ASSIGNMENT 5

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ET/ENG/03/032

CIVIL ENGINEERING

1) Define mathematical modelling

This is a mathematical representation of a system in order to steady its behaviour

2) Methods of obtaining a model

i) Differential equation

ii) use of balance law

(c) From Newtons law of cooling

$dT/dt = Kr(T - T_m)$

$dT = dx(T - T_m)dt$

$\frac{dT}{T - T_m} = Kdt$

integrating both sides

$\ln(T - T_m) = Kt + C$

$T - T_m = e^{kt+c}$

$T - T_m = e^{kt} \cdot e^{c}$

let $e^{c} = C$

$T - T_m = e^{kt} \cdot C$

$T - T_m = Ce^{kt}$

$T = Ce^{kt} + T_m$

at $t = 10$, $T = 10^\circ C$ $T_m = 25^\circ C$

$10 = Ce^{kt} + 25$

$10 = C + 25$

$C = 10 - 25$

$C = -15$

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

at $t = 5$, $T = 20^\circ C$

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

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

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

$\frac{1}{3} = e^{5k}$

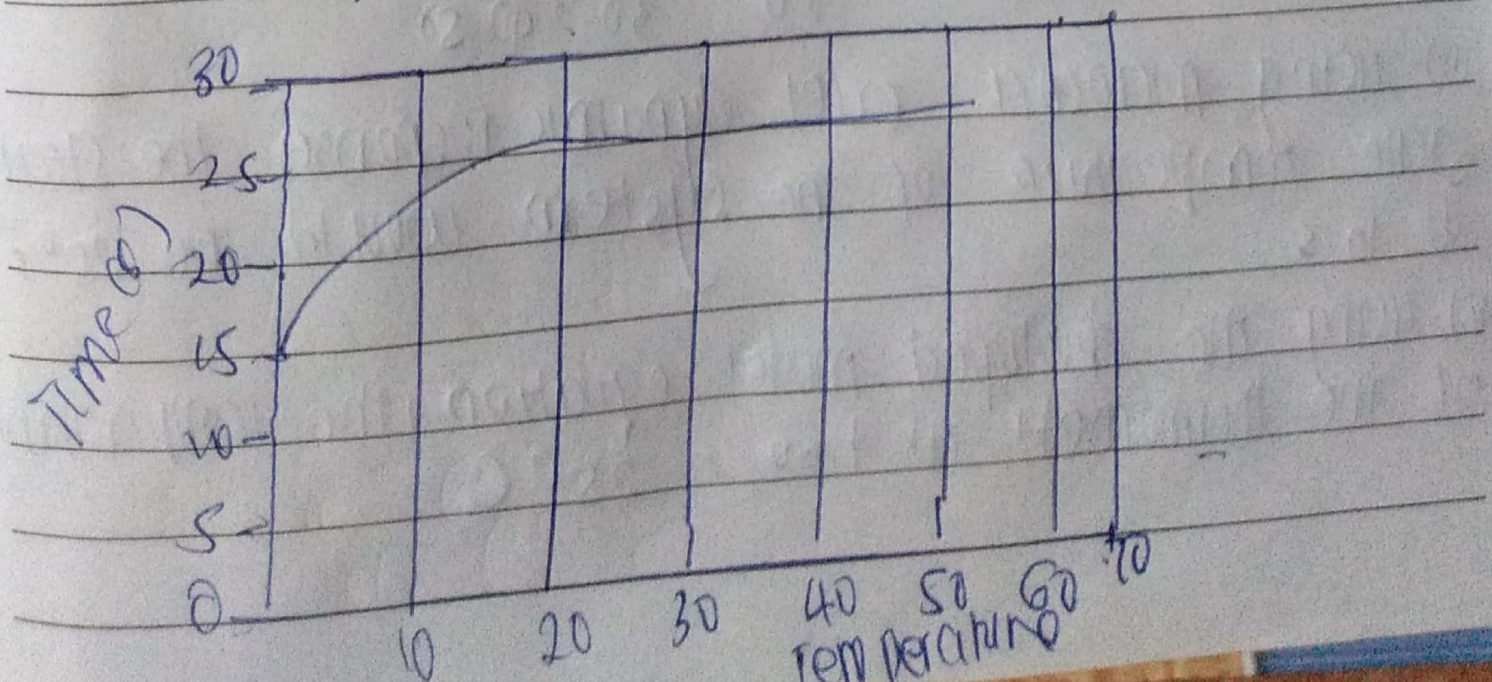
$5k = \ln(0.3333)$

$\frac{5k}{5} = \frac{\ln(0.3333)}{5}$

$k = -0.22$

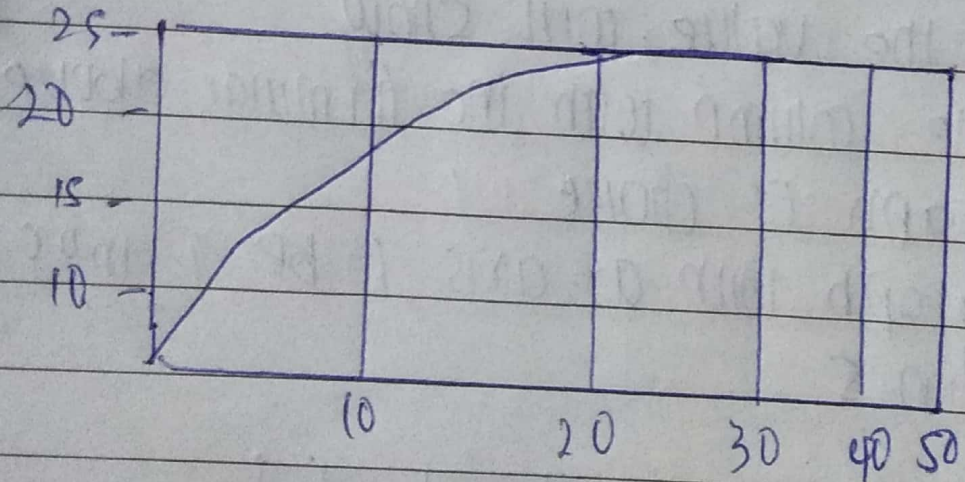
$T(t) = 25 - 15e^{-0.22t}$

(1) Using microsoft excel
- Pick a box and insert 'A'
- Pick another box and insert 'T'
- Insert a value 0 0 in an empty box in the column 't'
- Click on series
- Change the series to colums
- Insert a stop value of 60
- Select the box with 0 and double - click at the edge of the box the values from 0 to 60 appear
- select a box under the column 'T'
- Insert = 25 - (15 * EXP - (0.22 * A2) into the box and
- click enter, the value will show
- auto will the column with the formula above
- Pick a graph of choice
- label the graph with ax-axis to be T in C and to be t in S



Using Matlab

1) command window
2) clear
3) clc
4) close all
5) t = 0 : 1 : 60
6) T = 25 - 15 * exp(-0.22 * t)
7) Tn = subs(T)
8) plot(t, Tn)
9) grid on
10) find minor



(iv) using microsoft excel dynamic response the steady state temperature of the system would be 25°C at 10 s

(v) using the developed model equation, the temperature of the thermometer at t = 0 = 25°C