Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2023

Subject Code:3160506 Date:06-07-2023

Subject Name:Chemical Reactions 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)**	Describe the variables affecting the rate of reactions.	**03**
	(b)	Define molecularitiy, order of reaction and rate constant 'k'. State the general unit for rate constant 'k'.	**04**
	(c)	At 1100 K n-nonane thermally cracks (breaks down into smaller molecules) 20 times as rapidly as at 1000 K. Find the activation energy for this decomposition. molecules) 20 times as rapidly as at 1000 K. Find the activation energy for this decomposition.	**07**
Q.2	**(a)**	What do you mean by constant volume and variable volume system?	**03**
	(b)	Explain homogeneous and heterogeneous catalytic reaction with suitable example.	**04**
	(c)	Differentiate integral and differential method of analysis.	**07**
		OR	
	(c)	Explain with example autocatalytic reaction.	**07**
Q.3	**(a)**	What is multiple-reactor systems? Explain its importance.	**03**
	(b)	Derive the design equation for steady state plug flow reactor.	**04**
	(c)	In a homogeneous isothermal liquid polymerization, 20% of the monomer disappears in 34 minutes for initial monomer concentration of 0.04 and also for 0.8 mol/liter. What rate equation represents the disappearance of the monomer?	**07**
		OR	
Q.3	**(a)**	What is recycle reactor? Write its uses.	**03**
	(b)	Derive the design equation for steady state mixed flow reactor.	**04**
	(c)	The first-order reversible liquid phase reaction mentioned below takes place in a batch reactor. $$A \leftrightarrow R, \quad C_{A0} = 0.5\ mol/lit, \quad C_{R0} = 0$$ After 8 minutes, conversion of A is 33.3% while equilibrium conversion is 66.7%. Find the rate equation for this reaction.	**07**
Q.4	**(a)**	What is yield, selectivity and product distribution?	**03**
	(b)	Derive the equation in terms of concentration and conversion for zero order reaction.	**04**
	(c)	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 $$A + B \rightarrow R, \ -r_A = 200 C_A C_B\ mol/lit.min$$ Find the volume of reactor needed for 99.9% conversion of A to product.	**07**

OR

Q.4 **(a)** Discuss earliness and lateness of mixing in RTD. **03**

(b) What are the various non-idealities that can exist in a reactor? **04**

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

Q.5 **(a)** What do you mean by optimum temperature progression? **03**

(b) Describe in detail biochemical reactions. **04**

(c) Derive the relation between conversion and temperature for adiabatic operation. **07**

OR

Q.5 **(a)** Define half-life time and write the formula to calculate $t_{1/2}$. **03**

(b) Describe the mechanism of non-elementary reaction. **04**

(c) The concentration readings in table below represent a continuous response to a pulse input into a closed vessel which is to be used as a chemical reactor. **07**

Time, (min)	0	5	10	15	20	25	30	35
Output Tracer Concentration, (mol/lit)	0	3	5	5	4	2	1	0

Calculate the mean residence time of fluid in the vessel $\bar{t}$ and tabulate and plot the exit age distribution E.

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