

Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VII EXAMINATION – SUMMER 2025

Subject Code:2170501

Date:19-05-2025

Subject Name:Chemical Reaction Engineering - II

Time:02:30 PM TO 05:00 PM

Total Marks:70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		MARKS
Q.1	(a) State the reasons for the existence of Non-Ideal flow in a process vessel with diagram	03
	(b) State the application of Dispersion Model and Tanks-In-Series model in Non-Ideal flow in process vessel	04
	(c) Discuss the relationship between E, C and F curves in RTD theory	07
Q.2	(a) Discuss in brief linear and non-linear processes	03
	(b) Explain various methods used in Stimulus Response Procedure to find extent of non-ideality in the reactor	04
	(c) Explain the various contacting pattern for two phase systems	07
	OR	
	(c) Discuss earliness and lateness of mixing with diagram	07
Q.3	(a) Explain convolution Integral with diagram	03
	(b) Explain the film conversion parameter in fluid-fluid reaction	04
	(c) Discuss the concentration profile with diagram for slurry reaction kinetics	07
	OR	
Q.3	(a) State the important any three reasons for using fluid-fluid reaction system	03
	(b) Explain the role of Hatta Number M_H in fluid fluid reaction	04
	(c) Discuss in brief various cases based on speed of reaction for fluid-fluid reaction with diagram	07
Q.4	(a) Discuss in brief Unreacted core model with changing size with diagram	03
	(b) Discuss the limitations of Shrinking Core Model in fluid-particle reaction	04
	(c) Derive the equation for Shrinking Core Model considering diffusion through gas film as rate controlling step in a fluid-particle reaction	07
	OR	
Q.4	(a) Discuss in brief Progressive conversion model with diagram	03
	(b) Explain how to do selection of a model for any particular fluid-particle reaction	04
	(c) Derive the equation for Shrinking Core Model considering diffusion through Ash layer as rate controlling step.	07

Q.5 (a) Define Activation Energy, show the effect of using catalyst with graph comparing with a non-catalyzed reaction **03**

(b) The concentration readings in Table given below represent a continuous response to a pulse input into a closed vessel which is to be used as a chemical reactor. Calculate the mean residence time of fluid in the vessel t , and tabulate and plot the exit age distribution E **04**

Time, t , min	0	5	10	15	20	25	30	35
Tracer Output concentration, C_{pulse} gm/lt fluid	0	3	5	5	4	2	1	0

(c) The concentration of undesirable impurity in air (at 1 bar = 10^5 Pa) is to be reduced from 0.1% (or 100 Pa) to 0.02% (or 20 Pa) by absorption in pure water. Find the height of tower required for countercurrent operations. Data: $k_{Ag}a = 0.32 \text{ mol/hr} \cdot \text{m}^3 \cdot \text{Pa}$, $k_{Al}a = 0.1/\text{hr}$, $C_T = 56\,000 \text{ mol/m}^3$
 $H_A = p_{Ai}/C_{Ai} = 12.5 \text{ Pa} \cdot \text{m}^3/\text{mol}$, $F_g/A_{cs} = 1 \times 10^5 \text{ mol/hr} \cdot \text{m}^2$,
 $F_l/A_{cs} = 7 \times 10^5 \text{ mol/hr} \cdot \text{m}^2$ **07**

OR

Q.5 (a) Define Promoter, Inhibitors, Poisoning and give its examples **03**

(b) The vessel with RTD data as given in table is to be used as a reactor for a liquid decomposing with rate $-r_A = kC_A$, $k = 0.307 \text{ min}^{-1}$. Find the fraction of reactant unconverted in the real reactor and compare this with the fraction unconverted in a plug flow reactor of the same size. Data given is as in the table **04**

Time, t , min	0	5	10	15	20	25	30	35
Tracer Output concentration, C_{pulse} gm/lt fluid	0	3	5	5	4	2	1	0

(c) A batch of solids of uniform size is treated by gas in a uniform environment. Solid is converted to give a nonflaking product according to the shrinking-core model. Conversion is about 7/8 for a reaction time of 1h, conversion is complete in two hours. What mechanism is rate controlling? **07**
