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18/Eng02/025
Computer Engineering

Answers

1a) From $dy/dt = y_{in} - y_{out}$

$dy/dt = 50(1 + y_{out}) - 2.5\%$ of y.

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

$y_{out} = 2.5\%$ of $y = 1/40 y$

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

By separating variables

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

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

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

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

Using linear equation method;

$dy/dx + Py = Q$

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

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

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

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

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

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

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

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

Integrate by part

$\int e^{0.025t} \sin t \cdot dt$ $\qquad \int u\,dv = uv - \int v\,du$

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

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

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

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

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

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

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

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

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

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

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

$Q = -e^{0.025t} \cos t + 0.025 e^{0.025t} - 0.25^{-4} Q$

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

$1.00062 \, 5 Q = -e^{0.025t} (\cos t - 0.025)$

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

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

where $y = 150$, $t = 0$

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

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

$150 = 1950.032 + 50c$

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

$c = -36.00064$

$Q = \frac{-e^{0.025t}}{1.000025} (\cos t - 0.025) + c$

$\int e^{0.025t} \sin t = \frac{-e^{0.025t}}{1.000025} (\cos t - 0.025) + c.$

$$y \cdot e^{0.025t} = 50 \frac{e^{0.025t}}{0.025} - \frac{e^{0.025t}}{1.000625} \left(\cos t \, 0.025 \right) + c \Big]$$

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

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

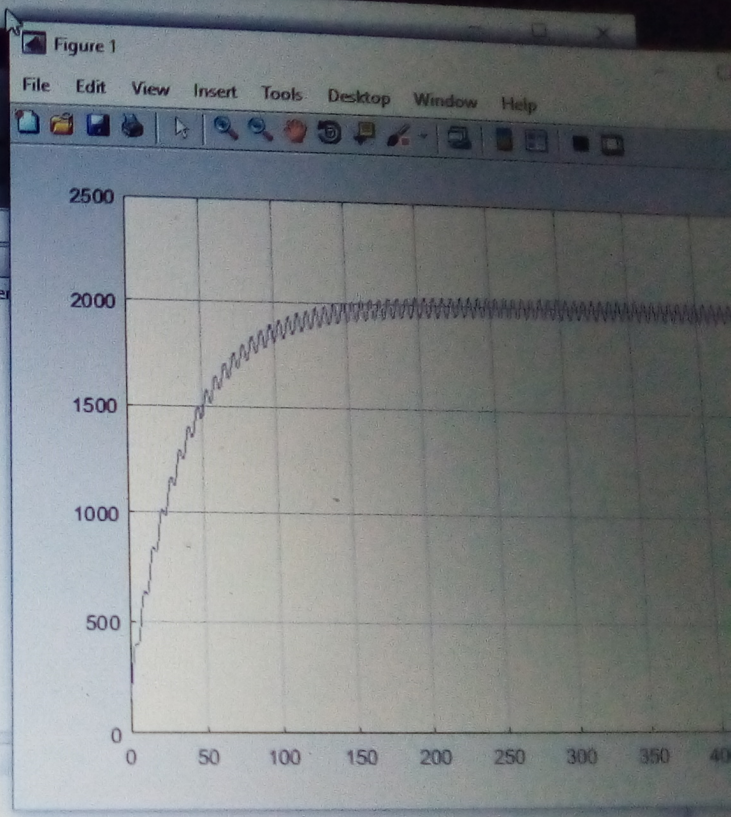
Editor - C:\Users\NGOZI S. AZUKA\Documents\examples\AZUKAassignment5.m

```
commandwindow
clear
clc
close all
syms m t
ans=dsolve('Dm+0.025*m=50+50*sin(t)','m(0)=150')
t=0:0.5:450
tn=subs(ans,t)
plot(t,tn)
grid on
```

Command Window

```
tn =

[ 150, 2000 - (2000*1601^(1/2)*cos(atan(1/40) + 1/2))/1601 - (2881850*exp(-1/80))/1601, 2000 - (2000*1601^
>>
```



MATLAB R2018a

C: ▸ Program Files ▸ MATLAB ▸ R2018a ▸ examples ▸

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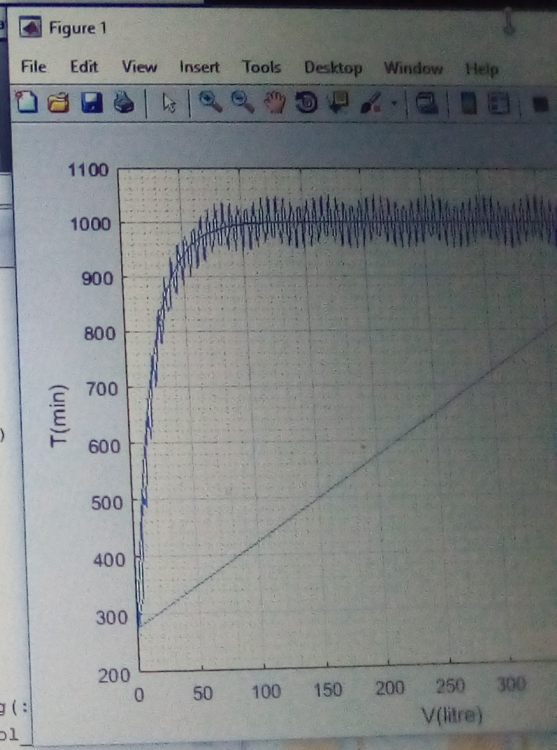
exercice_1.m | Azuka.m

```
commandwindow
clear
clc
close all
ta=2:2:500
tb=1:2:500
y=(50/0.05)+(50/1.0025)*sin(tb)+((50*0.05)/(1.0025))*cos(tb)-802.49*exp(-0.05*tb)
ym=1000-(800*exp(-0.05*ta))
yg=[y ym]
tg=[ta tb]
plot (tg,yg)
grid on
grid minor
xlabel ('V(litre)')
ylabel ('T(min)')
col_header={'t(min)','v(lire)'}
xlswrite('C:\Users\NGOZI S.AZUKA\Document\examples\Azuka.m\odevbesdata.xlsx',[tg(:
xlswrite('C:\Users\NGOZI S.AZUKA\Document\examples\Azuka.m\odevbesdata.xlsx',(col_
```