

modelling Ozdemir Augustine
18/Enyo/1027
Chemical Eng

a) modelling is a mathematical representation of a system and simulation of a system which involves solving the model and obtaining output variable for different values of input variables

b) differential equation
Balance law

c) $(T - T_0) \propto \frac{dT}{dt}$
 $k(T - T_0) = \frac{dT}{dt}$

$\frac{1}{T - T_0} dt = k dt$

$\ln(T - T_0) = kt + C$

$T - T_0 = e^{kt+C}$

$T - T_0 = e^{kt} + e^C$ where $e^C = T_0$

$T - T_0 = T_0 + e^{kt}$

$T - T_0 = T_0 e^{kt}$

T_0 = Temperature of thermostat

T = Temperature of system

T_0 = ambient temperature

t = time

where $t=0$ $T=10$ $T_0=25$

$10 - 25 = T_0 e^{k \cdot 0}$

$-15 = T_0$

where $t=23$ $T=20$ $T_0=25$

$20 - 25 = -15 \cdot e^{23k}$

$\frac{-5}{-15} = e^{23k}$

$0.33 = e^{23k}$

$\ln 0.33 = 23k$
 $\frac{-1.1087}{23} = k$

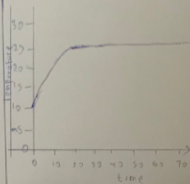
$k = -0.222$

1) Model

$T - 25 = -15 \cdot e^{-0.222t}$

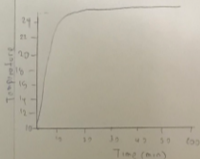
$T = 25 - 15 \cdot e^{-0.222t}$

t	T
0	10
10	23.37066
20	24.82306
40	24.99741
60	24.99998



11) Command window

```
clear
clc
close all
syms t
t=0:1:60
T=25-15*exp(-0.222*t)
T0=SubST
Plot (t,T0)
xlabel ('Time (min)')
ylabel ('Temperature')
axis tight
grid on
fid minor
```



Steady state temperature = 25°C

Using the model

$T = 25 - 15 \cdot e^{-0.222t}$

$T = 25 - 15 \cdot e^{-0.222 \cdot 23}$

$T = 25^\circ\text{C}$