t + e^{t/40} \cos t)}{1601} \quad (6)$$

x50

$$2000e^{t/40} (1 + \sin t) + \frac{80000(40e^{t/40} \sin t + e^{t/40} \cos t)}{1601} + c$$

$$= 2000e^{t/40} (\sin t - 40(\cos t + 160)) + C$$

$$m \cdot e^{0.025t} = \frac{2000e^{t/40} (\sin t - 40(\cos t + 160)) + C}{160}$$

$t = 0 \text{ min}$, K represents m_0 ,

$$m = 150 \text{ lb}$$

$$K = m \cdot e^{0.025t} = \frac{2000e^{t/40} (\sin t - 40(\cos t + 160))}{160}$$

$$m_0 = 150 \cdot e^{0.025(0)} = \frac{2000e^{0/40} (\sin 0 - 40(\cos 0 + 160))}{160}$$

$$m_0 = 150e^0 = \frac{2000e^0 (0 - 40 + 160)}{160}$$

$$m_0 = -1800.03$$

$$\therefore m = -1800.03e^{t/40} + \frac{2000e^{t/40} (\sin t - 40(\cos t + 160))}{160}$$



Files > MATLAB > R2018a > bin > win64 >

Editor - C:\Users\EKOK NZIE\plotofdsolve1.m
LOLOLOL.m x MATeq1.m x secondmodel.m x dsolvee.m x combined1.m x plotofdsolve1.m x Untitled5.m x +

```
1 - clearvars
2 - clc
3 - close all
4 - t = 0:0.5:7.5;
5 - y = 0.0769*exp(-t/40) - (2000*1601^(1/2)*cos(t + atan(1/40)))/1601 + 2000
6 - plot(y,t)
7 - xlabel('Time (hr)')
8 - ylabel('Amount of substance present (g)')
9 - grid on
10 - grid minor
```

Command Window

1.9501 1.95e8 1.9741 1.9978 2.0220 2.0409 2.0497 2.0464 2.0318 2.0094 1.9847

Columns 14 through 16

1.9515 1.9612 1.9839

MATLAB R2018a interface showing a script editor and a figure window.

Script Editor (LOLOLOL.m):

```

1 - clearvars
2 - clc
3 - close all
4 - t = 0:0.5:7.5;
5 - y = 0.0769*exp(-t/40)
6 - plot(y,t)
7 - xlabel('Time (hr)')
8 - ylabel('Amount of substance present (g)')
9 - grid on
10 - grid minor
    
```

Figure 1: A plot showing the amount of substance present (g) versus time (hr). The x-axis ranges from 1950 to 2050, and the y-axis ranges from 0 to 8. The plot shows two curves: one starting at approximately 6.1g at 1950 and decreasing to 3.0g at 2050, and another starting at 0g at 1950 and increasing to 3.0g at 2050. The curves meet at the point (2050, 3.0).

Command Window:

```

Columns 1 through 12
    1.9501    1.9568    1.9741    1.9978    2.0220    2.0409    2.0497    2.0464    2.0318    2.0099

Columns 13 through 16
    1.9517    1.9515    1.9632    1.9839
    
```

EDITOR

Insert
Comment
Indent

FILE NAVIGATE EDIT

C:\Program Files\MATLAB\R2018a\bin

Editor - C:\Users\...
LOLOLOL.m

```
1 - clc  
2 - close  
3 - clear  
4 - t = 0;  
5 - x = (1  
6 - plot(t  
7 - xlabel  
8 - ylabel  
9 - hold o  
10 - y = (1  
11 - plot(t  
12 - xlabel  
13 - ylabel  
14 - hold o  
15 - grid o  
16 - grid o
```

Value
1x501 double
1x501 double
1x501 double

Command Window
f >>

