Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V • EXAMINATION – WINTER 2013

Subject Code: 150403 Date: 04-12-2013

Subject Name: Chemical Reaction Engineering

Time: 10.30 am - 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.**

Q.1 **(a)** Derive performance equation for Mixed Flow Reactor (MFR). **07**

(b) Explain Qualitative product distribution. **07**

Q.2 **(a)** Consider a feed C_{Ao} = 200, C_{Bo} = 200, C_{io} = 100 (inert) 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? **07**

(b) Write short note on Optimum Temperature Progression. **07**

OR

(b) Explain contacting patterns for series and parallel reactions. **07**

Q.3 **(a)** Write short note on ideal reactors and its characteristics. **07**

(b) A two liquid reactant stream with C_{Ao} = 1 mol/L passing through two mixed flow reactors in series. The concentration of A in the exit stream from the first reactor is 0.5 mol/L. Find the concentration of A in the exit stream of the second reactor. The reaction A → R follows second order kinetics and V_2/V_1 = 2. **07**

OR

Q.3 **(a)** The homogeneous gas decomposition of phosphine $4PH_{3(g)} \rightarrow P_{4(g)} + 6H_{2(g)}$ proceed at 649^0C with the first order rate **07**

$$-r_{PH3} = (10/hr)\, C_{PH3}$$

What size of plug flow reactor operating at 649 ^{0}C and 460 KPa can produce 80 % conversion of a feed consisting of 40 mol of pure phosphine per hour.

(b) Write short note on differential method and integral method of analysis. **07**

Q.4 **(a)** The rate constant of a reaction is measured at different temperatures is reported below. Calculate the activation energy for this reaction. **07**

Temperature, ^{o}K	273	293	313	333
Rate constant, k, sec^{-1}	2.46 x 10^5	47.5 x 10^5	576 x 10^5	5480 x 10^5

(b) Explain kinetics of reactions of shifting order. **07**

OR

Q.4 **(a)** Explain auto catalytic reactions and derive kinetic equation for it. **07**

(b) Find first order rate constant for disappearance of A in the gas reaction 2A → R. If on holding the pressure constant, the volume of the reaction mixture starting with 80 % of A decrease by 20 % in 3 minute. **07**

Q.5 **(a)** Derive expression to determine kinetics by integral method for the irreversible bi-molecular elementary reaction of 2nd order of the type 2A → R, $-r_A = kC_A^2$ **07**

(b) Explain half life method to determine kinetics of reaction. **07**

OR

Q.5 **(a)** Thermal decomposition of nitrous oxide in the gas phase at 1020 ^{o}K is studied in a constant volume vessel at various initial pressure of nitrous oxide (N_2O). the half life data so obtained are as under: **07**

P_0, mm Hg	52.2	139	290	360
$t_{1/2}$, sec	860	470	255	212

Determine the rate expression to fit these kinetics.

(b) Derive performance equation of recycle reactors. **07**

****