Reaction Engineering, 2021
Test-4, Time-1hr

Q1. For the parallel reactions

$$A + B \rightarrow R \qquad r_R = k_1 C_A^{0.5} C_B^2$$
$$A + B \rightarrow S \qquad r_S = k_1 C_A^{1.5} C_B^{0.5}$$

R is the desired product and S is unwanted. Select the proper contacting scheme in a continuous flow reacting system for maximizing the desired product concentration. [5]

Q2. For the irreversible unimolecular type series reactions

$$A \overset{k_1}{\rightarrow} R \overset{k_2}{\rightarrow} S \quad where\ k_1 = 1.5\ min^{-1}\ and\ k_2 = 2.5\ min^{-1}$$

(a) What size of plug flow reactor maximizes the desired product (R) concentration ,C_R for a feed flow rate 100 L/min? C_{A0} =100 gmol/L. Compare the size of mixed flow reactor for maximizing C_R Calculate the maximum desired product concentration for both PFR and mixed reactor.
(b) How the desired product concentration will vary with the change of space time from 2 min to 10 min for mixed reactor? [5]

Q3. Liquid reactant A decomposes as per the following reactions:

$$A \rightarrow R \qquad r_R = k_1 C_A^2$$
$$A \rightarrow S \qquad r_S = k_2 C_A$$

Where, R is the desired product; k_1 = 0.4 m^3/(mol.min) and k_2 = 2 min^{-1}

An aqueous solution of A enters the plug flow reactor with C_{A0} = 40 mol/m^3. Mixture of A,R and S leaves the reactor. Find the space time (τ_P), C_R , and C_S for the plug flow reactor. [5]

Q4. (a) How can you find the exit age distribution plot from a response curve obtained by using a step-input tracer ?
[2]

(b) Describe a method for prediction of conversion for a first-order reaction using a non-ideal reactor. [3]