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17/MHS05/010

BIOMEDICAL ENGR

ENG 282: ENGINEERING MATHS II.

1. Define Mathematical Modelling

Mathematical modelling is a mathematical representation of a system and simulation of a system ~~involves~~ 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 $T = 10$

$$10 = A \cdot k(0) + 25$$

$$10 = A + 25$$

$$A = 10 - 25$$

$$A = -15$$

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

$$At \cdot f(5) = 20$$

$$20 = 25 - 15e^{k(5)}$$

$$20 = 25 - 15e^{5k}$$

$$15e^{5k} = 25 - 20$$

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

$$e^{5k} = 0.3333$$

$$5k = \ln 0.3333$$

$$5k = -1.0986$$

$$k = -0.22$$

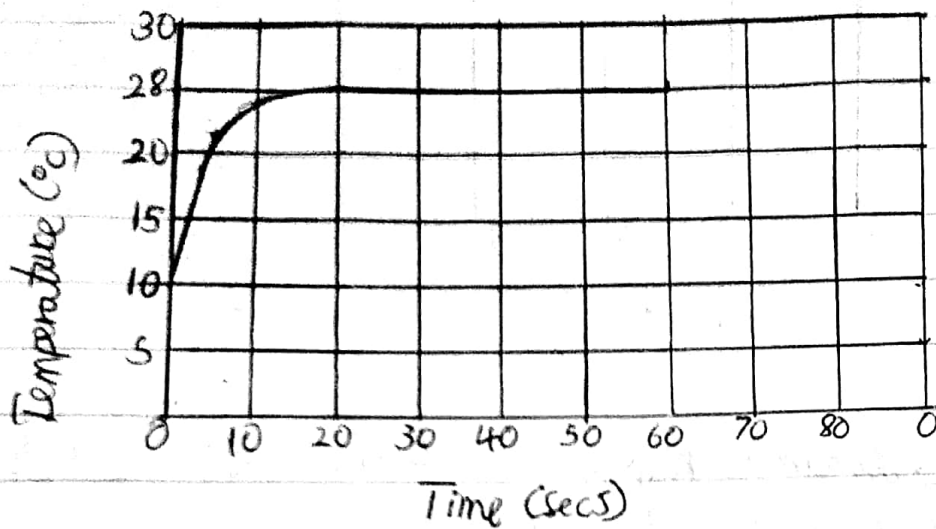
$$T_{10} = 25 - 15e^{-0.22}$$

Using Microsoft Excel

- Pick a box insert 't'
- Pick another box insert 't'
- 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 stop value of 60
- Under the already labelled box 2. '1'
- Pick a box
- Insert " $= 25 - [15 * \text{Exp}(-0.22 * A2)]$ "
- 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 = 25 - 15 * exp(-0.22 * t)

Plot (t;T)

grid on

grid minor

x label (Time (secs))

y label (Temperature)

grid on

grid minor