

Jude - Shima Favour

17/ENUG02 1039

Computer Engineering
Mathematics Assignment V

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 variables.

B) Methods of obtaining models for Engineering Systems are

- i) Differentiating and
- ii) Use of Balance law

C) From Newton's law of cooling
 $\frac{dT}{dt} = k(C - T)$ By separating the variables

$$\frac{dT}{(C - T)} = k dt \quad \text{Integrating through}$$

$$\int \frac{dT}{(C - T)} = \int k dt \quad = \quad -(C - T) = k t + C$$

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

$$\text{Initially } e^C = C \quad \therefore \quad T - T_A = C e^{kt}$$

Where T is the thermometer initial reading 10°C and T_A , the actual temperature of the system 25°C all at time $(t) = 0$

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

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

$$10 - 25 = C$$

$$\therefore C = -15$$

After 5 minutes, the temperature of the thermometer

$$T_i = 20^\circ\text{C} \quad \text{and } t = 150 \text{ min}$$

$$T - T_A = Ce^{kt}$$

$$20 - 25 = -15e^{k(150)}$$

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

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

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

$$-1/3 = e^{5k}$$

$$\ln 0.33 = 5k$$

$$k = \frac{\ln(-1.0986)}{5} = -0.222$$

$$k = -0.222$$

Therefore the model of the system is

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

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

Simulation using micro soft excel

Some selection from the table (01-60)

t	T
0	10
6	21.98627
12	23.95493
18	24.72416
24	24.92719
30	24.98078
36	24.99493
42	24.99866
48	24.99965
54	24.99994
60	24.99998

Matlab Simulation of the model

code

Command window

clear

clc

close all

syms t

t = 0 : 1 : 60

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

Tb = subs T

plot (t, Tb)

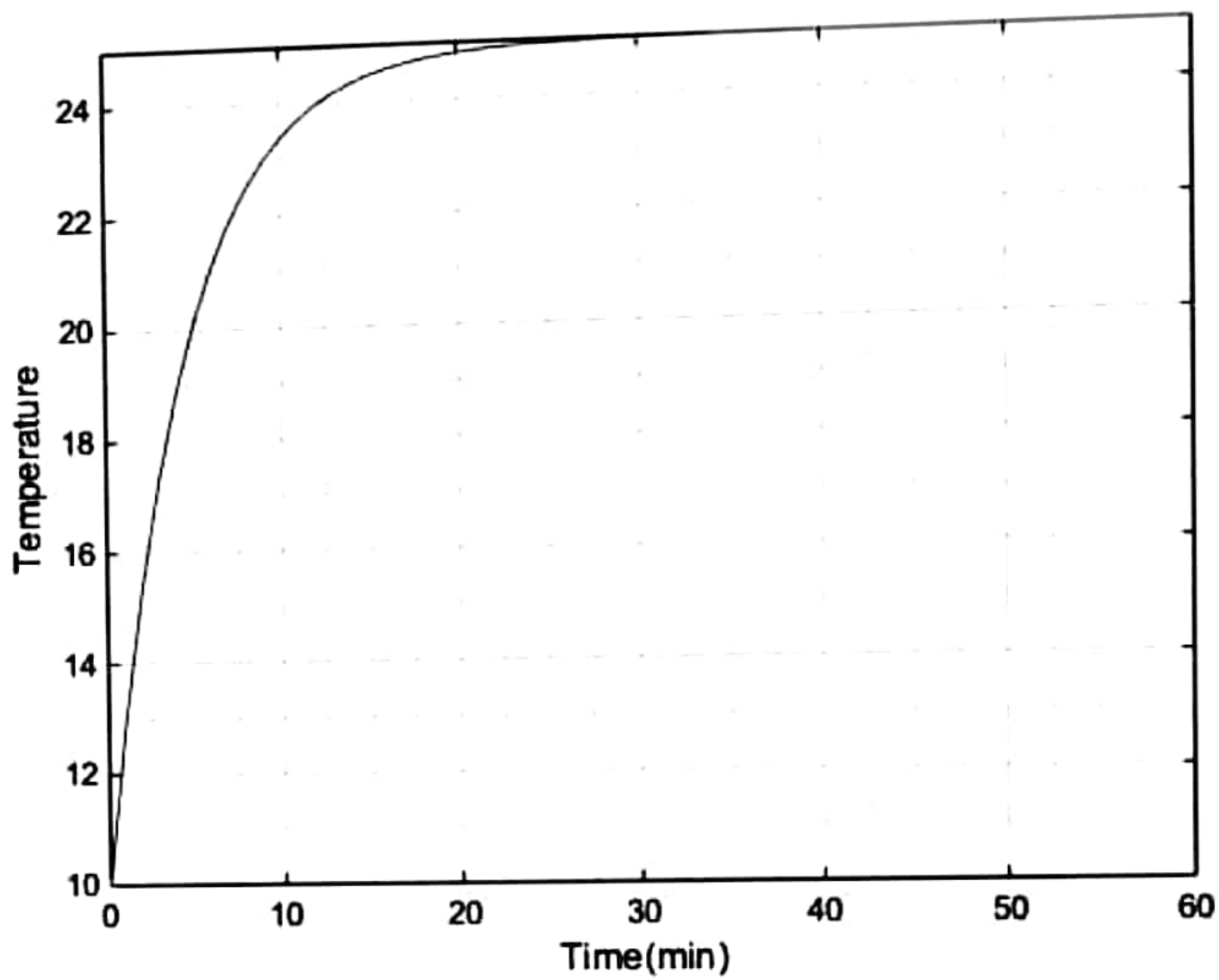
x label ('Time (min)')

