

ASITA ODOMISS

17/ENGD06/014

MECHANICAL ENGINEERING

ENG 282 (Assignment 5)

1 a, Mathematical modelling

The process of setting up the models, solving it mathematically and interpreting the results in physical or other terms

b, Methods of obtaining a Model

→ Differentiating

→ Use of balance law

$$C_1 i, T(0) = 10^\circ\text{C}$$

$$T(5) = 20^\circ\text{C}$$

$$\text{Actual temp} = 25^\circ\text{C} = T_a$$

$$\frac{dT}{dt} = k(T - T_a)$$

$$dT = k(T - T_a) dt$$

$$\frac{dT}{(T - T_a)} = k dt$$

Integrating both sides

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

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

Let e^C be A

$$T - T_a = e^{kt} \times A$$

$$T - T_a = Ae^{kt}$$

$$T = Ae^{kt} + T_a$$

When $T = 10$

$$10 = Ae^{k(10)} + 25$$

$$10 = A + 25$$

$$A = 25 - 10$$

$$A = 15$$

$$T = 25 - 15e^{-kt}$$

$$\text{At } t(s) = 20$$

$$20 = 25 - 15e^{-k(20)}$$

$$20 - 25 = -15e^{-k(20)}$$

$$15e^{-k(20)} = 25 - 20$$

$$15e^{-20k} = 5$$

$$e^{-20k} = 0.333$$

$$-20k = \ln 0.333$$

$$-20k = -1.0986$$

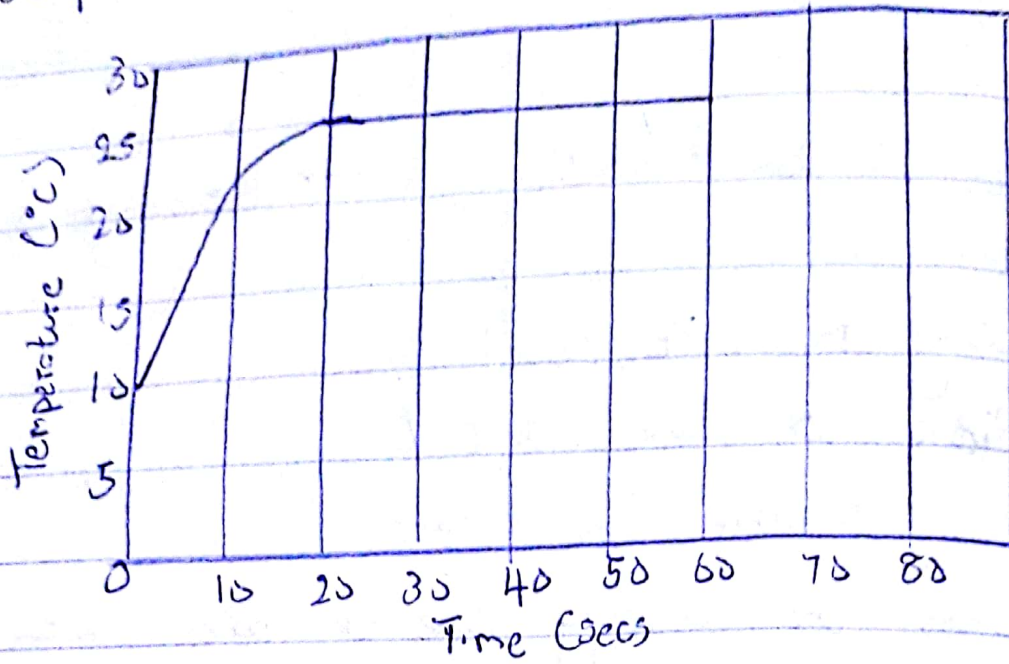
$$k = 0.22$$

$$P(t) = 25 - 15e^{-0.22t} \rightarrow \text{Belonging equation}$$

ii) Using Microsoft Excel

- Pick a box insert 't'
- Pick another box insert 'T'
- Undo the already labelled box 1 't'
- Insert a value of 0 in an empty box
- Click on Fill
- Click on Series and adjust what is needed to be adjusted that is, insert the step value of 4 and change series to column then the step value of 60
- Under the ~~old~~ already labelled box 2 't' pick a box insert $25 - (15 * \exp[-0.22 * A2])$
- Auto Fill
- Go to insert
- Pick a graph
- Label the graph

