CBCS SCHEME

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18CH53

Fifth Semester B.E. Degree Examination, July/August 2021
Chemical Reaction Engineering - I

Time: 3 hrs. Max. Marks: 100

Note : 1. ***Answer any FIVE full questions.***
2. ***Issue of Graph sheets are recommended.***

1 a. How chemical reactions are classified? Explain with one example for each. **(10 Marks)**

b. Explain the temperature dependency term given by Transition State theory in detail. **(10 Marks)**

2 a. On doubling the concentration of reactant triples, find the reaction order. **(10 Marks)**

b. Define the following terms : i) Rate ii) Order and iii) Molecularity of chemical reactions. **(10 Marks)**

3 a. Explain the difference between Integral and differential method of Analysis of kinetic data. **(05 Marks)**

b. The following table shows how the concentration of reactant A varied with time in a particular experiment :

Time (min)	0	18	31	55	79	157	∞
Concentration of A(mol/L) X 10^4	2.77	2.32	2.05	1.59	1.26	0.58	0.0

i) Plot a graph of concentration of A against time.
ii) Draw tangents at the curves 10, 50, 100 and 150 minutes and calculate their slopes.
iii) Plot a graph of rate of reaction against concentration of A. **(15 Marks)**

4 a. Derive overall order of irreversible reaction from the Half – life $t_{½}$ method for first order and second order. **(10 Marks)**

b. The data for a chemical reaction A + B → R is given below :

C_A	0.5	1.0	1.0
C_B	0.5	0.5	1.0
$\frac{-dC_A}{dt}$	0.02	0.08	0.16

Determine the overall order of reaction. **(10 Marks)**

5 a. Write the general performance equations for batch reactor ; CSTR/MFR and PFR. **(06 Marks)**

b. Describe the construction features of Semi batch reactor, with a neat sketch. **(05 Marks)**

c. In an isothermal batch reactor, the conversion of a liquid reactant A achieved in 13 mins is 70%. Find the space time and space velocity necessary to affect this conversion in a PFR. Consider first order kinetics. **(09 Marks)**

6 It is proposed to operate a batch reactor for converting A→ R. This is as liquid phase reaction with the stiochiometry A → R. Find the time required to drop the concentration of A from C_{A_o} = 1.3 mol/L to C_{A_f} = 0.3mol/L. The rate V/s concentration data are as given below :

C_A, mol/L	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.3	2.0
$-r_A$, mol/L.min	0.1	0.3	0.5	0.6	0.5	0.25	0.10	0.06	0.05	0.045	0.042

(20 Marks)

7 a. Derive an expression for the concentration of reactant in the exit stream from a series of MFR's in different sizes. Assume that the reaction follows first order kinetics and the holding time in the i^{th} order reactor is τ_i. **(10 Marks)**

b. A first order irreversible reaction $A \rightarrow R$ is carried out in a PFR followed by MFR in series. The concentration of A in the feed is 1 Kmol/m^3 and residence time for the reactor is 3600 sec. the specific rate constant for the reactor is 1/3600 sec^{-1}. Find the conversion of A at the exit and the system. **(10 Marks)**

8 a. Explain the graphical procedure for finding the outlet concentration from a series of MFR's of various sizes for reactions. **(10 Marks)**

b. Discuss the qualitative treatment about the product distribution of decomposition of A, for reaction of type

$A \rightarrow R$; desired product , rate constant k_1 and reaction order n_1.

$A \rightarrow S$; undesired product , rate constant k_2 and reaction order n_2.

For the cases : i) $n_1 > n_2$ ii) $n_1 < n_2$ iii) $n_1 = n_2$. **(10 Marks)**

9 a. Explain the effect of temperature on heat of reaction of the type :

$aA + bB \rightarrow rR + sS$.

ΔHR_1 is the enthalpy change at pressure 1 at m and temperature T_1.

ΔHR_2 is the enthalpy change at pressure 1 at m and temperature T_2. **(10 Marks)**

b. What is Chemical Equilibrium? Explain the characteristics of chemical equilibrium. Define equilibrium constant (k) from thermodynamics. **(10 Marks)**

10 a. Discuss about Optimum temperature progression. **(10 Marks)**

b. Describe stepwise procedure for adiabatic CSTR when conversion is specified (X_A) for determining volume (V) and temperature (T). **(10 Marks)**

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