Date: 03-12-2014

**Total Marks: 70** 

## **GUJARAT TECHNOLOGICAL UNIVERSITY** BE - SEMESTER-V • EXAMINATION – WINTER • 2014

Subject Code: 150403 Subject Name: Chemical Reaction Engineering Time: 10.30 am - 01.00 pm Instructions:

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.
- Q.1 (a) An irreversible elementary series reaction  $2A \rightarrow B$  is taking place in a constant 07 volume batch reactor with rate expression  $-r_A = kC_A^2$ . Derive an expression to determine kinetics of this reaction.
  - (b) Explain Arhenious theory of temperature dependency along with activation 07 energy and temperature sensitivity of reaction.
- Q.2 (a) The reaction  $A + B \rightarrow C$  is believed to be second order elementary reaction and following data are recorded at 20 °C using an initial concentration of A and B as 0.106 and 0.123 kmol/m<sup>3</sup> respectively. The data is consistent with the proposed rate expression. Find rate constant.

Apression. The fute constant.							
Time, sec	1	150	480	870	1500	2280	
C <sub>A</sub> , kmol/m <sup>3</sup>	0.106	0.099	0.087	0.076	0.062	0.05	

(b) Explain Empirical rate equation of n<sup>th</sup> order method for determination of kinetics of **07** reactions.

## OR

( <b>b</b> )	Explain half life method for determination of kinetics of reactions.	07
(0)	Explain han me method for determination of kineties of reactions.	07

- Q.3 (a) Write short note on auto catalytic reactions.
  - (b) Explain variable volume reactor. Derive its expression to find kinetics for first order 07 reaction.

## OR

Q.3 (a) Find the first order rate constant for the disappearance of A in the gas phase 07 reaction  $2A \rightarrow R$ , if on holding pressure constant, the volume of the reaction mixture, starting with 80 % of A, decreases by 20 % in 3 minute.

(b) Explain mechanisms by which non elementary reactions can proceeds.

- Q.4 (a) Define Recycle ratio R and derive the performance equation for recycle reactor. 07
  - (b) A liquid reactant stream (1 mo/L) passes through two mixed flow reactors in a series. The concentration of A in the exit of the first reactor is 0.5 mol/L. Find the concentration in the exit stream of second reactor. The reaction is second order with respect to A and  $V_2/V_1$  is 2.

## OR

- Q.4 (a) What do you understand by instantaneous fractional yield and overall fractional yield 07 of a product? Explain different contacting patterns for different concentration of reactant for non-continuous operations.
  - (b) Enzyme E catalyses the fermentation of substance A (The reactant) to product R. **07** Find the size of mixed flow reactor needed for 95% conversion of reactant in a feed stream (25 L/min) of reactant(2 mo/L) and enzyme. The kinetics of fermentation at this enzyme concentration is given by  $A \rightarrow R$  $-r_A = 0.1 C_A/(1+0.5 C_A)$

07

07

Derive design equation for mixed flow reactor. 07 Q.5 **(a)** Write short note on quantitative product distribution. **(b)** 07 OR Write a short note on optimum temperature progression. Q.5 **(a)** 07 How mixing of fluid of different composition is the key to the formation of **(b)** 07 intermediate for irreversible reactions in series? Discuss in detail the qualitative

\*\*\*\*\*

product distribution for series reaction.