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17/ENG02/063
COMPUTER ENGINEERING

A. Modelling is the mathematical representation and simulation of a system which involves solving the model and obtaining output variable for different values of input variable.

B. Balance law

- ii Differentiation
- iii Analysis method.

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

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

$$(T - T_A)$$

Integrate both sides

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

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

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

$$10 - 25 = C e^{k(0)}$$

$$C = -15$$

After 5 min, $T = 20^\circ\text{C}$ $t = 5$

$$T - T_A = -15 e^{k(5)}$$

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

$$-15$$

$$5k = \ln(0.33)$$

$$k = \frac{-1.0986}{5}$$

$$\therefore k = -0.222$$

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

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

$$T = 25 - 15 e^{-0.222t}$$

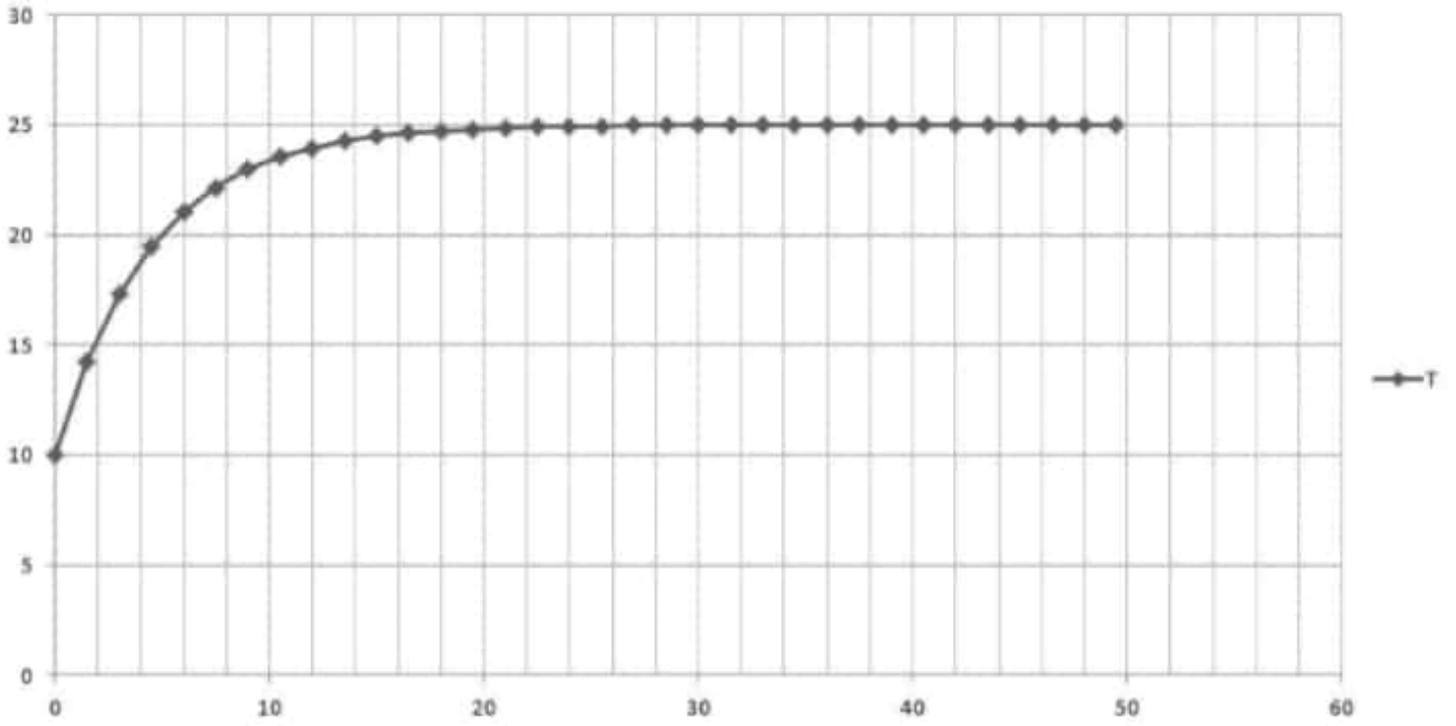
→ Microsoft Excel

$$t \Rightarrow 1-50$$

$$\Delta t = 1.5$$

$$T = 25 - 15 * (\text{EXP}(-0.222 * \Delta t))$$

T



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MATLAB SIMULATION CODE

Command window

Clear

clc

close all

Symst

t = 0:0.5:50

T = 25 - 15 * (exp(-0.222 * t))

Tb = Subs(T)