y label ('Temperature')

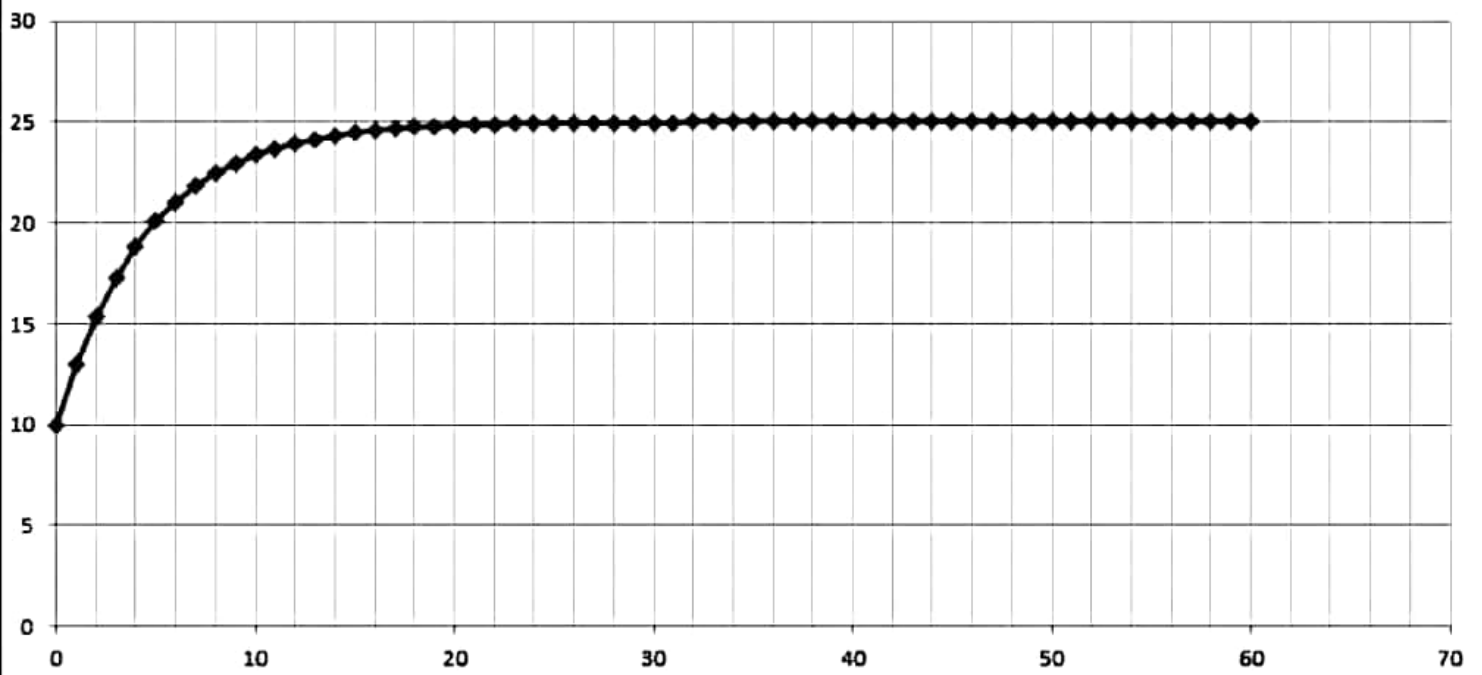
axis tight

grid on

grid minor



T



T