Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2018

Subject Code: 2173514/2173509 **Date: 26/11/2018**

Subject Name: Environmental Reaction Engineering

Time: 10:30 AM TO 01:00 PM **Total Marks: 70**

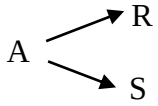
Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			MARKS
Q.1	**(a)**	Define: 1) space time, 2) space velocity, 3) Recycle ratio	**03**
	(b)	Discuss size comparison of mixed flow reactor and plug flow reactor for n^{th} order reaction.	**04**
	(c)	Derive the process design equation for mixed flow reactor.	**07**
Q.2	**(a)**	Discuss advantages and disadvantages of batch reactor.	**03**
	(b)	Justify that CSTRs connected in parallel behave as one single CSTR of the same total volume.	**04**
	(c)	In an isothermal batch reactor, the conversion of a liquid reactant A is 70% in 13 minutes. Find the space time and space velocity necessary to effect this conversion in a plug flow reactor. Consider first order kinetics.	**07**
		OR	
	(c)	A homogeneous liquid phase reaction with the stoichiometry and the kinetics $A \longrightarrow S$, $-r_A = KC_A^2$ takes place with 50% conversion in a MFR. 1) Find the conversion if this reactor is replaced by another MFR having volume 6 times that of the original reactor or other parameters remain same. 2) Find the conversion if the original reactor is replaced by plug flow reactor of the same size. All other parameters remain same.	**07**
Q.3	**(a)**	Explain instantaneous fractional yield and overall fractional yield.	**03**
	(b)	For following parallel reactions $A \longrightarrow R$ $A \longrightarrow S$ If R is the desired product and the order of reaction is same for both the reactions then how can one get more production of R?	**04**
	(c)	Prove that N number of same sized mixed flow reactors in series can be approximated as a plug flow reactor.	**07**
		OR	
Q.3	**(a)**	The reactor setup consists of three plug flow reactors in two parallel branches. Branch D has a reactor of volume 60 liters followed by a reactor of volume 40 liters. Branch E has a reactor of volume 50 liters. What fraction of the feed should go to branch D?	**03**
	(b)	For reactions in series $A \longrightarrow R \longrightarrow S$	

If the desired product is S then explain which method should be used?

(c) Reactant A in liquid produces R and S by the following reaction: **07**



Both these reactions are first order.

A feed with $C_{A0} = 1$, $C_{R0} = 0$ and $C_{S0} = 0$ enters in two mixed flow reactors in series ($\tau_1 = 2$ min, $\tau_2 = 5$ min). The composition in the first reactor is $C_{A1} = 0.40$, $C_{R1} = 0.40$ and $C_{S1} = 0.2$. Find the composition leaving the second reactor.

Q.4 **(a)** Define mean residence time and variance with equation. **03**

(b) Explain pulse input experiment for RTD studies. **04**

(c) The data 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 and tabulate and construct the E curve. **07**

t, min	C_{pulse} , g/l
0	0
5	3
10	5
15	5
20	4
25	2
30	1
35	0

OR

Q.4 **(a)** What are the causes of non-ideal flow in reactor? **03**

(b) Explain relationship between E and F curve. **04**

(c) A sample of tracer hytane was injected as a pulse into a vessel (to be used as a reactor) and the effluent concentration is measured as a function of time. The following data are obtained: **07**

t,min	C (g/m^3)
0	0
1	1
2	5
3	8
4	10
5	8
6	6
7	4
8	3
9	2.2
10	1.5
12	0.6
14	0

Construct the C and E curves and determine the fraction of material leaving the vessel that has spent between 3 and 6 min in the vessel.

Q.5	**(a)**	Define: i) heterogeneous reaction, ii) catalyst, iii) Catalyst activity	**03**
	(b)	Differentiate between packed bed reactor and fluidized bed reactor.	**04**
	(c)	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)**	Differentiate constant volume and variable volume batch reactor.	**03**
	(b)	Explain types of catalyst deactivation.	**04**
	(c)	Qualitative discussion about product distribution in reactions in parallel for two reactant.	**07**

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