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)	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)	CO2
	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)	CO2, CO4
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)	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 bimolecular parallel reactions.	(8)	CO1
	OR		
4b)	Explain the quantitative treatment of product distribution in multiple reactions for unimolcular parallel reactions	(8)	CO1, CO3
4c)	Derive expressions showing how reactor size for batch 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. 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 (τ_1 = 2 min, τ_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) CO1, CO3

Question No. 5

5a) Explain Pulse Input and Step Input Methods for determining RTD. What information does each provide? (8) CO1, CO3

OR

5b) Derive the RTD function E(t) for Mixed Flow Reactor (CSTR). Compare their RTD curves. (8) CO3, CO4

5c) Explain the concept of segregation and micromixing. How does it affect reactor performance and product distribution? (8) CO1, CO3

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) CO3

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**·····