# CLL:113-Tut-4(4.10.20)

## ***Multivariate Non-linear Algebraic Equations:***

**Q1.** The mass balance equations for the following reactions taking place in a CSTR:

$$A \xrightarrow{k_1} 2B$$

$$A \underset{k_3}{\overset{k_2}{\leftrightarrow}} C$$

$$B \xrightarrow{k_4} D + C$$

is given by:

$$F_1 = -C_A + C_{A0} + \left[-K_1 C_A - K_2 C_A^{\frac{3}{2}} + K_3 C_C^2\right]\theta = 0$$

$$F_2 = -C_B + \left[2K_1 C_A - K_4 C_B^2\right]\theta = 0$$

$$F_3 = -C_C + \left[K_2 C_A^{\frac{3}{2}} - K_3 C_C^2 + K_4 C_B^2\right]\theta = 0$$

$$F_4 = -C_D + \left[K_4 C_B^2\right]\theta = 0$$

Use Newton Raphson Method and find the concentrations $\left[C_A\ C_B\ C_C\ C_D\right]$ for the following situation as a function of iteration

$$K_1 = 1.0\frac{1}{\text{s}}$$

$$K_2 = 0.2\frac{\text{lit}^{\frac{1}{2}}}{\text{s} - \text{mol}^{\frac{1}{2}}} \qquad K_3 = 0.05\frac{\text{lit}}{\text{s} - \text{mol}}$$

$$K_4 = 0.4 \frac{\text{lit}}{\text{s} - \text{mol}} \quad \theta = 2s \quad C_{A0} = 1 \text{ mol/lit}$$