

## ASSIGNMENT V (FIVE)

1. Define Mathematical Modelling

Mathematical modelling is a mathematical representation of a system and simulation of a system ~~in which~~ which involves solving the model and obtaining its output variable for different values of its input variable or as input variable is changed from one value to another.

b. Methods of Obtaining a model

- Differentiating
- Use of Balance law

c. Solution

$$T_0 = 10^\circ\text{C}$$

$$T_5 = 20^\circ\text{C}$$

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

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

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

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

Integrating both sides

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

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

let  $e^C$  be  $A$

$$T - T_A = e^{kt} \cdot A$$

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

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

When  $T = 10$

$$10 = Ae^{k(0)} + 25$$



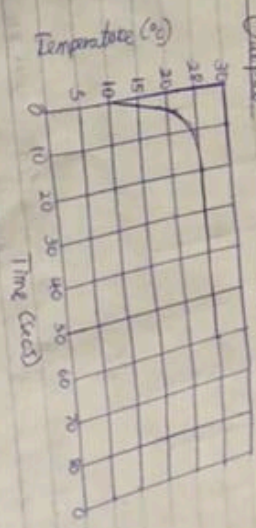
$10 = A + 2.5$   
 $A = 10 - 2.5$   
 $A = +7.5$   
 $2.5 - 1.5e^{0.2t}$   
 $A + f(t) = 2.0$   
 $2.0 = 2.5 - 1.5e^{0.2t}$   
 $1.5e^{0.2t} = 2.5 - 2.0$   
 $1.5e^{0.2t} = 0.5$   
 $e^{0.2t} = 0.3333$   
 $5k = \ln 0.3333$   
 $5k = -1.0986$   
 $k = -0.22$   
 $T_0 = 2.5 - 1.5e^{-0.22}$

Using Microsoft Excel

- Pick a box insert 't'
- Pick another box insert 'e'
- Under the already labelled box 't'
- Insert a value of 0 in an empty box
- Go to fill
- Click on series
- Insert a step value of 1
- Change the series into columns
- Insert a step value of 60
- Under the already labelled box 2. '1'
- Pick a box
- Insert = 2.5 - [1.5 \* Exp(-0.22 \* A2)]
- Auto fill
- Go to insert
- Pick a graph of choice

Label the graph

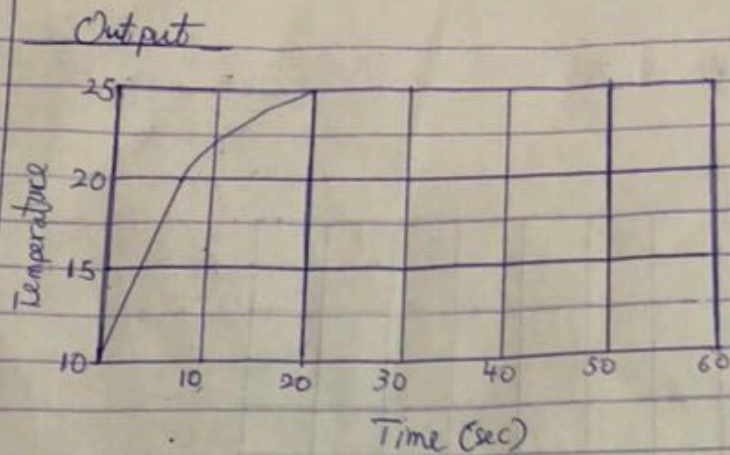
Output



Using MATLAB

Command window  
 clear  
 clc  
 close all  
 $t = 0:1:60$   
 $T = 2.5 - 1.5 * \exp(-0.22 * t)$   
 Plot (t,T)  
 grid on  
 grid minor  
 X label (Time (Sec))  
 Y label (Temperature)  
 grid on  
 grid minor





- i.v) Using Excel: dynamic response the steady state temperature of the system would be  $25^{\circ}\text{C}$  at 20 minutes.
- ii) Using the developed model equation, the temperature of the thermometer at  $t$  will be  $25^{\circ}\text{C}$