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Civil Engineering
17/ENG02/052
ENG 282

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a] Define Mathematically, Modelling.

Mathematically, Modelling is a mathematical representation of a system and simultation of a system 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
- By the use of Balance Law
- By differentiating

c] i) Solution

$T(0) = 10°C$

$T(5) = 20°C$

Actual temperature $= 25°C = T_A$

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

$$dT = K(T - T_A)\,dt$$

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

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 $T = 10$

$10 = A + 25$

$A = 10 - 25 = -15$

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

At $t(s) = 20$

$20 = 25 - 15e^{kt}$

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

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

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

$e^{5k} = 0.3333$

$5k = \ln(0.3333)$

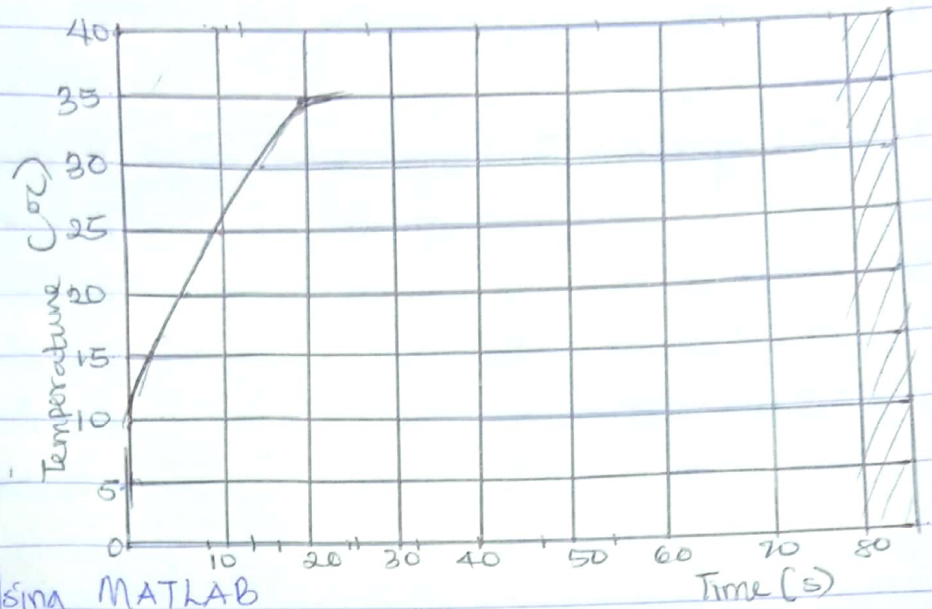
$k = -0.22$

$\therefore (T_{(t)} = 25 - 15e^{-0.22t})$ ⟶ Relating equation

(ii) Using Microsoft Excel

- Pick a box, insert 't'
- Pick another box, insert 'T'
- Under the already labelled box 1 't'
- Insert a value of 0 in an empty box
- Go to
- Adjust 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 'i'
- Pick a box
- Insert → 25 - (15 * EXP(-0.22 * A2))
- Auto fill
- Go to insert
- Pick a graph of choice
- Label the graph

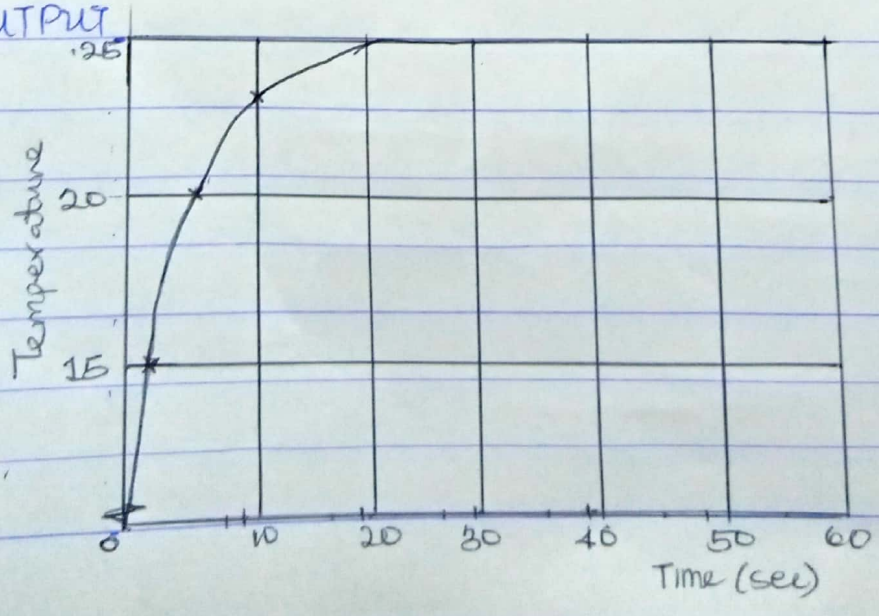
OUTPUT



(iii) Using MATLAB

- Commandwindow
- 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 (sec)')
- Y Label ('Temperature')

OUTPUT



(iv) Using excel's dynamic response, State temperature of the system would be 25°C at 20 minutes.

(v) Using the developed model equation, the temperature of the thermometer at t will be 25°C.