Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (OLD) - EXAMINATION – SUMMER 2017

Subject Code: 170501 **Date: 09/05/2017**

Subject Name: Chemical Reaction Engineering-I

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)** Give classification of chemical reactions and discuss variables affecting the rate of reaction. **07**

(b) Distinguish between holding time and space time for flow reactors. **07**

Q.2 **(a)** The half life period for a certain first order reaction is $2.5 * 10^3$ sec. How long will it take for ¼ of the reactant to be left behind? [C_{A0} = 1mol/lit] **07**

(b) Develop general expression which relates the changing total pressure of the system π to the changing partial pressure of any of reaction component in a constant volume batch system for isothermal gas reaction. **07**

OR

(b) State various theories of temperature dependency and discuss Arrhenius theory in detail. **07**

Q.3 **(a)** Prove that N number of same sized mixed flow reactors in series can be approximated as a plug flow reactor. **07**

(b) Explain elementary and non elementary reactions with examples. **07**

OR

Q.3 **(a)** Write short note on 'Equilibrium constant from thermodynamics'. **07**

(b) The homogeneous gas decomposition of phosphine $4PH3\ (g) \longrightarrow P4\ (g) + 6H_2$ proceeds at 649^0C with the first-order rate $-r_{PH3} = (10/hr)\ C_{PH3}$ **07**

What size of plug flow reactor operating at 649°C and 460 kPa can produce 80% conversion of a feed consisting of 40 mol of pure phosphine per hour?

Q.4 **(a)** Derive rate equation for autocatalytic reaction. **07**

(b) Explain the terms in details. (1) instantaneous fractional yield (2) overall fractional yield (3) selectivity **07**

OR

Q.4 **(a)** Write in brief about 'should it make any difference in the product distribution on how reactant A and B are mixed?' **07**

(b) At present we have 90% conversion of a liquid feed (n = 1, C_{A0} = 10 mol/liter) to our plug flow reactor with recycle of product (R = 2). If we shut off the recycle stream, Calculate the space time to the same 90% conversion for with and without recycle. **07**

Q.5 **(a)** What is Pseudo first order reaction? Derive rate equation for it. **07**

(b) For the two CSTRs in series, 40% conversion is achieved in the first reactor. What is the volume of each of the two reactors necessary to achieve 80% overall conversion of the entering species A? (If F_{A2} is the molar flow rate of A exiting from the last reactor in the sequence, $F_{A2} = 0.2F_{A0}$) F_{A0} = 0.867 mol/s **07**

Data:

X	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.85
$-r_A$ mol/dm^3.s	0.0053	0.0052	0.0050	0.0045	0.0040	0.0033	0.0025	0.0018	0.00125	0.00100

OR

Q.5	**(a)**	Discuss types of ideal reactors in detail.	**07**
	(b)	Derive performance equation for first order followed by zero order reaction. Also represent it graphically.	**07**

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