

GUJARAT TECHNOLOGICAL UNIVERSITY**B. E. VIIth Semester–Examination – Nov- 2011****Subject code: 172602****Subject Name: Polymer Kinetics****Date: 22/11/2011****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) Discuss the various forms of rate equation. **06****(b)** Answer the following

- i Explain the classification of reactors according to the mode of operation. **06**
- ii Draw an ideal contacting pattern for heterogeneous system when one phase is in plug flow and other in backmix flow. **02**

Q.2 (a) Compare the collision theory with transition state theory. **05****(b)** Answer the following

- i A reaction $2\text{HI}_{(g)} \rightarrow \text{H}_{2(g)} + \text{I}_{2(g)}$ is studied over a range of temperatures. The results obtained are tabulated as below. **06**

Temperature (K°)	633	666	697	715
Rate Constant (Liter/Mole*Second)	1.7×10^{-5}	1.07×10^{-4}	5.01×10^{-4}	1.05×10^{-3}

Find the value of activation energy graphically using given data.

- ii Write in brief about the integral method of analysis. **03**

OR**Q.2 (b)** Answer the following

- i Experiment shows that homogeneous decomposition of ozone proceeds with rate $-\text{r}_{\text{O}_3} = k[\text{O}_3]^2[\text{O}_2]^{-1}$. What is the overall order of reaction? Suggest two step mechanism to explain this rate and state how you could further test this mechanism. **06**
- ii Derive the empirical rate equation of n^{th} order reaction. **03**

Q.3 (a) Derive the integral rate expression for bimolecular type second order reaction $2\text{A} \rightarrow \text{products}$ for variable volume batch reactor. **07**

- (b)** The aqueous reaction $\text{A} + \text{B} \rightarrow \text{product}$ $-\text{r}_{\text{A}} = (500 \text{ Liter/Mole*Second}) \text{CA*CB}$ is to take place in experimental tubular reactor under following conditions: Volume of Reactor = 1 Liter, Volumetric feed rate = 0.05 Liter/Minute, Concentration of reactants in feed is $\text{CA}_0 = \text{CB}_0 = 0.01 \text{ Mole/Liter}$. (i) What fractional conversion of reactants can be expected? (ii) For the same conversion as in part (i) what size of stirred tank reactor is needed? (iii) What conversion can be expected in a mixed reactor equal in size to plug flow reactor? **07**

OR**Q.3 (a)** Answer the following

- i A zero order homogeneous gas reaction with stoichiometry $\text{A} \rightarrow \text{rR}$ proceeds in a constant volume bomb, $\pi = 1$ when $t = 0$ and $\pi = 1.5$ **04**

- when $t = 1$. If the same reaction, same feed composition and initial pressure proceeds in constant pressure set up. Find out the volume.
- ii Liquid A decomposes by second order kinetics, and in a batch reactor 50% of A is converted in 5 minute run. How much long would it take to reach 75% conversion? **04**
- (b) Derive the performance equation of ideal plug flow reactor with necessary assumptions. Also derive it for first order constant volume system. **06**
- Q.4** (a) Answer the following
- i Which generalized statements are made by studying the kinetics of free radical polymerization? Also show this generalization graphically. **06**
- ii Define the term chain transfer constant. List the factors on which it depends? **02**
- (b) Answer the following
- i Explain the ideal copolymerization with the conditions necessary for it. **04**
- ii Write down the net rate of reaction for propagation step of free-radical copolymerization. **02**
- OR**
- Q.4** (a) Answer the following
- i Derive the mathematical expression for kinetics of non-catalyzed polycondensation reaction. Also show its relationship with number average degree of polymerisation **06**
- ii Normally solvents are used as good chain transfer agent-Justify this statement with suitable example. **03**
- (b) What do you mean by reactivity ratio? How can we find the value of reactivity ratio for copolymer equation? **05**
- Q.5** (a) Answer the following
- i Explain the viscometry method to determine the polymer molecular weight. **06**
- ii In the particular samples of polymer, 100 molecules have molecular weight 10^3 each, 200 molecules have molecular weight 10^4 each and 200 molecules have molecular weight 10^5 each. Calculate the number average and weight average molecular weight respectively. **04**
- (b) Write about the addition reaction. **04**
- OR**
- Q.5** (a) Answer the following
- i How is molecular weight determined by end group analysis method? Which type of molecular weight is obtained by this method? **06**
- ii A sample of high polymer contains 20 percent by weight of macromolecules of molecular weight 10,000 and 80 percent by weight macromolecules of 1,00,000. Calculate the number average and weight average molecular weight respectively. **04**
- (b) Write about the substitution reaction. **04**
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