Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V(New) • EXAMINATION – WINTER 2016

Subject Code:2150403 Date:19/11/2016

Subject Name:Basics of Reaction Engineering

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.**

			MARKS
Q.1		**Short Questions**	**14**
	1	Define order of reaction.	
	2	Define activation energy.	
	3	Differentiate between elementary and non-elementary reactions.	
	4	Define space time.	
	5	Explain single and multiple reactions.	
	6	Define space velocity.	
	7	Define ideal reactors.	
	8	What is a recycle reactor?	
	9	What is the differential method of analysis?	
	10	Explain autocatalytic reactions.	
	11	Write performance equation of a PFR.	
	12	What is a zero-order reaction?	
	13	Define selectivity.	
	14	What is multiple reactor system?	
Q.2	**(a)**	Discuss the Integral method of analysis for irreversible elementary reactions in parallel.	**03**
	(b)	Show that for a first order irreversible reaction $\ln(1/(1 - X_A)) = kt$.	**04**
	(c)	Derive the C_{Rmax} and t_{Rmax} for the first order reactions given below: $A \rightarrow R \rightarrow S$	**07**
		OR	
	(c)	Find the first order rate constant for the disappearance of A in the gas phase reaction $2A \rightarrow R$ if on holding the pressure constant, the volume of the reaction mixture starting with 80% of A decreases by 20% in 3 minutes.	**07**
Q.3	**(a)**	Derive the design equation of recycle reactor.	**03**
	(b)	The rate of bimolecular reaction at 500 K is 10 times the rate at 400 K. Calculate the activation energy of reaction by Arrhenius law.	**04**
	(c)	Explain the size comparison of single ideal CSTR with PFR and mention the different parameter affecting the size of the reactor.	**07**
		OR	
Q.3	**(a)**	Write a brief note on variable volume batch reactor.	**03**
	(b)	In a batch reactor the conversion of a liquid reactant A is 70% in 13 minutes. Find the space time required to effect this conversion in a plug flow reactor and a mixed flow reactor. Assume first order kinetics.	**04**
	(c)	A first order reaction is to be treated in a series of two CSTR. show that the total volume of the two reactors is minimum when the reactors are equal in size.	**07**
Q.4	**(a)**	Discuss Molecularity. Mention the general formulae for the unit of rate constant K.	**03**
	(b)	Derive the design equation of steady-state mixed flow reactor.	**04**

	(c)	Assuming a stoichiometry A→R for first order gas phase reaction, the volume of a plug flow reactor for 99% conversion of pure A is calculated to be 32 liters. However, the stoichiometry of the reaction is A→ 3R. For this corrected stoichiometry, find the required volume of a reactor.	**07**

OR

Q.4	**(a)**	Explain various ideal reactors with its characteristics.	**03**
	(b)	Explain the importance of reactor design with broad classification of reactor types.	**04**
	(c)	How will you compare the performance of single batch reactor with the flow reactor and mixed versus plug flow reactor for a first order reaction?	**07**
Q.5	**(a)**	Briefly describe representation of non elementary reactions.	**03**
	(b)	Explain the Arrhenius theory of temperature dependency. How activation energy affects temperature sensitivity of reaction.	**04**
	(c)	Explain the qualitative product distribution for irreversible first order reactions in series.	**07**

OR

Q.5	**(a)**	Write short note on integral & differential method of analysis.	**03**
	(b)	Find the conversion after 1 hour in a batch reactor for A→R, $-r_A = 3C_A$ mol/lit.hr, $C_{Ao} = 1$ mol/lit.	**04**
	(c)	Write a short note on optimum temperature progression.	**07**

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