

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER- VII (New) EXAMINATION – WINTER 2019

Subject Code: 2173612

Date: 30/11/2019

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.

- | | | MARKS |
|-----|--|-------|
| Q.1 | (a) Explain the temperature dependent term of rate equation from Arrhenius law. | 03 |
| | (b) The half-life period of a reaction of the first order is 2500 second. How long will it take for 1/4 of the reactant to be left behind? | 04 |
| | (c) Explain the classification of reaction with proper example of each type. | 07 |
| Q.2 | (a) On doubling the concentration of reactant, the rate of reaction triples. Find the reaction order | 03 |
| | (b) Derive the integrated form of rate expression for Irreversible bimolecular type First order reactions. | 04 |
| | (c) Show that decomposition of N_2O_5 at $67^\circ C$ is a first order reaction. Calculate the value of rate constant | 07 |

Time, min	0	1	2	3	4
C (N_2O_5) mol/l	0.16	0.113	0.08	0.056	0.04

OR

- | | | |
|-----|--|----|
| | (c) The elementary II-order liquid phase reaction $A + B \rightarrow C + D$ is conducted isothermally in PFR. The volumetric flow rate is $10 \text{ m}^3/\text{hr}$ and $C_{A0} = C_{B0} = 2 \text{ mol/m}^3$. Find out the volume of PFR needed to achieve 50% conversion of A. Take the value of rate constant $K = 5 \text{ m}^3/\text{mol.hr}$. | 07 |
| Q.3 | (a) Derive the integrated rate equation for zero order reaction for a variable volume system. | 03 |
| | (b) Discuss Differential method for analysis of rate data. | 04 |
| | (c) This reaction is carried out at 422.2 K at a total pressure of 10 atm with 50% A and remaining 50% inerts. If volumetric feed rate is $6 \text{ dm}^3/\text{sec}$. Calculate the volume necessary to achieve a conversion level of 80% in a CSTR. | 07 |

Conversion, x	0	0.2	0.4	0.6	0.8
$-r_A, (\text{mol/dm}^3\text{S})$	0.0053	0.005	0.004	0.0025	0.00125

OR

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|-----|--|----|
| Q.3 | (a) Define and explain the Space time and space velocity for flow reactors. | 03 |
| | (b) Consider a gaseous feed $C_{A0} = 100$, $C_{B0} = 200$ enters an isothermal reactor. For $X_A = 0.8$ find the C_A , C_B and X_B . | 04 |
| | (c) Discuss with suitable sketches the different types of continuous reactor systems used in process industries | 07 |
| Q.4 | (a) Discuss the size comparison for mixed flow and plug flow reactor for first order and second order reactions. | 03 |
| | (b) Liquid A decomposes by first order kinetics in an isothermal batch reactor 50% of A is converted in 300 sec, find the time required for the 75% conversion of A in the same reactor. | 04 |
| | (c) Prove that for a first order reaction N-CSTRs connected in series will approximate to the behavior of PFR. | 07 |

OR

- Q.4 (a) What is Chemical Equilibrium? Mention the characteristics of Chemical Equilibrium **03**
- (b) Explain standard heat of formation, standard heat of combustion and standard heat of reaction **04**
- (c) Enzyme E catalyzed the fermentation of substrate A to product R find the size of the MFR for 95% conversion of reactant, in a feed stream of 25 lit/min of reactant (2 mol/lit), and enzyme kinetics is **07**
- $$-r_A = 0.1 C_A / (1 + 0.5 C_A)$$
- Q.5 (a) Write a short note on Optimum temperature progression? **03**
- (b) Explain the effect of temperature on equilibrium conversion as predicted by thermodynamics by keeping pressure fixed. **04**
- (c) Synthesize a rate law for the decomposition of Cumene to form benzene and propylene considering that surface reaction is rate limiting. **07**
- OR**
- Q.5 (a) Write a short note on classification of Catalysts. **03**
- (b) Explain the role of modifier, promoter and inhibitor in a catalytic reaction. **04**
- (c) With the help of a sketch mention the seven steps involved in a catalytic reaction. **07**

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