CBCS SCHEME

USN | | | | | | | | | | |

18BT52

Fifth Semester B.E. Degree Examination, June/July 2024
Chemical Reaction Engineering

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. The rate of bimolecular reaction at 227°C is ten times the rate of 127°C. Find the activation energy of this reaction from Arrhenius law. **(06 Marks)**

b. Define the following :
i) Order and molecularity ii) Elementary and non elementary reaction
iii) Law of mass action. **(06 Marks)**

c. Explain Integral and differential method of analyzing the kinetic for constant volume system. **(08 Marks)**

OR

2 a. Derive an integrated rate equation for bimolecular irreversible 2nd order reaction both interms of concentration and conversion. ($2A \rightarrow P$, where $C_A = C_B$). **(10 Marks)**

b. After 8 min in a batch reactor reactant A (C_{AO} = 1 moles/lit) is 80% converted. After 18 min, the conversion is 90%. Find the rate equation to represent this reaction. **(10 Marks)**

Module-2

3 a. Derive the design equation for a steady state plug flow reactor both interms of concentration and conversion. **(10 Marks)**

b. 1 ℓpm of a liquid containing A and B flows into a mixed flow reactor (MFR) [C_{AO} = 0.1mole/lit and C_{BO} = 0.01 mole/lit] of volume 1 lit. The material reacts in a complex manner for which the stiochiometry is unknown. The outlet stream from the reactor contains A , B and C (C_A = 0.02mole/lit , C_B = 0.03 mole/lit and C_C = 0.04 mole/lit). Find the rate equation of A, B and C for the condition within the reactor. **(10 Marks)**

OR

4 a. Derive the design equation for batch reactor both interms of conversion and concentration with a graphical representation. **(10 Marks)**

b. A liquid stream of 1 mole/lit passes through 2 MFR's in series. The concentration of A in the exit of 1st reactor is 0.5 mole/lit. Find the concentration of exit stream of 2nd reactor if the reaction is 2nd order w.r.t A $\left(\frac{V_2}{V_1} = 2\right)$. **(10 Marks)**

Module-3

5 a. Explain the pulse experiment to idealize the non ideal reactor. **(10 Marks)**

b. With a neat sketch, explain the reasons for non ideality in the reactor operations. **(06 Marks)**

c. Write a brief note on characteristics of trach. **(04 Marks)**

OR

6 a. A first order liquid phase reaction, $A \rightarrow P$, $-r_A = KC_A$, where $K = 0.307\ min^{-1}$ is carried out in a reactor for which the results of pulse tracer test is given below. Calculate the conversion using ideal PFR , ideal MFR and tanks in series model. **(12 Marks)**

t, min	0	5	10	15	20	25	30	35
e_{pulse} g/lit	0	3	5	5	4	2	1	0

b. Derive an equation for Residence Time Distribution (RTD) in MFR. **(08 Marks)**

Module-4

7 a. Derive Michaelis – Menten equation stating all assumptions. **(10 Marks)**

b. Determine M.M parameters V_{max} and K_m for the reaction

$$\text{Urea} + \text{Urease} \underset{K_2}{\overset{K_1}{\rightleftarrows}} [ES] \xrightarrow{K_3} NH_3 + CO_2 + \text{Enzyme}.$$

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

Urea, [S] $(Kmol/m^3)$	0.2	0.02	0.01	0.005	0.002
Rate, V ($Kmol/m^3$, sec)	1.082	0.55	0.38	0.2	0.09

(10 Marks)

OR

8 a. What is Enzyme Inhibition? Explain competitive and non – competitive inhibition. **(12 Marks)**

b. Explain any two methods for estimation of M – M parameters. **(08 Marks)**

Module-5

9 a. Discuss about Monod model and Lue deKing – Piret model of growth rate of micro organisms. **(12 Marks)**

b. Discuss in detail the thermal death kinetics of micro organisms. **(08 Marks)**

OR

10 a. Write a note on the different medium requirement for fermentation process. **(10 Marks)**

b. Explain the objective of heating , holding and cooling operations of sterilization. **(10 Marks)**

* * * * *