

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VII (OLD) EXAMINATION – SUMMER 2019

Subject Code: 170501
Date: 18/05/2019
Subject Name: Chemical Reaction Engineering - I
Time: 02:30 PM TO 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) An irreversible elementary series reaction $A + B \rightarrow C$ is taking place in a constant volume batch reactor with rate expression $-r_A = k_C A_C B_C$. Derive an expression to determine kinetics of this reaction. **07**
- (b) Explain the temperature dependency term in the rate equation using Arrhenius theory. **07**
- Q.2** (a) Define autocatalytic reactions. Derive an expression to find its kinetics. Explain plots of rate of reaction Vs. time and concentration Vs. time **07**
- (b) Derive the integrated rate expression for first order reversible reactions. **07**
- OR**
- (b) 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 performance equation of ideal Plug flow reactor. **07**
- (b) The decomposition of sulfurile chloride to sulfur dioxide and chlorine is carried out in closed vessel (Batch reactor) for 60 minutes at 610 0F. Calculate the time required to decompose 95% of sulfurile chloride, when the reaction proceeds according to first order reaction and the reverse reaction is negligible. The specific reaction rate constant at 610 0F is 0.00132 per minute **07**
- OR**
- Q.3** (a) Define recycle ratio. Derive the design equation of Recycle reactor. **07**
- (b) Derive the design equation of Ideal batch Reactor. **07**
- Q.4** (a) Write short notes on the qualitative discussion about product distribution for parallel reaction. **07**
- (b) Write short note on half life method to determine kinetics. **07**
- OR**
- Q.4** (a) A two liquid reactant stream with $C_{AO} = 1$ mol/L passing through two mixed flow reactors in series. The concentration of A in the exit stream from the first reactor is 0.5 mol/L. Find the concentration of A in the exit stream of the second reactor. The reaction $A \rightarrow R$ follows second order kinetics and $V_2/V_1 = 2$. **07**
- (b) Show how rate constants are evaluated for irreversible reactions in parallel. **07**
- Q.5** (a) Define and explain the following terms. **07**
- i) Order of reaction (ii) Elementary and non-elementary reactions
 iii) Activation Energy (iv) Single and multiple reactions. v) Space time
 (vi) Space velocity (vii) molecularity
- (b) Write short note on quantitative product distribution for series reaction. **07**
- OR**
- Q.5** (a) Write a short note on optimum temperature progression. **07**
- (b) Explain various contacting patterns to get favorable distribution of products for multiple reactions. **07**