Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VII (NEW) EXAMINATION – WINTER 2020

Subject Code:2173612 **Date:28/01/2021**

Subject Name:Fundamentals of Reaction Engineering

Time:10:30 AM TO 12:30 PM **Total Marks: 56**

Instructions:

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

MARKS

Q.1 **(a)** Explain the temperature dependent term of rate equation from Arrhenius law. **03**

(b) Define and Explain, Rate and Molecularity of the reaction. **04**

(c) Consider a feed C_{A0}=100, C_{B0}=200, C_{i0}=100 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? Notations have their conventional meanings. **07**

Q.2 **(a)** On doubling the concentration of reactant, the rate of reaction triples. Find the reaction order **03**

(b) Explain the different types of reaction with proper example of each type. **04**

(c) The aqueous reactions A → R+S proceeds as follows **07**

Time, min	0	36	65	100	160	∞
C_A, mol/lt	0.1823	0.1453	0.1216	0.1025	0.0795	0.0494

With C_{A0} = 0.1823 mol/lt, C_{R0} = 0, C_{S0} = 55 mol/lt. Find the rate equation for this reaction

Q.3 **(a)** Milk is pasteurized if it is heated to 63 ^{0}C for 30 min, but if it is heated to 74 ^{0}C it only needs 15 s for the same result. Find the activation energy of this sterilization process. **03**

(b) The reaction between nitric oxide and oxygen 2 NO + O_2 → 2 NO_2 follows the rate law $d[O_2]/dt = k[NO]^2[O_2]$ Suggest a reaction mechanism which is consistent with this rate law. **04**

(c) Derive the integrated rate equation for zero order reaction for a variable volume system. **07**

Q.4 **(a)** Liquid A decomposes by second order kinetics, and in a batch reactor 50% of A is converted in a 5 minute run. How much longer would it take to reach 75% conversion? **03**

(b) How will you compare the performance of single batch reactor with the flow reactor and mixed versus plug flow reactor for a first order reaction? **04**

(c) What are the different types of ideal reactors? Derive the performance equation of steady state mixed flow reactor. **07**

Q.5 **(a)** Explain the significance of space time and space velocity **03**

(b) Derive the performance equation of the plug flow reactor. **04**

(c) A homogenous gas reaction A 3R has a reported rate at 215 ^{0}C **07**

$$-r_A = 10^{-2} C_A^{1/2} \quad [\text{mol/lit sec}]$$

Find the space time needed for 80% conversion of a 50% A-50% inert feed to a plug flow reactor operating at 215 ^{0}C and 5 atm (C_{A0}=0.0625 mol/liter).

Q.6 **(a)** Explain differential method of analysis to find kinetics of any reaction of n^{th} order. **03**

(b) Define autocatalytic reactions. Derive an expression to find its kinetics. **04**

(c) An irreversible bimolecular type reaction A+B→P is taking place in a constant volume batch reactor. Derive an expression for estimating conversion at any time 't'. **07**

Q.7 **(a)** Derive an expression to find kinetics of 1st order reaction taking place in a variable volume batch reactor. **03**

(b) How mixing of different composition of fluid is the key to the formation of intermediate for irreversible reactions in series? Discuss in detail the qualitative product distribution for series reaction. **04**

(c) Derive the C_{Rmax} for the reaction first order followed by zero-order reaction for **07**

$$A \xrightarrow{k1} R \xrightarrow{k2} S$$

Q.8 **(a)** Derive the performance equation of the Batch reactor. **03**

(b) Derive an equation of equal size mixed flow reactors connected in series for first order reaction **04**

(c) What do you understand by instantaneous fractional yield and overall fraction yield of a product? Give different contacting patterns for different concentration of reactant. **07**

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