Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2022

Subject Code:3163612 Date:03/06/2022

Subject Name:Fundamentals of 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.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	What are the different methods for testing kinetic mode? Explain one method.	**03**
	(b)	Write and explain material and energy balance equation with chemical reaction.	**04**
	(c)	Derive the design equation of the ideal batch reactor.	**07**
Q.2	**(a)**	Differentiate between elementary and non-elementary reactions	**03**
	(b)	Explain the size comparison of single ideal CSTR with PFR and mention the different parameter affecting the sizes of the reactor.	**04**
	(c)	Define ideal reactors. Explain the importance of reactor design with broad classification of reactor types.	**07**
		OR	
	(c)	Find the overall order of the irreversible reaction $2H_2+2NO \rightarrow N_2+2H_2O$ From the following constant volume data using equimolar amount of hydrogen and nitric oxide.	**07**

Total Press., mm Hg	200	240	280	320	360
Half-life, Sec	265	186	115	104	67

Q.3	**(a)**	Explain in detail free radicals reaction mechanism.	**03**
	(b)	Continuous stream of gaseous enters a vessel at temperature T_0=400 K, P_0=4 atm, reacts there and leaves at T=300 K, P=3 atm and C_{AO}=100, C_{BO}=200, A+B--→2R find X_A, X_B.	**04**
	(c)	What are the different ideal reactors? Derive the performance equation of Ideal Plug flow reactor (PFR).	**07**
		OR	
Q.3	**(a)**	Define and Explain single and multiple reactions.	**03**
	(b)	Define recycle ration. Derive the performance equation of recycle reactor.	**04**
	(c)	Find the conversion after 1 hr. in a batch reactor for A--→R, $-r_A=3C_A^{0.5}$ mol/lit-hr and C_{A0}=1 mol/l.	**07**
Q.4	**(a)**	Differentiate between rate of reaction and order of the reactions.	**03**
	(b)	Derive the rate expression for first order irreversible reaction.	**04**

	(c)	Explain the temperature dependency term in the rate equation using thermodynamics and collision theory.	**07**

OR

Q.4	**(a)**	Write short notes on Activation Energy	**03**
	(b)	What is instantaneous yield and over all fractional yield of the reaction.	**04**
	(c)	Derive the performance equation of steady state Mixed Flow Reactor for the first order reaction with change in density case.	**07**
Q.5	**(a)**	Define and Explain Molecularity and order of reaction	**03**
	(b)	Derive the performance equation of Ideal Mixed Flow Reactor (MFR).	**04**
	(c)	The activation energy of a chemical reaction is 17982 cal/mol in the absence of a catalyst, and 11980 cal/mol with a catalyst. By how much times will the rate of the reaction will grow in the presence of catalyst, if a reaction proceeds at 25 ^{0}C	**07**

OR

Q.5	**(a)**	Define and Explain Space time and Space Velocity	**03**
	(b)	Show that total volume required is minimum when two equal sizes CSTR is connected in series.	**04**
	(c)	Substance A reacts according to second-order kinetics. 95% conversion of A is achieved in a single flow reactor. We buy a second reactor identical to the first. For the same 95% conversion, by how much is the capacity increased if we operate these two Plug flow reactor in series.	**07**

****