$$ye^{0.025t} = \int 50(1+\sin t)\, e^{0.025t}\, dt$$
$$ye^{0.025t} = 50\int (1+\sin t)\, e^{0.025}\, dt$$
$$ye^{0.025t} = 50\int e^{0.025t} + e^{0.025t} \sin t \cdot dt$$
$$ye^{0.025t} = 50\int e^{0.025t}\, dt + e^{0.025} \sin t \cdot dt$$
$$ye^{0.025t} = 50 \cdot \frac{e^{0.025t}}{0.025} + \int e^{0.025} \sin t \cdot dt \quad ---(*)$$

Using Integration by part method;

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

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

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

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

Using integration by part method;

$= e^{0.025t} \cos t$

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

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

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

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

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

$$Q = -e^{0.025t} \cos t + 0.025 \left[e^{0.025t} \sin t - 0.025\, Q \right] + C$$
$$Q = -e^{0.025t} \cos t + 0.025\, e^{0.025t} - 6.25^{-4} Q + C$$
$$Q + 6.25^{-4} Q = -e^{0.025t} \cos t + 0.025\, e^{0.025t} + C$$
$$1.000625 Q = -e^{0.025t} \cos t + 0.025 e^{0.025t} + C$$
$$1.000625 Q = -e^{0.025t} (\cos t - 0.025) + C$$
$$Q = \frac{-e^{0.025t}}{1.000625} (\cos t - 0.025) + C$$
$$\int e^{0.025t} \sin t = \frac{-e^{0.025t}}{1.000625} (\cos t - 0.025) + C \quad ---(i)$$

subst eqn (i) into eqn (*)

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

```
ll
t
lve('Dm+0.025*m=50+50*sin(t)','m(0)=150
:450
(ans,t)
tn)
```

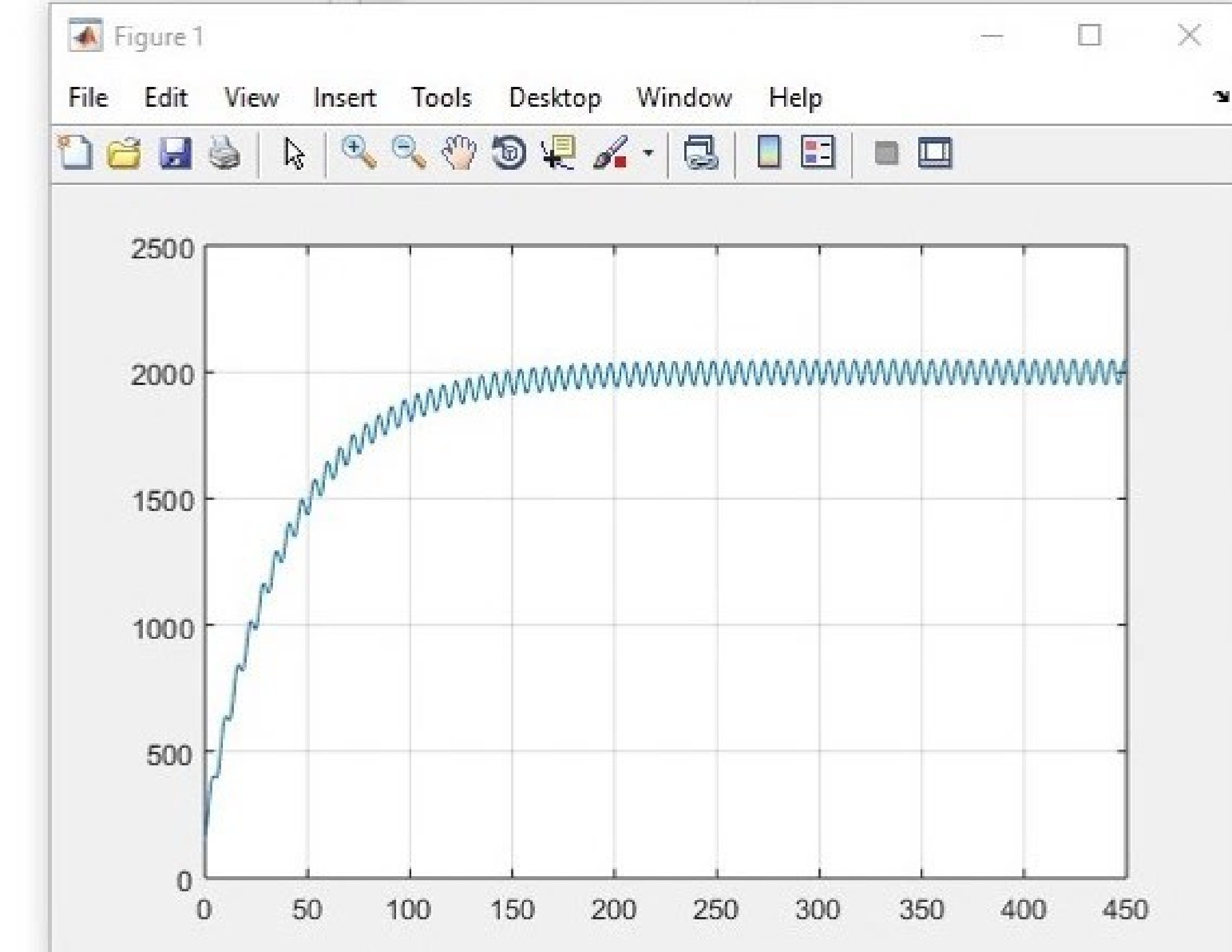
Figure 1
File Edit View Insert Tools Desktop Window Help
2500
2000
1500
1000
500
0
0 50 100 150 200 250 300 350 400 450

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Assignment

1a) From ; $\frac{dy}{dt} = y_{in} - y_{out}$

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

$y_{out} = \frac{30}{1200} = 0.025 = 2.5\%$ of y

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

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

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

Multiply both sides by dt.

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

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

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

Using $dy/dx + Py = Q$

$\therefore P = 0.025, Q = \text{€}\, 50(1 + \sin t).$

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

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

$I \cdot F = e^{0.025t}$

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

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

Divide through by $e^{0.025t}$

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

So when $y = 150, t = 0$

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

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

$$150 = 1950.032 + 50c$$

$$c = \frac{150 - 1950.032}{50} = \frac{-1800.032}{50}$$

$$c = -36.00064$$