Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering - SEMESTER - V EXAMINATION - WINTER 2025

Subject Code: 3154402 **Date: 27-11-2025**

Subject Name: Chemical Reaction Engineering - I

Time: 10:30 AM TO 01:00 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)**	Define Chemical Kinetics. List out the factors that effects the rate of reaction.	**03**
	(b)	Differentiate between i) order and molecularity of reaction and ii) elementary and non elementary reaction	**04**
	(c)	Define variable batch reactor and establish the performance equation.	**07**
Q.2	**(a)**	Define space time and space velocity with their empirical equations.	**03**
	(b)	Differentiate between i) integral and differential method and ii) batch and continuous reactor.	**04**
	(c)	Define Arrhenius equation. Deduce the relationship between activation energy and temperature.	**07**
		OR	
	(c)	Calculate the first order rate constant for the disappearance of A as per the gas phase reaction : A = 1.6 R if the volume of the reaction mixture, starting with pure A increases by 50 % in 4 minutes . the total pressure of the system remains constant at 1.2 atm and the temperature is 25ºC.	**07**
Q.3	**(a)**	Define Early and late mixing of fluids.	**03**
	(b)	Explain the importance of Residence Time Distribution (RTD) studies in Chemical Reaction Engineering.	**04**
	(c)	Derive the performance equation for Plug Flow reactor.	**07**
		OR	
	(a)	Define selectivity and auto catalytic reactions.	**03**
	(b)	Differentiate between F curve and E curve.	**04**
	(c)	A gas feed of pure 'A' (mol /Lit) enters a mixed flow reactor (2 lit) and reaction as follows 2A = R $-r_A = 0.05\ C_A^2$ mol/ lit.sec and $C_A = 0.5$ mol /Lit Find feed rate (lit/min) will give an outlet concentration.	**07**

Q.4 **(a)** Write a short note on heat of reaction from thermodynamics. **03**

(b) Explain the optimum temperature progression and its application. **04**

(c) Derive the performance equation for two equal size CSTR reactor in series. **07**

OR

(a) Define and classify the types of reactions. **03**

(b) Derive RTD in Plug flow reactor. **04**

(c) Product distribution of irreversible first order reaction followed by zero order reaction. **07**

Q.5 **(a)** Define equilibrium conversion, fractional yield and overall yield. **03**

(b) Discuss the steps for calculation of equilibrium constant from thermodynamics point of view. **04**

(c) First order unimolecular irreversible reaction in series **07**

$$A \rightarrow R \rightarrow S$$

takes place with specific reaction rate k_1 and k_2. Express the variation of concentration of A, R and S with time. Find the expression for the time when formation of R becomes maximum.

OR

(a) Name the methods used for analyzing kinetic data of batch reactor. **03**

(b) Define Residence Time Distribution (RTD). State the characteristics of tracer. **04**

(c) Derive the performance equation for recycle reactor. **07**

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