國立雲林科技大學
100學年度碩士班暨碩士在職專班招生考試試題

系所：化材系
科目：化工動力學

1. In a continuous plug-flow tubular reactor (PFTR), feedstock of pure A is transformed into desired product B in the reaction of A → B at the flow-rate of 4 liter/min with $C_{A0} = 2$ moles/liter. However, there is a second reaction A → C, which can also occur. Both reactions are first order and irreversible with $k_1 = 0.45\ min^{-1}$ and $k_2 = 0.05\ min^{-1}$. Find reactor volume (V), concentration of B (C_B), selectivity of B (S_B) and yield of B (Y_B) for 95% conversion of A. (20%)

2. For the reversible reaction A ↔ B, $r = k_f C_A - k_b C_B$, find the residence times for 50% conversion of A in a continuous stirred tank reactor (CSTR) and in a PFTR respectively, if $k_f = 0.7\ min^{-1}$, $k_b = 0.1\ min^{-1}$, $C_{A0} = 4$ moles/liter, feedstock flow-rate of 6 liter/min and $C_{B0} = 0$. (20%)

3. In a reaction rate expression, rate constant is usually presented as following:

$$k(T) = k_o \exp(-E/RT)$$

where E is the activation energy and k_o is the pre-exponential factor.
Please make descriptions to obtain E and k_o using "differential reactor" method. (10%)

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4. The parallel reactions

$$A \rightarrow D$$
$$A \rightarrow U$$

react in a CSTR. The entering molar flow rates are F_{A0}=5 mol/min and F_{D0}=F_{U0}=0. The effluent molar flow rates are F_A=1 mol/min, F_D=3 mol/min, and F_U=1 mol/min. Determine (10%)

(a) instantaneous selectivity $S_{D/U}$ and overall selectivity $\tilde{S}_{D/U}$

(b) instantaneous Yield Y_D and overall Yield $\tilde{Y}_D$

5. The following liquid-phase reactions were carried out in a CSTR with the space time τ. (20%)

$3A \rightarrow B + C$ $\quad -r_{1A} = k_{1A}C_A$

$2C \rightarrow 3D$ $\quad r_{2D} = k_{2D}C_c$

$3B + 4D \rightarrow 3E$ $\quad r_{3E} = k_{3E}C_BC_D$

(a) What are the net rates of reaction for A, B, C, D, and E?

(b) If the inlet feed only includes species A (C_{A0}), what is the exit concentration of C?

6. The irreversible elementary reaction

$$A + B \rightarrow C$$

reacts in two CSTRs in series ($\tau_1 = 2.5\text{min}, \tau_2 = 5\text{min}$). The influent and effluent volumetric flow rate keep the same (change in volumetric flow rate is negligible). The feed ($C_{A0} = 1.0\text{M}$, $C_{B0} = 1.6\text{M}$) enters the first CSTR and the compositions in the first reactor are $C_{A1} = 0.4\text{M}$. Find the C_{B1}, C_{A2} and C_{B2} (20%)