Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:2150403 **Date:16/11/2018**

Subject Name:Basics 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.**

Q.1 **(a)** Discuss the different ways in which rate of reaction can be defined. **03**

(b) What do you understand by instantaneous fractional yield and overall fraction yield of a product? **04**

(c) Write a short note on differential method and integral method of analysis of kinetic data. **07**

Q.2 **(a)** Find the conversion for the reaction A → R, after 1 hour in a batch reactor. **03**
$-r_A = 3C_A$ mol/lit.hr, C_{Ao} = 1 mol/lit.

(b) Define and explain the following terms: **04**
i) Series reactions ii) Parallel reactions
iii) Molecularity iv) Rate constant

(c) Derive the C_{Rmax} and t_{Rmax} for the first order reactions given below: **07**
A → R → S

OR

(c) Find the overall order of the irreversible reaction, **07**

$$2H_2 + 2NO \rightarrow N_2 + 2H_2O$$

at 296 K from the following constant volume data using equimolar amount of hydrogen and nitric oxide.

Total Pressure, mmHg	200	240	280	320	360
Half life, sec	265	186	115	107	67

Q.3 **(a)** Explain different types of ideal reactors. **03**

(b) Explain the classification of reaction in details with examples. **04**

(c) The rate constant of a reaction is measured at different temperatures is reported below. Calculate the activation energy for this reaction. **07**

Temperature, K	273	293	303	313
Rate constant, k, sec^{-1}	2.46×10^5	47.5×10^5	576×10^5	5480×10^5

OR

Q.3 **(a)** Write a brief note on variable volume batch reactor. **03**

(b) Consider a feed C_{Ao} = 200, C_{Bo} = 200, C_{io} = 100 (inert) to a steady flow reactor. The isothermal gas phase reaction is A + 3B → 6R. If C_A = 40 at the reactor exit, what is C_B, X_A and X_B there? **04**

(c) Derive an expression to determine the kinetics by integral method for the irreversible bi-molecular elementary reaction of 2nd order of the type **07**
2A → R, $-r_A = kC_A^2$

Q.4 **(a)** Derive the performance equation of ideal batch reactor. **03**

(b) Show that for a first order irreversible reaction $\ln(1/(1 - x_A)) = kt$. **04**

	(c)	The irreversible reaction $A + B \rightarrow AB$ has been studied kinetically, and the rate of formation of product has been found to be well correlated by the following rate equation: $r_{AB} = kC_B^2$, …. independent of CA. What reaction mechanism is suggested by this rate expression if the chemistry of the reaction suggests that the intermediate consists of an association of reactant molecules and that a chain reaction does not occur?	**07**

OR

Q.4	**(a)**	How mixing of different composition of fluid is the key to the formation of intermediate for irreversible reactions in series?	**03**
	(b)	Liquid A decomposes by first order kinetics, and in a batch reactor 50% of A is converted in 5 minutes. How long it will take to reach 75% conversion?	**04**
	(c)	Write a brief note on variable volume batch reactor.	**07**
Q.5	**(a)**	Derive the performance equation of ideal plug flow reactor (PFR).	**03**
	(b)	Write a short note on optimum temperature progression.	**04**
	(c)	Define autocatalytic reactions. Derive an expression to find its kinetics. Explain plots of rate of reaction Vs. time and concentration Vs. time	**07**

OR

Q.5	**(a)**	Explain the size comparison of single ideal CSTR with PFR and mention the different parameter affecting the sizes of the reactor.	**03**
	(b)	Define recycle ratio. Derive the design equation of Recycle reactor.	**04**
	(c)	Product Explain the qualitative distribution for irreversible first order reactions $A \xrightarrow{k_1} R \xrightarrow{k_2} S$ in series.	**07**

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