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: VI
Class: TY	Program: B.Tech
Branch Code: CHE	Pattern: 2022
Name of Course: Chemical Reaction Engineering II	Course Code: CHE223012
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 expression relating time and conversion for unreacted core model when chemical reaction controls.	(6)	CO1
Question No. 2			
2a)	Discuss the types of fluid-fluid reactions with examples, and write the factors affecting the fluid-fluid reactions.	(6)	CO2
Question No. 3			
3a)	Write short notes on adsorption isotherms? How do temperature and pressure affect the adsorption rate and capacity of adsorbents? Provide real-world examples.	(8)	CO3
	OR		
3b)	Explain the systematic procedure for determining the specific surface area of a solid material using the BET (Brunauer–Emmett–Teller) method.	(8)	CO3
3c)	Describe the deactivation of catalysts. What are the causes of catalyst Fouling, and how can catalysts be regenerated.	(8)	CO3
	OR		
3d)	Explain different methods used for the preparation of solid catalysts	(8)	CO3
Question No. 4			
4a)	Derive expression of effectiveness factor for solid catalyzed reactions.	(8)	CO4
	OR		
4b)	Explain different steps involved in solid catalysed reactions.	(8)	CO4
4c)	The reaction A $\rightarrow$ 3R is carried out at 800^{o}C in a catalytic tubular reactor.	(8)	CO4

$-r_A^I$=10 (l/(h.kg cat))$C_{A,}$ A tubular reactor 20 mm ID to be used on a pilot scale is packed with 30% of these catalyst pellets evenly mixed with 70% of inert pellets. For a flow rate of 500 mo/h of feed

containing 60% A and 40% inert gas at 8.5 atm and 800^{o}C, what should be the weight of the catalyst bed so that ratio of partial pressure of A in exit stream to that in inlet stream is 0.15.

Data:
(i) Catalyst and inert pellets are porous (d_p=3 mm)

(ii) Particle density ρ_s=2 g/cm^3

(iii) Bulk voidage of packed bed, ε=50%

(iv) Internal diameter of tubular reactor = 2 cm^2

OR

4d) The results of the kinetic runs on the reaction A → R made in an experimental packed bed reactor using a fixed feed rate F_{Ao} = 10 kmol/h are as follows: (8) CO4

W	1	2	3	4	5	6	7
X_A	0.12	0.2	0.27	0.33	0.37	0.41	0.44

Find the reaction rate at 40% conversion.

Question No. 5

5a) Explain the working principle, advantages, and limitations of slurry reactors with suitable examples (8) CO5

OR

5b) Differentiate between gas-liquid, gas-solid, and gas-liquid-solid reactors. Give industrial examples for each. (8) CO5

5c) With the help of a plot, explain how the integrated M-M equation predicts the variation of substrate concentration with time for different values of Michaelis constant (K_M). (8) CO5

OR

5d) Write a short note on enzyme fermentation (8) CO5

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