Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V • EXAMINATION – WINTER • 2014

Subject Code: 150403 Date: 03-12-2014

Subject Name: Chemical Reaction Engineering

Time: 10.30 am - 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.**

Q.1 **(a)** An irreversible elementary series reaction 2A →B is taking place in a constant volume batch reactor with rate expression $-r_A = kC_A^2$. Derive an expression to determine kinetics of this reaction. **07**

(b) Explain Arhenious theory of temperature dependency along with activation energy and temperature sensitivity of reaction. **07**

Q.2 **(a)** The reaction A + B → C is believed to be second order elementary reaction and following data are recorded at 20 ^oC using an initial concentration of A and B as 0.106 and 0.123 kmol/m^3 respectively. The data is consistent with the proposed rate expression. Find rate constant. **07**

Time, sec	1	150	480	870	1500	2280
C_A, kmol/m^3	0.106	0.099	0.087	0.076	0.062	0.05

(b) Explain Empirical rate equation of n^{th} order method for determination of kinetics of reactions. **07**

OR

(b) Explain half life method for determination of kinetics of reactions. **07**

Q.3 **(a)** Write short note on auto catalytic reactions. **07**

(b) Explain variable volume reactor. Derive its expression to find kinetics for first order reaction. **07**

OR

Q.3 **(a)** Find the first order rate constant for the disappearance of A in the gas phase reaction 2A→ R, if on holding pressure constant, the volume of the reaction mixture, starting with 80 % of A, decreases by 20 % in 3 minute. **07**

(b) Explain mechanisms by which non elementary reactions can proceeds. **07**

Q.4 **(a)** Define Recycle ratio R and derive the performance equation for recycle reactor. **07**

(b) A liquid reactant stream (1 mo/L) passes through two mixed flow reactors in a series. The concentration of A in the exit of the first reactor is 0.5 mol/L. Find the concentration in the exit stream of second reactor. The reaction is second order with respect to A and V_2/V_1 is 2. **07**

OR

Q.4 **(a)** What do you understand by instantaneous fractional yield and overall fractional yield of a product? Explain different contacting patterns for different concentration of reactant for non-continuous operations. **07**

(b) Enzyme E catalyses the fermentation of substance A (The reactant) to product R. Find the size of mixed flow reactor needed for 95% conversion of reactant in a feed stream (25 L/min) of reactant(2 mo/L) and enzyme. The kinetics of fermentation at this enzyme concentration is given by A→ R **07**

$-r_A = 0.1\ C_A/ (1+ 0.5\ C_A)$

Q.5	**(a)**	Derive design equation for mixed flow reactor.	**07**
	(b)	Write short note on quantitative product distribution.	**07**

OR

Q.5	**(a)**	Write a short note on optimum temperature progression.	**07**
	(b)	How mixing of fluid of different composition is the key to the formation of intermediate for irreversible reactions in series? Discuss in detail the qualitative product distribution for series reaction.	**07**

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