CP303 – Set #0 (January-May 2012)

Differential Equations in Reaction Engineering

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(1) Solve the following differential equations for the given initial conditions:

(i) $\dfrac{dx}{dt} = a\,x$ with $x = x_o$ at $t = 0$.

(ii) $\dfrac{dx}{dt} = a\,(1 + \epsilon x)$ with $x = 0$ at $t = 0$.

(2) Solve the following differential equations for a non-zero value of ϵ and give the solutions in terms of integrating constants:

(i) $\dfrac{dx}{dt} = a\,\dfrac{(1-x)}{(1+\epsilon x)}$

(ii) $\dfrac{dx}{dt} = a\,\dfrac{(1-x)^2}{(1+\epsilon x)}$

(iii) $\dfrac{dx}{dt} = a\,\dfrac{(1-x)^2}{(1+\epsilon x)^2}$

(3) Solve the following differential equation for the two different cases, (i) $p \neq q$ and (ii) $p = q$,

$$\frac{dx}{dt} = a\,(x-p)\,(x-q)$$

and give the solutions in terms of integrating constants.

(4) Solve the following differential equation

$$\frac{dx}{dt} = \frac{(c+gx)}{(a+bx)}$$

for the initial condition $x = 0$ at $t = 0$.

(5) Solve the following set of differential equations for (i) $k_1 \neq k_2$ and (ii) $k_1 = k_2$,

$$\begin{aligned} \frac{dC_A}{dt} &= -k_1\,C_A \\ \frac{dC_B}{dt} &= -k_2\,C_B + k_1\,C_A \end{aligned}$$

with the initial condition of $C_A = C_{Ao}$ and $C_B = 0$ at $t = 0$.