Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. - SEMESTER – VII • EXAMINATION – WINTER 2012

Subject code: 172602 Date: 31/12/2012

Subject Name: Polymer Kinetics

Time: 10.30 am – 01.00 pm Total Marks: 70

Instructions:

1. **Attempt any five questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q. 1 (a) Discuss in detail about the factors affecting the rate of reaction. **06**

Q. 1 (b) Answer the following

(i) Which is temperature dependent term in reaction rate? Write in brief about the Arrhenius theory of temperature dependency on rate of reaction. **06**

(ii) Define the following terms: (i) Single Reaction (ii) Multiple Reaction **02**

Q. 2 (a) Discuss in detail about the classification of reactors. **07**

Q. 2 (b) Give the pseudo steady state hypothesis. The primary reaction occurring in the heterogeneous decomposition of nitrous oxide is found to be $-r_{N2O}=k_1*[N_2O]^2/1+k_2*[N_2O]$.Devise the mechanism to explain this reaction. **07**

OR

Q. 2 (b) Answer the following

(i) At 500ºK the rate of bimolecular reaction is five times the rate at 400 ºK. Find out the activation energy of reaction(i)From Arrhenius law (ii) From collision theory **05**

(ii) The rate constant of reaction at 27ºC is $1.3*10^{-3}sec^{-1}$. Determine the frequency factor. Take E= 128170 calorie/gram mole. **02**

Q. 3 (a) Derive the integral rate expression for liquid phase bimolecular type second order reaction A+B→ products for constant volume batch reactor. **07**

Q. 3 (b) Pure gaseous reactant A (C_{A0}=100millimole/liter) is fed at steady rate in to a mixed reactor (V=0.1 liter) where it dimerizes (2A→R). For different gas feed rates the following data is obtained: **07**

Run Number	1	2	3	4
ν_0(Liter/hour)	30.0	9.0	3.6	1.5
$C_{A,out}$ (millimole/liter)	85.7	66.7	50	33.3

Find the rate equation for this.

OR

Q. 3 (a) Aqueous A at a concentration C_{A0}=1mole/liter is introduced into a batch reactor where it reacts away to form product R according to stoichiometry A→R. The concentration of A in the reactor is monitored at various times as shown below: **07**

t, minutes	0	100	200	300	400
C_A, mole/m^3	1000	500	333	250	200

For C_{A0}=500mole/m^3 find the conversion of reactant after 5 hours in batch reactor.

Q. 3 (b) The homogeneous gas phase decomposition of phosphine, $4PH_{3(g)} \rightarrow P_{4(g)}+6H_{2(g)}$ proceeds at 649ºC with first order rate $-r_{PH3}=(10/hr)C_{PH3}$. What size of plug flow reactor (PFR) operating at 649ºC and 4.6 atmosphere can produce 80% conversion of feed consisting 2 kg moles of pure phosphine per hour? **07**

Q. 4 (a) Answer the following

(i) Explain the practical significance of polymer molecular weight. **05**

(ii) Write down the formula to calculate the number average and weight average degree of polymerization. **02**

Q. 4 (b) Discuss the kinetics of cationic polymerization. **07**

OR

Q. 4 (a) Answer the following

(i) Derive the mathematical expression for non-catalyzed polycondensation type polymerization. **05**

(ii) Explain the term ceiling temperature. **02**

Q. 4 (b) Explain the effect of reactivity ratios on the copolymerization behavior. **07**

Q. 5 (a) Calculate Number Average Molecular Weight, Weight Average Molecular Weight and Z-average Molecular Weight for a polydispersed polymer composed of the following mixture of fractions(mass% and molecular weight of each of the fractions are given) **07**

Mass%	20	30	50
Molecular Weight	50,000	1,00,000	2,00,000

Q. 5 (b) Which method is used to determine the viscosity average molecular weight? Discuss that method in detail. **07**

Q. 5 (a) The following data were obtained for intrinsic viscosity of some polyisobutylene samples in CCl_4 solutions at 30ºC. Verify suitable plot that the data fit to the equation $[\eta] = k(M_v)^{\alpha}$. Determine the constants k and α. **08**

$[\eta]$, cm^3/gm	430	206	78	73	43	15.1
M_v, cm^3/gm	12,60000	4,63,000	1,10,000	92,700	48,000	10,000

OR

Q. 5 (b) How number average molecular weight is is determined by end group analysis method? **06**

****