Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI(NEW) – EXAMINATION – SUMMER 2019

Subject Code:2160506 **Date:27/05/2019**

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.**

			MARKS
Q.1	**(a)**	Explain: 1) Elementary reaction 2) Molecularity 3) Rate constant.	**03**
	(b)	Derive the equation for half-life using overall order of irreversible reaction.	**04**
	(c)	Derive performance equation for steady state plug flow reactor.	**07**
Q.2	**(a)**	Derive equation for a unimolecular type first order reaction for constant volume batch reactor using integral method.	**03**
	(b)	Evaluate quantitatively the behavior of N equal sized mixed flow reactors in series.	**04**
	(c)	A homogeneous gas reaction A $\rightarrow$ 3R has a reported rate at 215^{O}C $-r_A = 10^{-2}C_A^{1/2}$, [mol/liter sec] Find the space-time needed for 80% conversion of a 50% A, 50% inert feed to a plug flow reactor operating at 215^{O}C and 5 atm (C_{Ao} = 0.0625 mol/liter).	**07**
		OR	
	(c)	Explain recycle ratio and derive the performance equation of recycle plug flow reactors.	**07**
Q.3	**(a)**	Explain space time, space velocity and holding time.	**03**
	(b)	Discuss parallel reaction with example. Also discuss fractional yield, overall yield and selectivity for parallel reaction.	**04**
	(c)	Compare the Integral and Differential method of analysis for analyzing reaction kinetics data.	**07**
		OR	
Q.3	**(a)**	Explain shifting order reaction.	**03**
	(b)	Discuss autocatalytic reaction with conversion-time and rate-concentration Curves.	**04**
	(c)	Discuss optimum temperature progression in detail.	**07**
Q.4	**(a)**	Brief the rules for the best arrangement for the ideal reactors.	**03**
	(b)	Discuss Activation energy and its temperature dependency from Arrhenius Law and Collision Theory.	**04**
	(c)	Using given data in Table, calculate the reactor volume V1 and V2 for the mixed-flow sequence in series. when the intermediate conversion is 40% and the final conversion is 80%. The entering molar flow rate is the 0.867 mol/s.	**07**

X	0	0.1	0.2	0.4	0.6	0.7	0.8
$-r_A$	0.0053	0.0052	0.0050	0.0040	0.0025	0.0018	0.00125

OR

Q.4	**(a)**	Milk is pasteurized if it is heated to 63^{O}C for 30 min, but if it is heated to 74°C it only needs 15 s for the same result. Find the activation energy of this sterilization process.	**03**

	(b)	Show the graphical representation of energy balance equation for adiabatic operation.	**04**
	(c)	Derive an expression for effects of temperature on heat of reaction from thermodynamics.	**07**
Q.5	**(a)**	State the different ways to define the reaction rate	**03**
	(b)	Discuss batch reactor including its advantages and limitations.	**04**
	(c)	Discuss qualitative product distribution for irreversible first order in series.	**07**

OR

Q.5	**(a)**	Discuss variable affecting the rate of reaction.	**03**
	(b)	Experiments show that the reaction between H_2(g) and I(g) to produce HI (g) proceeds with a rate $(1/2)d[HI]/dt = k[H_2] [I_2]$ Suggest a two step mechanism which is consistent with this rate.	**04**
	(c)	Write short note on 'Searching for reaction mechanism'.	**07**

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