Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER V • EXAMINATION – WINTER - 2012

Subject code: 150403 Date: 17-01-2013

Subject Name: Chemical Reaction Engineering

Time: 02:30 pm to 05:00 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 in detail the effects of temperature, pressure and concentration of inerts on equilibrium conversion for all type of reactions **07**

(b) Define Autocatalytic reactions and explain rate-concentration curve for autocatalytic reaction. Derive the equation for optimum recycle ratio. **07**

Q.2 **(a)** State the Quantitative treatment method of product distribution for reactions in parallel **07**

(b) Explain in detail Qualitative method for product distribution for successive first order reactions in series **07**

OR

(b) Discuss the theory of determining the best system to minimize size of two mixed reactors in series for a given conversion **07**

Q.3 **(a)** Derive an equation of equal size mixed flow reactors connected in series for first order reaction **07**

(b) The aqueous reactions $A \longrightarrow R+S$ proceeds as follows **07**

Time, min	0	36	65	100	160	∞
C_A, mol/lt	0.1823	0.1453	0.1216	0.1025	0.07 95	0.0494

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

OR

Q.3 **(a)** Derive an equation for the plug flow reactors connected in series and parallel. Discuss best feeding technique for parallel connection of plug flow reactors **07**

(b) After 8 minutes in a batch reactor a reactant (C_{A0} = 1 mol/lt) is 80% converted, after 18 min the conversion is 90%. Find a rate equation to represent the reaction. **07**

Q.4 **(a)** The primary reaction occurring in the homogeneous decomposition of nitrous oxide is found to be, **07**

$$N_2O \longrightarrow N_2 + \tfrac{1}{2} O_2$$

With rate, $-r_{NO2} = K_1 [NO_2]^2 / (1+ K_2[NO_2])$

Derive a mechanism to explain this observed rate.

(b) Define space time and space velocity. Derive a performance equation for ideal batch reactor and steady state mixed flow reactor **07**

OR

Q.4 **(a)** Derive an equation for second order reversible reaction in terms of equilibrium conversion **07**

(b) 100 lt/hr of radioactive fluid having half life period of 20 hr is to be treated by passing it through two ideal mixed reactors in series of volume 40,000 lt each. In passing through the system, how much has the activity decayed? **07**

Q.5 **(a)** Derive an equation for irreversible reactions in parallel and discuss typical concentration-time curve for competing reactions **07**

(b) Equimolar quantities of A, B and D are fed continuously to a MFR where they combine by the elementary reaction **07**

$A+D \xrightarrow{K1} R$

$B+D \xrightarrow{K2} S,\ K_2/K_1 = 0.2$

a) 50% of incoming A is consumed, find out what fraction of product formed is R

b) 50% of incoming B is consumed, find out what fraction of product S is formed.

OR

Q.5 **(a)** Explain the differential method of analysis for rate equation. State major differences between integral method and differential method of analysis **07**

(b) A first order reaction is to be treated in a series of two mix reactors. Show that the total volume of the two reactors is minimum when reactors are of equal size. **07**

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