

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VII • EXAMINATION – WINTER 2013****Subject Code: 172602****Date: 05-12-2013****Subject Name: Polymer Kinetics****Time: 10.30 am - 01.00 pm****Total Marks: 70****Instructions:**

- 1. Attempt all questions. 2. Write the answers to the points.**
- 3. Make suitable assumptions wherever necessary.**
- 4. Figures to the right indicate full marks.**

Q. 1 (a) Give the pseudosteady state hypothesis. The irreversible reaction $A+B \rightarrow AB$ has been studied kinetically and rate of formation of product has been found to be well correlated by the following rate equation: $r_{AB} = kC_B^2 \dots$ Independent of C_A . What reaction mechanism is suggested by this rate expression if the chemistry of the reaction suggests that the intermediate consists of an association of reactant molecules and that a chain reaction does not occur? **07**

Q. 1 (b) Answer the following

- i** Compare the collision theory with transition state theory. **05**
- ii** Define the following terms: (i) Rate Constant (ii) Transition Complex **02**

Q. 2 (a) Develop the general expression which relates the changing total pressure P to the changing concentration or partial pressure of any reaction components, for given initial conditions and any reaction stoichiometry. **07**

Q. 2 (b) Answer the following

- i** Write down the step wise procedure for analyzing the complete rate equation by differential method. **05**
- ii** Which points are taken in account before the kinetic study of heterogeneous reaction system? **02**

OR

Q. 2 (b) Answer the following

- i** Write down the general procedure of analyzing the kinetic data by integral method. **05**
- ii** Draw any two ideal contacting patterns for two flowing fluids for heterogeneous reaction system. **02**

Q. 3 (a) Pure gaseous A at about 3 atmosphere and 30°C (120 millimole/liter) is fed into a liter mixed flow reactor at various flow rate. There it decomposes and exit concentration of A is measured for each flow rate. From the following data find the rate equation to represent the kinetics of the decomposition of A. Assume that reactant A alone affects the rate. Reaction is $A \rightarrow 3R$ **07**

v_0 (liter/Min)	0.06	0.48	1.5	8.1
C_A (millimole/liter)	30	60	80	105

Q. 3 (b) Answer the following

- i** A reaction $A \rightarrow B$ occurs in plug flow tubular reactor with 90% conversion. If $k=0.5\text{min}^{-1}$, $C_{A0} = 2\text{moles/liter}$ and $v_0 = 4\text{ liters/min}$, what residence time and reactor volume will be required? **05**

- ii The rate constant of zero order reaction is 0.2 mole/liter*hour. What will be the initial concentration of the reactant if, after an hour, its concentration is 0.05 mole/liter? **02**

OR

- Q. 3 (a)** Derive the first order rate equation of ideal plug flow reactor for constant volume and variable volume system respectively. **07**

- Q. 3 (b)** Answer the following

- i A zero order homogeneous gas reaction $A \rightarrow rR$ proceeds in constant volume bomb, 20% inert and pressure rises from 1 to 1.3 atmosphere in 2 minutes. If the same reaction takes place in a constant pressure batch reactor, what is the fractional volume change in 4 minutes, if the feed is at 3 atmospheres and consists of 40% inert? **05**
- ii For the gas phase reaction at 350K, the rate is reported as: $-dP_A/dt = 3.55P_A^2$ Atmosphere/hour. What is the value and the unit of rate constant? **02**

- Q. 4 (a)** Discuss in detail about the polymerization reactors with their characteristics which are different from other reactors. Also list the reactors which are preferred for polymerization. **07**

- Q. 4 (b)** Answer the following

- i Write a note on ceiling temperature. **04**
- ii Explain the term kinetic chain length with its equations. **03**

OR

- Q. 4 (a)** Discuss the kinetics of free radical polymerization reactions. **07**

- Q. 4 (b)** Answer the following

- i What do you mean by Mayo equation? Also explain its applications. **04**
- ii Explain the telomerization with suitable example. **03**

- Q. 5 (a)** Discuss in detail about the sedimentation velocity method to determine the molecular weight. **07**

- Q. 5 (b)** Answer the following

- i If the polymer sample has population as: **04**

No. of molecules	10	20	20	25
Mass of each molecule	5,000	7,500	10,000	15,000

Calculate the number average and weight average molecular weight respectively.

- ii Which assumptions are made to find out the degree of polymerization in case of kinetics of anionic polymerization? **03**

OR

- Q. 5 (a)** Give the name of the method which is used to determine the viscosity average molecular weight and discuss that method in detail. **07**

- Q. 5 (b)** Answer the following

- i Calculate the number average molecular weight and weight average molecular weight respectively for a polymer mixture of following amount of fractions (with respective molecular weights given in parenthesis). 1gm (20,000), 2grams (50,000) and 0.5 grams (1,00,000). **04**
- ii Which principles are adopted to achieve the narrow composition distribution in commercial copolymerization? **03**
