系所:化材系 科目:化工動力學

- 1. Please show how to obtain the designed equations for batch reactor, continuous stirred-tank reactor (CSTR), and tubular flow reactor, respectively. (21%)
- 2. 100 moles of B are to be produced hourly from a feed consisting of a saturated solution of A ( $C_{A0}$ = 0.1 mol/liter) in a mixed flow reactor. The reaction is

 $A \rightarrow B$ , and reaction rate of B  $r_B = (0.2/hr) \bullet C_A$ 

Cost of reactant at  $C_{A0}= 0.1$  mol/liter is

NT\$ 0.5/mole A.

Cost of reactor including instillation, auxiliary equipment, instrumentation, overhead, labor, etc., is

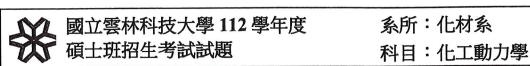
NT\$ 0.01/(hr · liter).

What reactor size, feed rate, and conversion shall be used for optimum operations? What is the unit cost of B for these conditions if unreacted A is discarded? (19%)

3. Acetaldehyde vapor is decomposed in an ideal tubular-flow reactor according to the reaction:

 $CH_3CHO \rightarrow CH_4 + CO$ 

The reactor is 3.3 cm ID and 80 cm long and maintained at a constant temperature  $518^{\circ}$ C. The acetaldehyde vapor is measured at room temperature and slightly above atmospheric pressure. For consistency, the measured flow rate is corrected to the standard condition (0°C, 1atm). In one run, 35% of the acetaldehyde is decomposed in the reactor. The second-order specific rate constant is 0.33 liter/(s)(g mol) at 518 °C, and the reaction is irreversible. The pressure is essential atmospheric. Calculate the actual residence time. (10%)



4. Consider the following complex reactions in a reactor:

$3A \rightarrow B + 2C$	$-\mathbf{r}_{1\mathbf{A}} = k_{1\mathbf{A}}C_{\mathbf{A}}$
$A + 2B \rightarrow 3D$	$r_{\rm 2D} = k_{\rm 2D} C_A C_B^2$

What are the net rates of reaction for A, B, C, and D ( $r_A$ ,  $r_B$ ,  $r_C$ , and  $r_D$ )? (16%)

5. A liquid-phase irreversible reaction  $A \rightarrow B$ ,  $-r_A = kC_A^n$ , was carried out in a constant-volume batch reactor where the variation of concentration was recorded as follows:

t, min	0	10	20	30	40
Сл, М	1	0.16	0.0625	0.0331	0.0204

Determine the reaction order (n) and the rate constant (k). (20%)

6. Substance A in a liquid-phase reactor produces B and C by the following parallel reactions:

$$A \rightarrow B, \quad r_B = k_1 C_A, \quad k_1 = \alpha_1 e^{-\frac{E_1}{RT}}$$
$$A \rightarrow C, \quad r_C = k_2 C_A, \quad k_2 = \alpha_2 e^{-\frac{E_2}{RT}}$$
where  $\alpha_1 = 10^{15} \ s^{-1}$ ,  $\alpha_2 = 5 \times 10^{16} \ s^{-1}$ ,  $E_1 = 89 \ \frac{kJ}{mol}$ , and  $E_2 = 100 \ \frac{kJ}{mol}$ . What temperature makes that  $r_B = r_C$ ? (14%)