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18/engo7/079

CIVIL ENGINEERING

EMG 282 (engineering mathematics 2)

1. using Balance law, The acceleration rate at salt within a system is equal to the input rate of salt into the system minus the output rate of salt from the system.

Accelemtion rate of salt within a system =

= input rate of salt into the system

= output rate of salt from the system

let the amount of salt present in the tank at any time 't' be 'y'. Time rate of change of $y = \frac{dy}{dt}$

$= f_{in} - f_{out}$

if 50gal of brine enters the tank per minute & one gallon contains (1+ sin t) lb of salt, then at $t = 1$, $(1 + \sin t) = (1 + \sin(1)) = 1.02$ lb

Hence, the amount of salt entering into the tank is = 51 lb/min.

The tank contains 1200gal of water with dissolved salt and 30gal of the solution exits the tank per min i.e $\frac{30gal}{1200gal}$ = 0.025.25%

of the content of the tank. So 2.5% of the salt present inside the tank per minute i.e

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

a) $\frac{dy}{dx}$ (lb/min = 5 lb/min − 2.5% of y lb/min

b) $\frac{dy}{dt} = 5 - 0.025y$; $dy/dt = -0.025y + 5$

$dy/dt = -0.025\left(\frac{-0.025y}{-0.025} + \frac{5}{-0.025}\right)$; $\frac{dy}{dt} = -0.025(y - 200)$

$dy/(y - 200) = -0.025\,dt$; $\int_{(y-200)}^{dy} = \int -0.025\,dt$

$\int \frac{dy}{(y-200)} = -0.025\int dt$; $\ln(y-200) = -0.025t + c$

$y - 200 = e^{-0.025t + c}$; $y - 200 = e^{-0.025t}\,e^{c}$

$y - 200 = e^{-0.025t}\,y_0$; $y - 200 = y_0 e^{-0.025t}$

$150 = y_0 e^{-0.025t} + 200$; $150 - 200 = y_0 \times 1$

$y_0 = -1892$

50;

$y = -1892e^{-0.025t} + 200$

$y = 200 - 1890e^{-0.025t}$

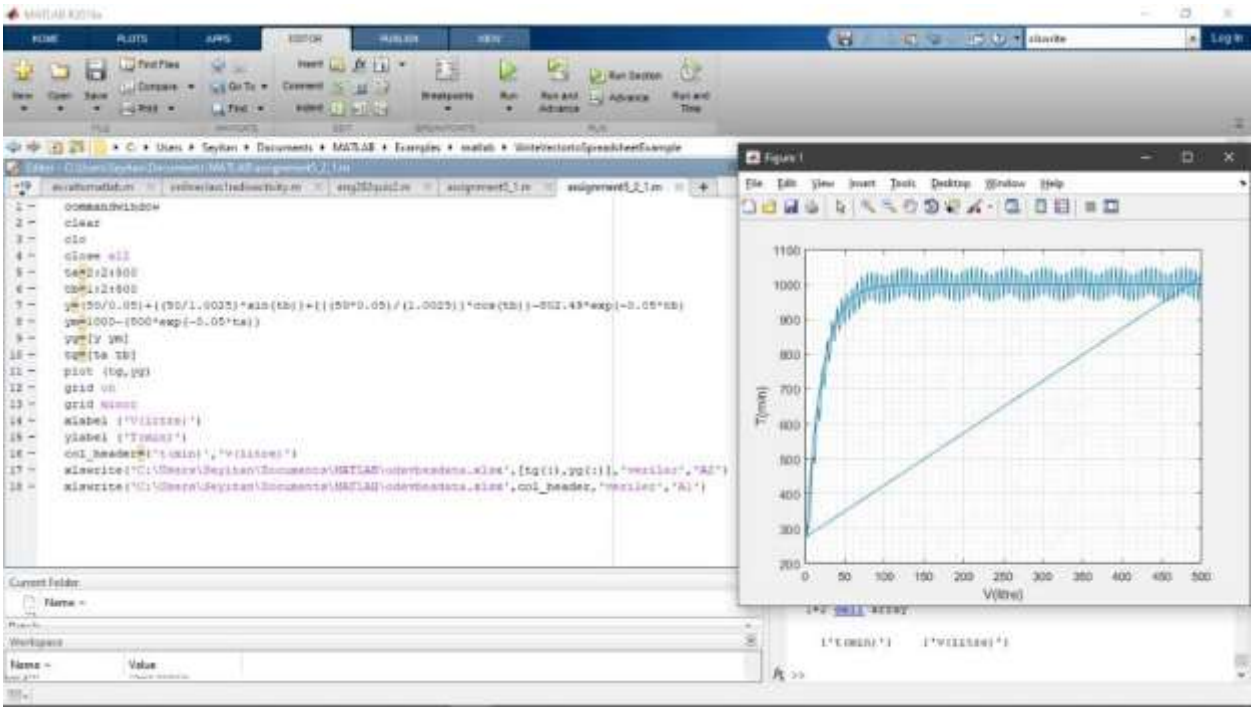
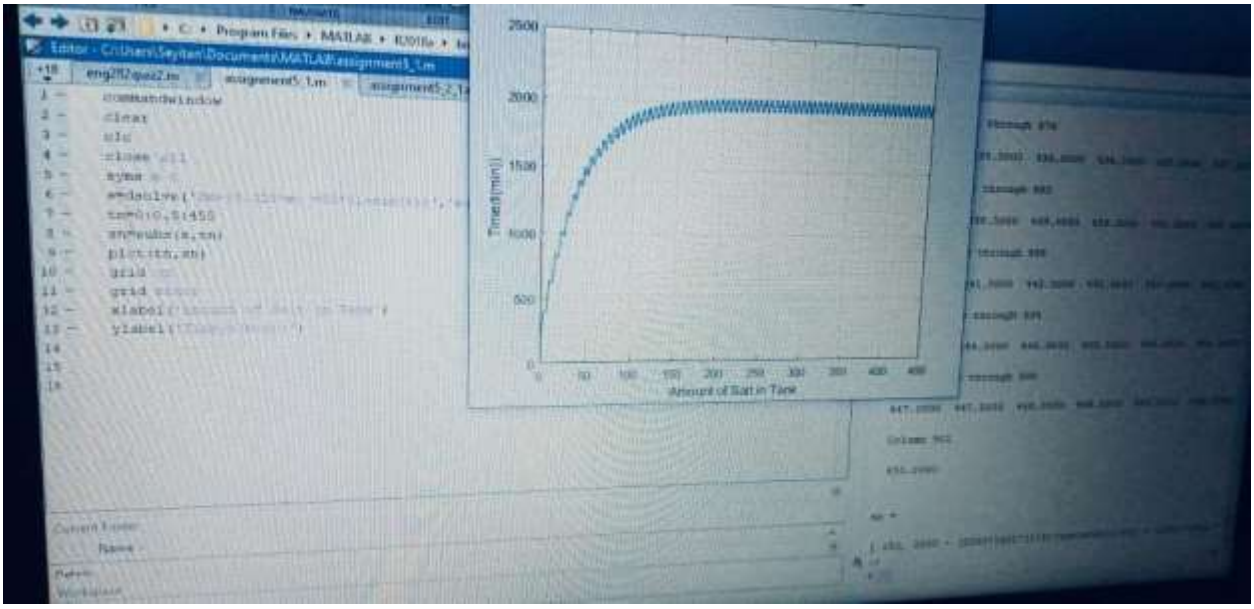


Figure 1
T(min)
V(litre)


Time(min)
Amount of Salt in Tank