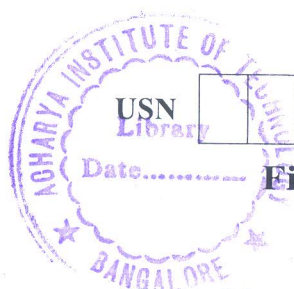


CBCS SCHEME



18BT52

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

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions.

1.
 - a. Derive rate equation for first order rate of reaction $A \rightarrow R$ both in terms of concentration and conversion. (08 Marks)
 - b. The activation energy of a chemical reaction is 17982 cal/mol in the absence of a catalyst and 11980 cal/mol with the catalyst. By how many times with the rate of the reaction will grow in the presence of a catalyst, if the reaction proceeds at 25°C. (06 Marks)
 - c. At 25°C, the rate constant for the hydrolysis of ethyl acetate by NaOH is 6.5 l/(mol) (min) starting with concentration of base and ester of 0.03 mol/l of each. What proportion of ester will be hydrolysed in 10min. (06 Marks)

2.
 - a. Compare differential and integrals of reaction data of a reaction mixture. (04 Marks)
 - b. Derive rate equation for second order rate of reaction $A + B \rightarrow R$ in terms of conversion. (12 Marks)
 - c. Decomposition of a gas in second order. When the initial concentration of gas is 5×10^{-4} mol/l, it is 40% decomposed in 50min. Calculate the value of rate constant. (04 Marks)

3.
 - a. Derive performance equation for mixed flow reactor and plug flow reactor. (10 Marks)
 - b. In an isothermal batch reactor the conversion of a liquid reactant A is 70% in 13min. Find the space time and space velocity necessary to effect thin conversion in a plug flow reactor and in a mixed flow reactor. Consider first order reaction. (10 Marks)

4.
 - a. Derive the performance equation of equal size CSTR are connected in parallel. Explain space velocity and space time. (08 Marks)
 - b. An aqueous feed of A and B (400l/min) with $C_{A_0} = 100$ mmol/l and $C_{B_0} = 200$ mmol/l is to be converted into product in a plug flow reactor. The kinetics and stoichiometry of the reaction are given by $A + B \rightarrow$, $-r_A = 200 C_A C_B$ (mol/l.min). Estimate the volume of plug flow reactor required to achieve 99% conversion of A to product. (12 Marks)

5.
 - a. Explain the experimental method to determine residence time distribution (pulse input) and list out the properties of tracer. (08 Marks)
 - b. The data given below represent a continuous response to a pulse input into a closed vessel which is to be used as a chemical reactor. Calculate the mean residence time of fluid in the vessel. \bar{t} and tabulate and construct E curve.

t min	0	5	10	15	20	25	30	35
C_{pulse} (g/l) (tracer output conc ⁿ)	0	3	5	5	4	2	1	0

(12 Marks)

6.
 - a. Discuss residence time distribution in mixed flow reactor. (12 Marks)
 - b. Enumerate the relationship between the F and E curve in non ideal flow. (08 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

- 7 a. Compare Competitive and Non – competitive inhibition. (08 Marks)
 b. The K_m value of an enzyme is known to be 0.01 mol/l . To measure the rate catalysed by enzyme, you measure the initial rate of the reaction and find that 10% of the initial substrate concentration is $3.4 \times 10^{-4} \text{ mol/h}$. Assume that the reaction rate can be expressed by $M - m$ kinetics. i) What is the reaction rate? ii) What is the concentration of substrate after 15 mins? (12 Marks)

- 8 a. Compare LB plot and Eadie – Hofree plot and find k_m and V_{\max} from graph. (08 Marks)
 b. Determine the $M - M$ parameter V_m and k_{mn} for



The rate equation is given as a function of concentration of urea.

Urea conc ⁿ Kmole/m ³ [S]	0.2	0.02	0.01	0.05	0.02
Rate Kmole/m ³ sec [V]	1.082	0.55	0.38	0.2	0.09

(12 Marks)

- 9 a. Derive Monod model of growth kinetics with ideal reactor kinetics. (06 Marks)
 b. Aerobic degradation of Benzoic acid by mixed culture of micro organisms is given by
 $\text{C}_6\text{H}_5\text{COOH} + a\text{O}_2 + b\text{NH}_3 \rightarrow c\text{C}_5\text{H}_7\text{NO}_2 + d\text{H}_2\text{O} + e\text{CO}_2$.
 i) Determine the stoichiometric coefficient if $\text{RQ} = 0.9$.
 ii) Determine the yield coefficients by $Y_{X/S}$ & Y_{X/O_2} . (14 Marks)

- 10 a. Explain Primary and Secondary product formation kinetics. (10 Marks)
 b. Write a short note on Growth Filamentous bacteria. (10 Marks)