Output



iii Using MATLAB

Command Window

Clear

clc

close all

t = 0:1:60

T = 25 - 15 * exp(-0.22 * t)

Plot (t, T)

grid on

grid minor

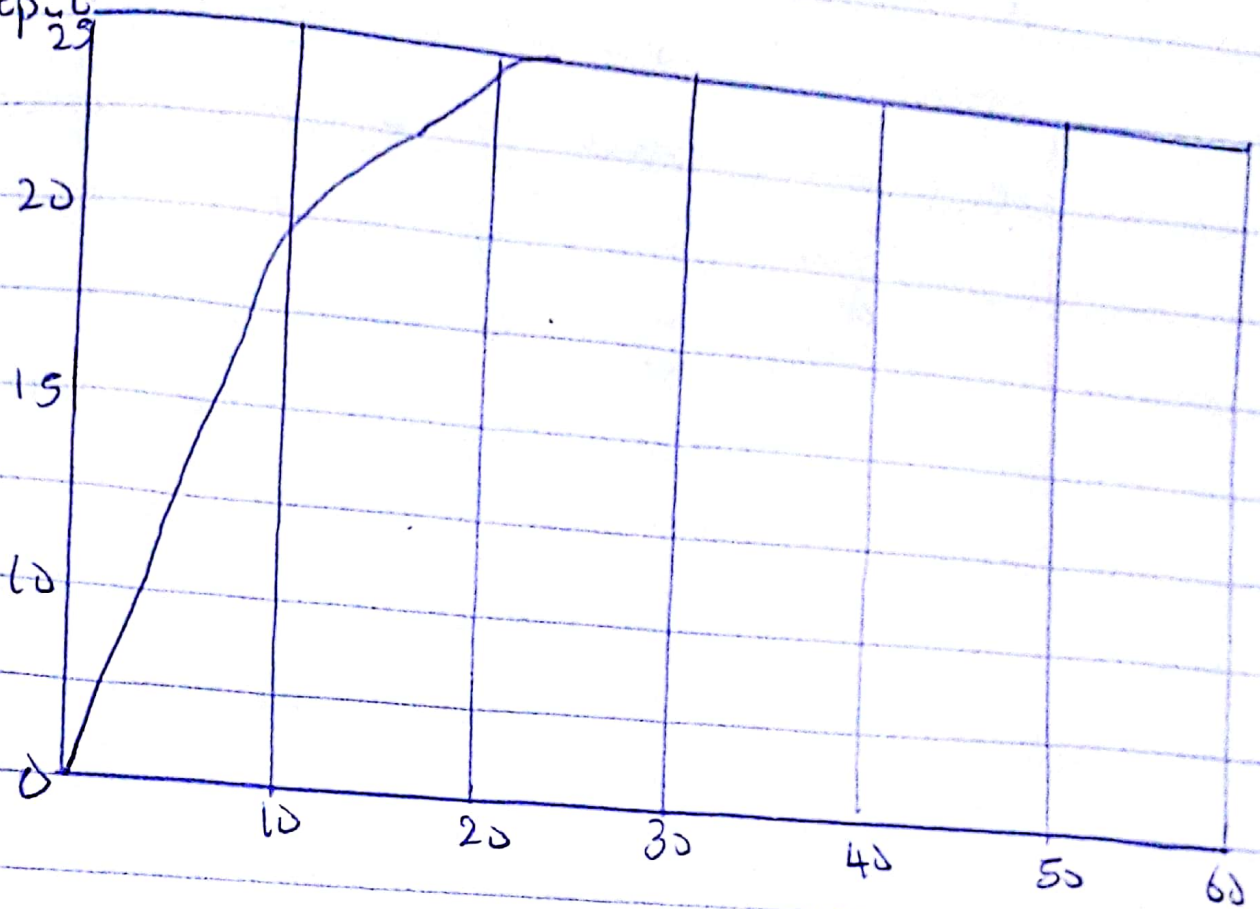
x - Label ('TIME (secs)')

y - Label ('TEMPERATURE')

grid on

grid mbar

Output



iv Using excel's dynamic response, the steady state, temperature of the system would be 25°C at 20 mins

v Using the developed model equation, the temperature of the thermometer at $t = \infty$ will be 25°C