Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER – VI (NEW).EXAMINATION – WINTER 2016

Subject Code: 2160506 **Date: 27/10/2016**

Subject Name: Chemical Reaction Engineering - I

Time: 10:30 AM to 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)** Explain various kinetic models for Nonelementary reactions. **07**

(b) Discuss various forms of rate equations. Also explain variables affecting rate of reaction. **07**

Q.2 **(a)** For a gas reaction at 400 K, the rate is reported as $-\frac{dp_A}{dt} = 3.66P_A^2$ atm/h **07**

(a) What are the units of rate constant?

(b) What is the value of the rate constant for this reaction if the rate equation is written as (i) $-r_A = -\frac{1}{V}\frac{dN_A}{dt} = kC_A^2$, mol/lh (ii) $-r_A = kC_A^2$, mol/m^3 s

(b) With the use of data provided, prove that the decomposition of N_2O_5 at 67 ° C is a first order reaction. Calculate the value of rate constant. **07**

Time, min	0	1	2	3	4
C_{N2O5} mol/l	0.16	0.113	0.08	0.056	0.040

OR

(b) Compare various theories related to temperature dependency term of a rate equation **07**

Q.3 **(a)** In an isothermal batch reactor, the conversion of a liquid reactant A achieved in 13 min is 70%. Determine the space time and space velocity necessary to effect this conversion in a plug flow reactor and in a mixed flow reactor considering first order kinetics. **07**

(b) Compare Integral method of analysis and Differential method of analysis for finding order and reaction rate. Derive equation for irreversible unimolecular-type first order reaction used in Integral method of analysis. **07**

OR

Q.3 **(a)** Derive an integral rate equation for nth order. Also derive an equation for determination of overall order of irreversible reactions from half-life method. **07**

(b) Write a short note on 'Types of reactors'. **07**

Q.4 **(a)** Derive the performance equation for steady state plug flow reactor for constant density and variable density system. **07**

(b) Define (1) Space time (ii) Space velocity (iii) Holding time (iv) Rate constant **07**

OR

Q.4 **(a)** The elementary liquid phase reaction A+B→R +S is carried out in a plug flow reactor. For equimolar amounts of A and B (C_{A0} = C_{B0} =0.9 mol/l), 94% conversion is achieved in it. If a CSTR, 10 times as large as the plug flow reactor, were arranged in series with the existing unit, which unit needs to be arranged first in series to enhance the production rate? **07**

(b) Describe quantitative discussion about product distribution for reactions in parallel. **07**

Q.5 **(a)** First order unimolecular irreversible reaction in series A →R →S takes place with specific reaction rate k1 and k2. Express the variation of concentration of A, R and S with time. Find the expression for the time when formation of R becomes maximum. **07**

(b) Derive an expression showing effects of temperature on heat of reaction from thermodynamics. **07**

OR

Q.5 **(a)** Discuss the size comparison of mixed flow reactor with plug flow reactor for first order reaction. Also discuss the general graphical comparison of performance of mixed flow reactor with that of plug flow reactor for any reaction kinetics. **07**

(b) An exothermic reaction is carried out in an adiabatic batch reactor. Show how fractional conversion X, is related to temperature T. **07**

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