Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2160506 **Date: 10/05/2017**

Subject Name: Chemical Reaction Engineering - I

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	List two important pieces of information needed for design of reactor as predicted by thermodynamics	**01**
	2	Discuss the basis for the classification of chemical reactions	**01**
	3	Define single and multiple reactions	**01**
	4	Define Elementary and Non-elementary reactions with example	**01**
	5	Define the general unit of rate constant K for any order of reaction	**01**
	6	Discuss the assumptions made in the Collision Theory	**01**
	7	Back mixing is allowed in MFR – State true or false	**01**
	8	Discuss the factors affecting the rate of reaction for zero order reaction	**01**
	9	Define homogenous catalyzed reactions	**01**
	10	State the necessary and sufficient condition to exist for an ideal plug flow reactor	**01**
	11	State the condition to be maintained while connecting Plug flow reactors of different size in parallel	**01**
	12	State the use of catalyst in product distribution for reactions in parallel	**01**
	13	Define space time and space velocity	**01**
	14	Define recycle ratio and what will be the behaviour when R = 0	**01**
Q.2	**(a)**	State three rules for best arrangement or effective use of the set of given ideal reactors	**03**
	(b)	Discuss the theory of maximization of rectangle for finding the optimum volume of MFR in series	**04**
	(c)	Derive the performance equation for Plug Flow reactor	**07**
		OR	
	(c)	Derive the process design equation for Mixed Flow reactor	**07**
Q.3	**(a)**	Write a note on temperature dependency of rate constant according to Arrhenius law	**03**
	(b)	Compare the temperature dependency theory of Arrhenius law with that of Collision and Transition state theory	**04**
	(c)	Establish the relation between conversion – time and reaction rate constant using the half-life method for irreversible unimolecular type reactions using integral method of analysis.	**07**
		OR	
Q.3	**(a)**	Discuss the method for classification of chemical reactions with example	**03**
	(b)	Compare the Integral and Differential method of analysis for analyzing reaction kinetics data	**04**
	(c)	Explain the total pressure data analysis in a constant volume system and also establish relation of partial pressure of gaseous component in reaction mixture.	**07**

Q.4 **(a)** State the different ways to define the reaction rate **03**

(b) Discuss the theory of equal size mixed reactors connected in series and derive equation in terms of total residence time for N reactors in series. **04**

(c) Using following data for the bimolecular second-order formation of methyl-ethyl ether in ethyl alcohol solution, Calculate the activation Energy and frequency factor for this reaction. **07**

Temp,°C	0	6	12	18	24	30
K. lt/mol.sec	5.6×10^5	11.8×10^5	24.5×10^5	48.8×10^5	100×10^5	208×10^5

OR

Q.4 **(a)** Discuss autocatalytic reaction with conversion-time and rate-concentration curves **03**

(b) Derive the design equation for Recycle reactor with diagram in terms of Volume requirement **04**

(c) After 8 minutes in a batch reactor a reactant (C_{A0} = 1 mol/lit) is 80% converted, after 18 minutes the conversion is 90%. Find a rate equation to represent the reaction **07**

Q.5 **(a)** Define the Overall fractional yield and Instantaneous fractional yield for the decomposition of A into product R **03**

(b) Discuss the Qualitative discussion for product distribution for reaction in series $A \xrightarrow{k1} R \xrightarrow{k2} S$ considering that it is a light induced reaction. **04**

(c) Derive a relation for overall fractional yield in PFR for following reaction in parallel. **07**

$$A \underset{k2}{\overset{k1}{\rightleftarrows}} \begin{matrix} R \text{ (desired)} \\ S \text{ (undesired)} \end{matrix}$$

OR

Q.5 **(a)** Describe the optimum temperature progression and its application **03**

(b) Show the graphical representation of energy balance equation for adiabatic operation **04**

(c) A first order reaction is to be treated in a series of two mix reactors. Show that the total volume of the two reactors is minimum when reactors are of equal size. **07**

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