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A) Mathematical modelling Can be defined as the mathematical representation of a System and Simulation of a System involves Solving the mode and obtaining it's mathematical Solution and physical Solution

b) By the use of Balance law
By Differentiation
iii) The use of newton's law of Cooling

c) From newton's law of Cooling States

$$\frac{dt}{dt} \propto (T-T_A)$$

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

$$\therefore T = T_A + T_u e^{ut}$$
$$= 25 - 15e^{-1kt} \quad ..(2)$$

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

integrate both sides

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

$$-(T-T_A) = e^{K+C}$$

$$(T-T_A) = e^{KT} \cdot e^{c}$$

But $e^c = \overline{T}$

$$T - TA = \overline{T_0} e^{ut} \quad ..(1)$$

initially at $t = 0$ $T = 10°C$

and actual $\overline{T}$emperature

$$TA = 25°c$$

Equation one becomes

$$10 - 25 = T c^{K \cos}$$

$$15 = T_0 \times c = T_u$$

$$T_u = -15°c$$

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Equation one becomes

$10 - 25 = T c^{K \cdot 0s}$

$15 = T_0 \times c = T_u$

$T_u = -15°c$

$\therefore T = T_A + T_u e^{ut}$

$= 25 - 15e^{Kt} \quad ..(2)$

at $t = 5$ mn $T = 20°c$

From $t = 25 - 15e^{ut}$

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

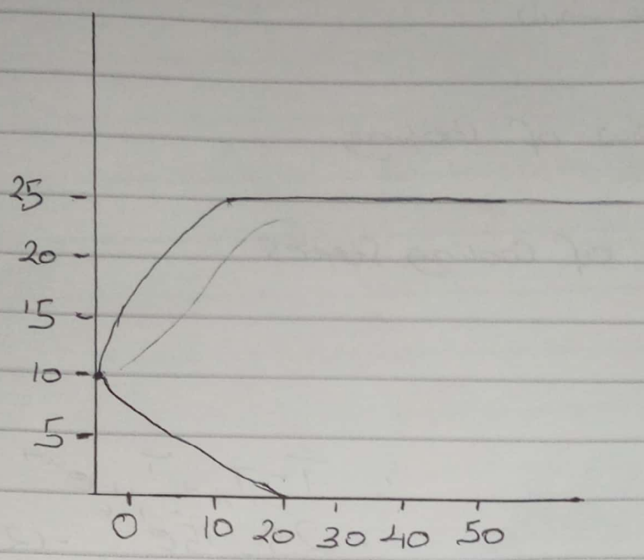
$-5 = -15e^{5i}$

$\ln(1/3) = 5u$

$K = \ln(1/3)/5 = -0.22$

$\therefore$ The model for the system

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



Command window

Clear

clc

Close all

t = ~~0:05~~ 0 - 0 : 5 : 50

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

Plot (t, T)

grid on

grid minor

xlabel (Time (sec)")

ylabel (Temperature (c°)")

The steady rate Temperature

= 25°c

5) At the temp of 25°c it was 0.5 second that there was no change in the temp despite the increase in the time therefore the system is said to be stable at low temp

6) For t = ? and t = 24.9°c

from the equation $T = 25 - 15e^{-0.22t}$

$24.9 = 25 - 15e^{-0.22t}$

$0.1 = 15e^{-0.22t}$

$t = 22.76$ mins

0.76 minutes -> Seconds

$0.76 \times 60 = 45.6 \rightarrow 46$ seconds

∴ The time required = 22 min and 46 sec.