Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2017

Subject Code: 2173509/2173514 **Date: 10/11/2017**

Subject Name: Environmental Reaction Engineering

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.**

			MARKS
Q.1	**(a)**	Make a mole balance on a batch reactor conducting a liquid phase bimolecular reaction with a reaction rate constant k_2 in units of liter, mol, and min to estimate time required for certain conversion of a reactant of the reaction.	**03**
	(b)	An aqueous feed of A and B (400 liter/min, 100 mmol A/liter, 200 mmol B/liter) is to be converted to product in a plug flow reactor. The kinetics of the reaction is represented by A + B → R, $-r_A = 200\ C_A C_B$ mol/(liter)(min). Find the volume of reactor needed for 99.9% conversion of A to product. Draw a schematic diagram.	**04**
	(c)	We plan to replace our present mixed flow reactor with one having double the volume. For the same aqueous feed (10 mol A/liter) and the same feed rate find the new conversion. The reaction kinetics are represented by A → R, $-r_A = k\ C_A^{1.5}$, and present conversion is 70%. Draw a schematic diagram.	**07**
Q.2	**(a)**	Given the elementary reaction taking place in a batch reactor $A \xrightarrow{k_1} R \xrightarrow{k_2} S$ and $k_1 > k_2$, derive for C_A and C_R as functions of time, and sketch the concentration-time profiles of A, R, and S.	**07**
	(b)	Given the elementary reaction $A \xrightarrow{k_1} R \xrightarrow{k_2} S$ taking place in a CSTR, show that $\tau_{m,opt} = \frac{1}{\sqrt{k_1 k_2}}$	**07**
		OR	
	(b)	Given the elementary reaction $A \xrightarrow{k_1} R \xrightarrow{k_2} S$ taking place in a PFR, show that $\tau_{p,opt} = 1/k_{\text{log mean}}$	**07**
Q.3	**(a)**	Give names of two industrial products produced by catalytic reactions and the catalysts used therein.	**03**
	(b)	Give two chemical equations of catalytic reactions and the catalysts used therein.	**04**
	(c)	List out sequentially the steps involved in gas-solid catalytic reactions by Langmuir-Hinshelwood approach.	**07**
		OR	
Q.3	**(a)**	What is catalyst deactivation?	**03**
	(b)	Explain adsorption and desorption in gas-solid catalytic reactions.	**04**

(c) Describe with neat sketches fixed and fluidized bed catalytic reactors. 07

Q.4 **(a)** Mention at least two series-parallel reactions of industrial importance. Define selectivity and overall and instantaneous fractional yields. **07**

(b) Describe with appropriate graphical representation the Jones graphical method to determine concentration in each MFR connected in a series of unequal sized MFRs. **07**

OR

Q.4 **(a)** Describe the graphical method to determine the best arrangement for given conversion of unequal sized MFRs connected in a series. **07**

(b) Differentiate between physical and chemical adsorption. **07**

Q.5 **(a)** Evaluate the variance for the following distribution. **07**

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

(b) Write the sequence of steps according to shrinking core model for gas-solid non-catalytic reactions. Draw a schematic figure to show these steps when reaction *A (g) + bB (s) → products* takes place on a solid spherical particle of unchanging size. **07**

OR

Q.5 **(a)** Plot the exit age distribution E using the following data. **07**

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

(b) Explain with the help of graphs or sketches the following with reference to RTD. **3+2+2= 07**

i. F curve
ii. Impulse function
iii. Mean residence time

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