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17/ENG07/019

Petroleum Engineering

ENR 282 Assignment V

(a) Mathematical modelling is the process of setting up a model, solving it mathematically, and interpreting the result in physical or other terms.

b(i) Differentiation

(ii) Balance law

$$(i) T(0) = 10^\circ\text{C}$$

$$T(5) = 20^\circ\text{C}$$

$$\text{Input} = 25^\circ\text{C}$$

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

$$dT = k dt \cdot$$

$$(T - T_A)$$

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

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

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

$$A = e^C$$

$$T - T_A = Ae^{kt} + T_A$$

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

$$\text{when } T(0) = 10^\circ$$

$$10 = Ae^{k(0)} + 25$$

$$10 = A(1) + 25$$

$$10 - 25 = A$$

$$A = -15^\circ$$

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

$$\text{At } T(5) = 20^\circ$$

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

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

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

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

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

$$5k = \ln(5/15)$$

$$5k = -1.0986$$

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

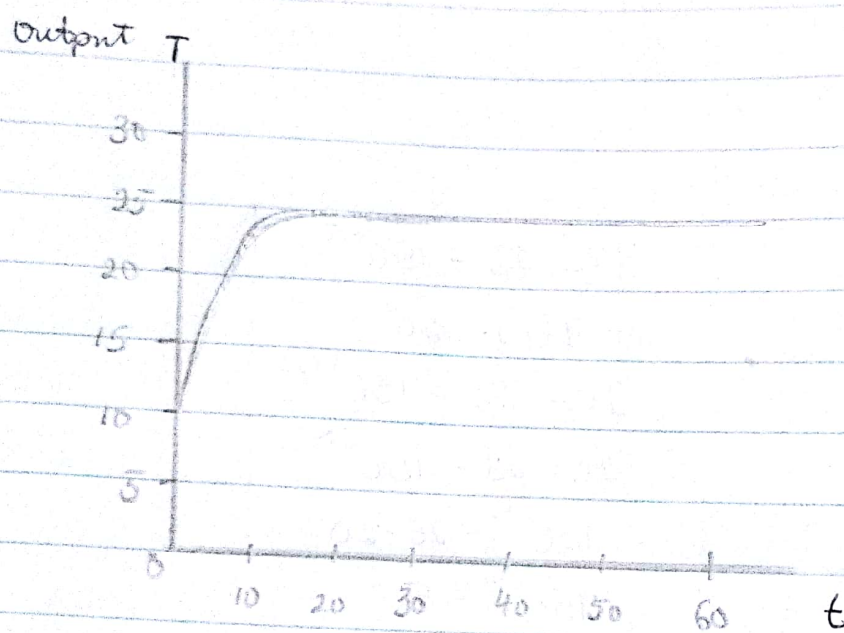
$$5$$

$$k = -0.21972 \approx$$

$$k = -0.22$$

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

(ii)	t	T
	0	$25 - 15 * \text{EXP}(-0.22 * B3) = 12.96222$
	1	$25 - 15 * \text{EXP}(-0.22 * B4) = 15.33945$
	2	$25 - 15 * \text{EXP}(-0.22 * B5) = 17.24723$
	58	$25 - 15 * \text{EXP}(-0.22 * B60) = 24.99996$
	59	$25 - 15 * \text{EXP}(-0.22 * B61) = 24.99997$
	60	$25 - 15 * \text{EXP}(-0.22 * B62) = 24.99997$



iii) Command window
 clear
 etc
 close all

$$t = [0:1:60]$$

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

Plot (t, T)

- iv) The steady-state temperature of the system is 25°C
 v) The temperature at $t \rightarrow \infty = 25^{\circ}\text{C}$