Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII • EXAMINATION – SUMMER 2013

Subject Code: 172602 Date: 24-05-2013

Subject Name: Polymer Kinetics

Time: 02.30 pm - 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)**	Which is temperature dependent term in the reaction rate? Write in brief about the collision theory of temperature dependency on rate of reaction.	**07**
Q.1	**(b)**	Answer the following	
	i	Explain the elementary reaction and non-elementary reaction respectively with suitable examples.	**04**
	ii	Explain the classification of reactors according to variations in the process variables with time.	**03**
Q.2	**(a)**	Discuss the factors affecting the rate of reaction.	**07**
Q.2	**(b)**	At 400ºK, the rate of bimolecular reaction is ten times the rate at 300ºK. Find the activation energy of this reaction: (a) From Arrhenius law (b) From collision theory (c) What is the percentage difference in the rate of reaction at 500ºK predicted by these two methods?	**07**
		OR	
Q.2	**(b)**	What do you mean by pseudo steady state hypothesis? Experiment shows that homogeneous decomposition of ozone proceeds with rate $-r_{O3} = k*[O_3]^2*[O2]^{-1}$. What is the overall order of reaction? Suggest two step mechanism to explain this rate and state how you could further test this mechanism.	**07**
Q.3	**(a)**	Derive the integral rate expression for bimolecular type second order reaction A + B → products for constant volume batch reactor.	**07**
Q.3	**(b)**	Answer the following	
	i	One liter/min of liquid containing A and B(C_{A0}=0.10mole/liter, C_{B0}=0.01mole/liter) flow into mixed reactor of volume V=1liter. The materials react in such a manner for which stoichiometry is unknown. The outlet stream from the reactor contains A, B and C (C_{Af} =0.02mole/liter, C_{Bf}=0.03mole/liter, C_{Cf}=0.04mole/liter). Find the rate of reaction of A, B and C for the conditions within the reactor.	**05**
	ii	Define the following terms: (i) space time (ii) space velocity	**02**
		OR	
Q.3	**(a)**	Derive the performance equation for ideal plug flow reactor.	**07**
Q.3	**(b)**	The homogeneous gas decomposition of phophine $4PH_{3(g)} \rightarrow P_{4(g)} + 6H_{2(g)}$ proceeds at 1400ºF with first order rate $-r_{PH3} = (10/hr)\ C_{PH3}$. What size of plug flow reactor operating at 1400ºF and 5 atm can proceed 80% conversion of feed consisting of 4 lb-mole of pure phophine per hour?	**07**

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

Q.4	**(b)**	Answer the following	
	i	Which conclusions can be drawn regarding to kinetics of free radical polymerization?	**04**
	ii	Normally solvents are used as good chain transfer agent-justify this statement with suitable example.	**03**
		OR	
Q.4	**(a)**	Derive the mathematical expression for kinetics of non-catalyzed polycondensation reaction. Also show its relationship with number average degree of polymerization.	**06**
Q.4	**(b)**	Answer the following	
	i	Which principles are adopted to achieve the narrow composition distribution in case of copolymerization?	**05**
	ii	Write a brief note on chain modifier.	**03**
Q.5	**(a)**	Which method is used to determine the viscosity average molecular weight? Discuss that method.	**07**
Q.5	**(b)**	Answer the following	
	i	Equal number of molecules with M_1=10,000 and M_2=1,00,000 are mixed. Calculate number average, weight average and z-average molecular weight.	**04**
	ii	Write a brief note on the ceiling temperature.	**03**
		OR	
Q.5	**(a)**	Discuss the ultracentrifugation method to determine the molecular weight.	**07**
Q.5	**(b)**	Answer the following	
	i	Equal mass of polymer molecules with M_1=10,000 and M_2=1,00,000 are mixed. Calculate the number average and weight average molecular weight respectively.	**04**
	ii	What do you mean by kinetic chain length? Give its relationship with degree of polymerization.	**03**

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