



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: 2022
Name of Course: Chemical Reaction Engineering I	Course Code: CHE223002
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) Derive the temperature dependency of the rate constant using the Arrhenius equation. (6) CO1

Question No. 2

- 2a) The rates of reaction at concentrations 0.15 mol/l and 0.05 mol/l are 2.7×10^{-3} and 0.3×10^{-3} mol/l.min. What is the order of the reaction with respect to reactant (6) CO2

Question No. 3

- 3a) Derive performance equation of batch reactor and predict time required for particular conversion using graphical presentation. (8) CO3

OR

- 3b) In an industrial operation, second order reaction takes place in MFR with 50% conversion. Find the conversion if this reactor is replaced by PFR of the same size- all else remain unchanged. (8) CO3

- 3c) 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) CO3

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) CO3

Question No. 4

- 4a) Discuss the qualitative behavior of product distribution in bimolecular parallel reactions. (8) CO4

OR

- 4b) Explain the quantitative treatment of product distribution in multiple reactions for unimolecular parallel reactions (8) CO4

- 4c) Derive expressions showing how reactor size for batch influences the distribution of products. (8) CO4

OR

- 4d) Reactant A in liquid phase reacts to produce product R and S by parallel reactions. Both reactions are of first order. A feed with $C_{A0} = 1$ and $C_{R0} = C_{S0} = 0$, enters in two mixed flow reactors in series ($\tau_1 = 2$ min, $\tau_2 = 5$ min). The composition within the first reactor is $C_{A1} = 0.4$, $C_{R1} = 0.4$ and $C_{S1} = 0.2$. Find the composition of the exit stream from the second reactor. (8) CO4

Question No. 5

- 5a) Explain Pulse Input and Step Input Methods for determining RTD. What information does each provide? (8) CO5

OR

- 5b) Derive the RTD function $E(t)$ for Mixed Flow Reactor (CSTR). Compare their RTD curves. (8) CO5
- 5c) Explain the concept of segregation and micromixing. How does it affect reactor performance and product distribution (8) CO5

OR

- 5d) A first-order liquid-phase reaction with a rate constant of 0.05 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 34.61 minutes. Calculate the variance and conversion in ideal flow reactors and tanks in series model (8) CO5

t	0	10	20	30	40	50	60	70
E(t)	0.013	0.014	0.015	0.015	0.015	0.014	0.0136	0.013

..... End of question paper.....