Ex 1 MEMBRANE REACTOR

$$A \underset{K_{-1}}{\overset{K_1}{\rightleftharpoons}} B + C$$

PFR

$$\begin{cases} \dfrac{dF_A}{dV} = R_A \\ \dfrac{dF_B}{dV} = R_B \\ \dfrac{dF_C}{dV} = R_C \end{cases}$$

$$R_A = -r$$

$$R_B = r$$

$$R_C = r$$

$$r = K_1 \cdot C_A - K_{-1} \cdot C_B C_C$$

$$= K_1 C_A - \frac{K_1}{K_{eq}} C_B C_C$$

$$= K_1 \left(C_A - \frac{C_B C_C}{K_{eq}} \right)$$

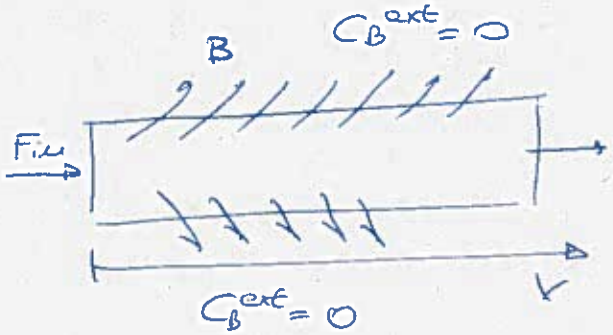
MEMBRANE

$$\begin{cases} \dfrac{dF_A}{dV} = R_A \\ \dfrac{dF_B}{dV} = R_B - K_m C_B \\ \dfrac{dF_C}{dV} = R_C \end{cases}$$

$$C_A = \frac{F_A C_{TOT}}{F_{tot}}, \quad C_B = \frac{F_B C_{TOT}}{F_{tot}}, \quad C_C = \frac{F_C C_{TOT}}{F_{tot}}$$

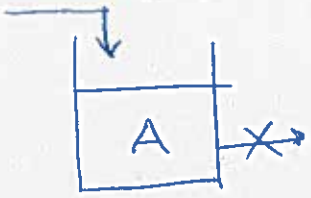
$$F_{tot} = F_A + F_B + F_C$$

$$C_{TOT} = \frac{P}{RT}$$



EX2 SEMI BATCH REACTOR

H_2SO_4 (S)



$A \xrightarrow{H_2SO_4} C \qquad r = K C_A C_S$

$$\frac{dN_A}{dt} = R_A V \qquad R_A = -r$$

$$\frac{dN_S}{dt} = F_S^{in} \qquad F_S^{in} = C_S^{in} Q_{in}$$

$$\frac{dV}{dt} = Q_{in}$$

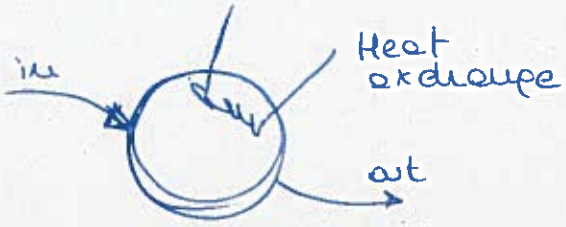
initial number of moles

$N_A^0 = C_A^0 V^0$

$N_S^0 = 0$

EX 3 STABILITY of CSTRS

$$A \xrightarrow{k_1} B \xrightarrow{k_2} C$$



$$\begin{cases} r_1 = k_1 C_A \\ r_2 = k_2 C_B \end{cases}$$

Mass balance equations

$$\frac{C_{A0} - C_A}{\tau} = -R_A = k_1 C_A \rightarrow C_{A0} = C_A(k_1\tau + 1)$$

$$C_A = \frac{C_{A0}}{1 + k_1\tau}$$

$$\frac{C_{B0} - C_B}{\tau} = -k_1 C_A + k_2 C_B = \frac{-k_1 C_{A0}}{1+k_1\tau} + k_2 C_B$$

$$C_{B0} - C_B = \frac{-k_1\tau C_{A0}}{1+k_1\tau} + k_2\tau C_B$$

$$C_B(k_2\tau + 1) = C_{B0} + \frac{k_1\tau C_{A0}}{1+k_1\tau} \rightarrow$$

$$\rightarrow C_B = C_{A0}\frac{k_1\tau}{(1+k_1\tau)(1+k_2\tau)}$$

$$\begin{cases} C_A = \dfrac{C_{A0}}{1+k_1\tau} \\ C_B = C_{A0}\dfrac{k_1\tau}{(1+k_1\tau)(1+k_2\tau)} \end{cases} \rightarrow \begin{cases} r_1 = k_1 C_A \\ r_2 = k_2 C_B \end{cases}$$

Energy balance equation

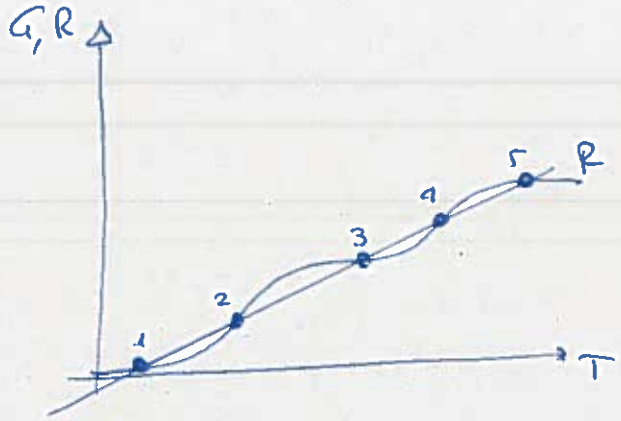
$$UA(T_{ex} - T) - F_{s0}\rho_{in}(T - T_{in}) + V(r_1 \Delta\tilde{U}_{R1} + r_2 \Delta\tilde{U}_{R2}) = 0$$

$\frac{UA}{F_{s0}\rho_{in}}$ → definitions

$$\begin{cases} K \triangleq UA / \dot{F}_{s0}\tilde{\rho}_{in} \\ T^* \triangleq \dfrac{T_{in} + K T_{ex}}{1+K} \end{cases}$$

PSP III

$$\underbrace{\overline{C_p^{in}}\,(1+k)(T-T^*)}_{R(T)} = \underbrace{\frac{V_0}{F\Delta 0}\left(-\tau_1 \Delta\overline{\Pi}_{R1} - \tau_2 \Delta\overline{\Pi}_{R2}\right)}_{G(T)}$$



1. STABLE 310K
2. UNSTABLE 363K
3. STABLE 498K
4. UNSTABLE 558K
5. STABLE 677K