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

$$ye^{0.025} = 2000e^{0.025} - \frac{50e^{0.025t}}{1.000625}(\cos t - 0.0025) + 50c$$

divide by through $e^{0.025t}$

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

When $y = 150$
$t = 0$

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

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

$$150 = 1950.032 + 50c$$

$$-1800.0322 = 50c$$

$$c = -36.00064$$

5

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

using integration by part

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

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

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

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

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

Let $Q = \int e^{0.025t}\sin t$

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

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

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

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

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

$$Q = \frac{-e^{0.025t}}{1.00625}(\cos t - 0.025) + c$$

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

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

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

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

$IF = e^{0.025t}$

$y \cdot IF = \int Q\ I.F \cdot dt$

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

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

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

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

using integration by part,

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

$v = -\cos t$

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

$du = 0.025 e^{0.025t}$

1. $\int e^{0.025t} \sin t = e^{0.025t} \cdot -\cos t - \int -\cos t \cdot 0.02$

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

3

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

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

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

from

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

$\frac{dy}{dt} = 50(1 + \sin t) - 2.5\%$ of y

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

By separating the variables

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

multiply both sides by dt

$1 + 0.025y\,dy = 50(1 + \sin t)\,dt$

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

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

Using the linear equation method

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

Rowalyn Ife Ayomide
18/ENG05/054
mechatronics

1) Mixing
1200 gal of water } initially
150 pounds of salt

50 gallons of brine each contain (1 + sint) pounds of salt

30 gal/min removes from the tank
Accumulation rate within a system
Input rate into the ~~t~~ output rate from the system

$\frac{dy}{dt} = y_{in} - y_{out}$; $\frac{dm}{dt} = m_{in} - m_{out}$

Since 50 gal removes per minute, and one gallon ~~of da~~ contains (1 + sint) pounds of salt, it means that the amount of salt leaving the tank

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

$m_{in} = 50 (1 + \sin t)$ lb/min
The tank contains 1200 gal of water with salt, and 30 gal of the solution leaves the per minute

$\frac{30 gal}{1200 gal} = 0.025 = 2.5\%$ of the content of the tank if that is the case 2.5% of salt present in the tank will also leave the tank per minute, therefore,

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