Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII EXAMINATION – WINTER 2015

Subject Code: 170501 **Date: 12/12/2015**

Subject Name: Chemical Reaction Engineering-I

Time: 10:30am to 1:00pm **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)** Define 'Recycle ratio' and derive the performance equation for recycle reactor. **07**

(b) Explain the mechanism of various kinds with example for non elementary reaction. **07**

Q.2 **(a)** Determine the order of reaction and rate constant for A→B using following data. Take initial concentration of reactant = 1 mol/lit. **07**

Time, min	0.02	0.06	0.1	0.14	0.2
% conversion	5	15	25	35	50

(b) Discuss the Integral method of analysis for irreversible elementary reactions in parallel. **07**

OR

(b) Find the conversion after 1 hour in a batch reactor for A→R, $-r_A=3C_A^{0.5}$ mol/lit*hr, C_{Ao} = 1 mol/lit. **07**

Q.3 **(a)** Explain the term 'Ideal reactor' and compare ideal reactors. **07**

(b) An aqueous feed of A and B (400 liter/min, 100mmol A/liter, 200 mmol B/liter) is to be converted to product in a plug flow reactor. The kinetics of the reaction is represented by A + B → R, $-r_A= 200C_AC_B$ mol/lit*min. Find the volume of reactor needed for 99.9% conversion of A to product. **07**

OR

Q.3 **(a)** Define the following terms and write significance of each **07**
(i) Space time (ii) Space velocity (iii) Activation energy (iv) Rate constant

(b) A gaseous feed of pure A (1 mol/liter) enters a mixed flow reactor (2 liters) and reacts as follow : **07**
2A → R, $-r_A = 0.05C_A^2$ mol/lit*sec
Find what feed rate (liter/min) will give an outlet concentration C_A = 0.5 mol/liter.

Q.4 **(a)** Explain the procedure to determine the best system of mixed flow reactors of different sizes in series for a given conversion. **07**

(b) Discuss the conclusions which may be drawn from thermodynamics for chemical reaction. **07**

OR

Q.4 **(a)** List theories with expressions for temperature dependency term of a rate equation and discuss its evaluation. **07**

(b) Differentiate between (i) Homogeneous reaction and Heterogeneous reaction (ii) Elementary reaction and Non elementary reaction **07**

Q.5 **(a)** Derive the expression for A + B → Product by applying Integral method of analysis. Take $C_{Ao} \neq C_{Bo}$. **07**

(b) Given a dilute aqueous feed, $C_{Ao} = C_{Bo} = 100$, A + 2B → R + S, $C_A = 20$. Find X_A and X_B. **07**

OR

Q.5 **(a)** Discuss the product distribution for the following reaction qualitatively. **07**

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

(b) Draw the concentration profile for following reaction: **07**

(i) $A \xrightarrow{1} R \xrightarrow{1} S$ (ii) $A \underset{1}{\overset{1}{\rightleftharpoons}} R \xrightarrow{1} S$ (iii) $A \xrightarrow{1} R \underset{1}{\overset{1}{\rightleftharpoons}} S$ (iv) $A \underset{1}{\overset{1}{\rightleftharpoons}} R \underset{1}{\overset{1}{\rightleftharpoons}} S$

(v) $A \xrightarrow{1} R$, $A \xrightarrow{1} S$

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