Plot (t, Tb)

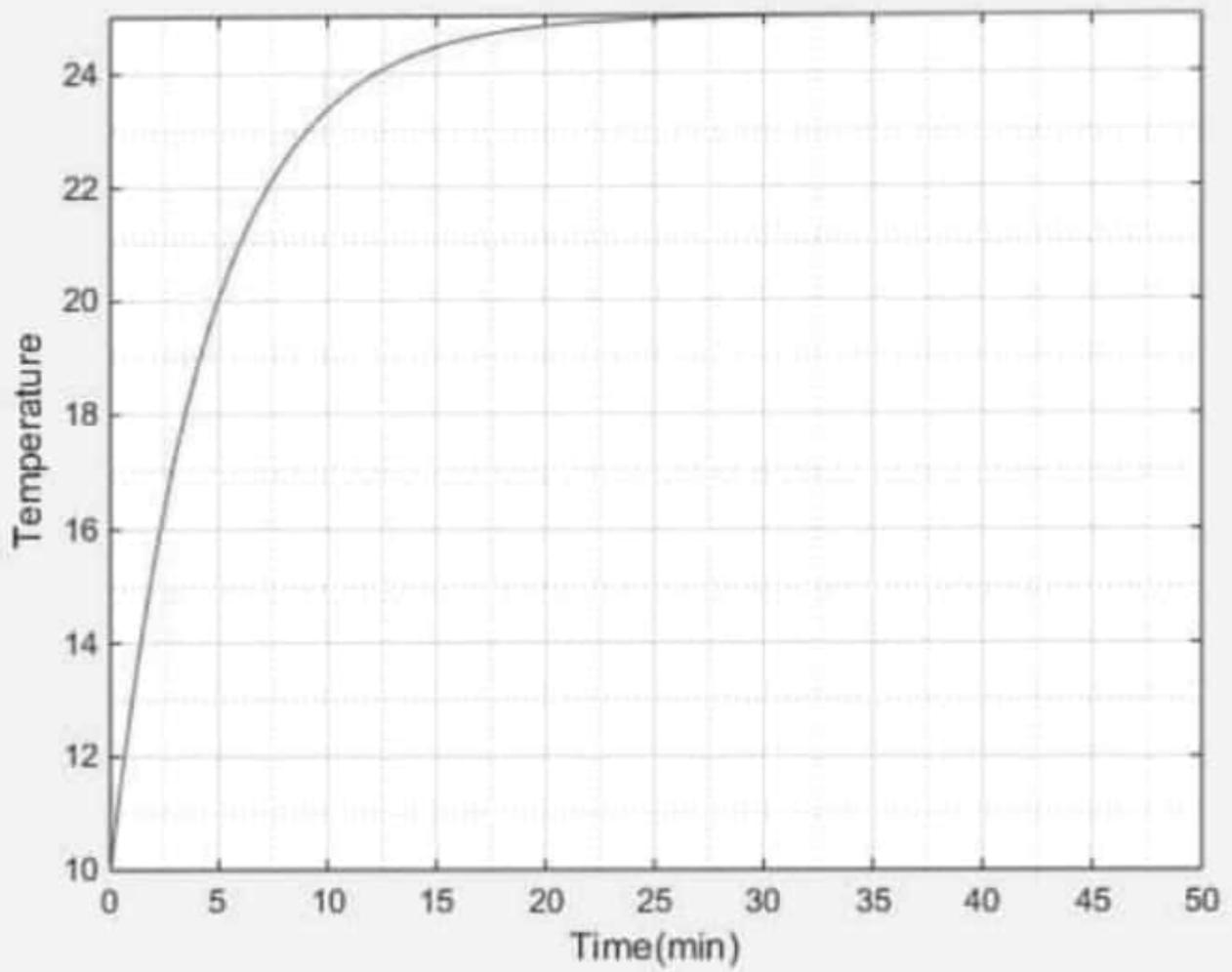
x label ('Time (min)')

y label ('Temperature')

grid on

grid minor

Axis tight



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iv. The steady state temperature of the system is 25°C

v. The system is not stable as the temperature changes with time.

vi. $T = T_A + Ce^{kt}$

Here our $T = 24.9^{\circ}\text{C}$

$$24.9 = 25 - 15e^{-0.222t}$$

$$24.9 - 25 = -15e^{-0.222t}$$

$$\ln \left[\frac{-0.1}{-15} \right] = -0.222t$$

$$t = \frac{-5.011}{-0.222}$$

$$t = 22.57 \approx 23 \text{ min}$$