



K. K. Wagh Institute of Engineering Education & Research, Nashik
(An Autonomous Institute From A.Y. 2022-23)

WINTER-2025	
Exam Seat No.:	
Academic Year: 2025-2026	Semester: V
Class: TY	Program: B.Tech
Branch Code: CHE	Pattern: 2023
Name of Course: Chemical Reaction Engineering I	Course Code: 2307302
Max. Marks: 60	Duration: 2.30 Hrs.

Instructions: Candidates should read carefully the instructions printed on the Question Paper and on the cover page of the Answer Book, which is provided for their use.

1. This question paper contains two pages.
2. Answer to each new question is to be started on a new page.
3. Assume suitable data wherever required, but justify it.
4. Draw the neat labelled diagrams, wherever necessary.
5. The last columns indicates the Course Outcome.

Marks CO

Question No. 1

- 1a) Explain the concept of rate constant and discuss the factors affecting it. (6) CO1

Question No. 2

- 2a) Explain half-life method of analysis of kinetic data. (6) CO1

Question No. 3

- 3a) Derive performance equation of mixed flow reactor and predict design of reactor using graphical presentation. (8) CO2

OR

- 3b) An industrial unit has two mixed reactors of unequal sizes for producing a specified product that forms by homogeneous first order reaction. How should these reactors be connected to achieve maximum production rate? (8) CO4

- 3c) In an industrial operation, mixed flow reactors of different sizes are connected in series. Derive an expression for concentration of reactant in the exit stream considering first order kinetics. (8) CO2, CO4

OR

- 3d) Derive expression of fractional conversion in terms of Damkohler number for first order reaction taking place in mixed flow reactor. Explain its significance. (8) CO2

Question No. 4

- 4a) Discuss the qualitative behavior of product distribution in unimolecular parallel reactions. (8) CO1

OR

- 4b) Explain the quantitative treatment of product distribution in multiple reactions for unimolecular parallel reactions (8) CO1, CO3

- 4c) Derive expressions showing how reactor size (for PFR) influences the distribution of products. (8) CO1, CO3

OR

- 4d) Reactant A in liquid phase reacts to produce product R and S by parallel reactions. Order of reaction A to R is 2, then for A to S is 1. A feed with $C_{A0} = 1$ and $C_{R0} = 0$, $C_{S0} = 0.30$, enters in two mixed flow reactors in series ($\tau_1 = 2.5$ min, $\tau_2 = 10$ min). The composition within the first reactor is $C_{A1} = 0.4$, $C_{R1} = 0.2$ and $C_{S1} = 0.7$. Find the composition of the exit stream from the second reactor. (8) CO3

Question No. 5

- 5a) Explain Residence Time Distribution (RTD). Derive expressions for E(t) and F(t) curves. (8) CO1, CO3

OR

- 5b) Discuss the significance of RTD in diagnosing non-ideal flow in chemical reactors. (8) CO1, CO3
- 5c) Explain the Dispersion Model. State assumptions for derive the RTD for a reactor with axial dispersion. (8) CO1, CO3

OR

- 5d) A first-order liquid-phase reaction with a rate constant of 0.25 min^{-1} is conducted in a reactor. Based on pulse tracer test results t vs E(t) given below, the reactor has a mean residence time of 5.15 minutes. Calculate the variance and conversion in ideal flow reactors and Tanks-in-series model (8) CO1, CO3

t	0	1	2	3	4	5	6	7	8	9	10	12	14
E(t)	0	0.02	0.10	0.16	0.20	0.16	0.12	0.08	0.06	0.044	0.03	0.012	0

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