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

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–VI (NEW) - EXAMINATION – SUMMER 2016**

**Subject Code:2160506** **Date:13/05/2016**

**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.**

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|---|---|---|---|
| **Q.1** | **(a)** | Write physical significance of activation energy. Also discuss temperature dependency of activation energy using Arrhenius theory. | **07** |
| | **(b)** | The reaction between CO and $NO_2$ at low temperature proceeds with a rate $$-r_{NO_2} = k C_{NO_2}^2$$ Suggest a mechanism to explain this rate law. | **07** |
| **Q.2** | **(a)** | State the various methods to analyze the kinetic data and explain any one in detail. | **07** |
| | **(b)** | The rate constant at 27 $^0$C for a reaction is $1.3 \times 10^{-3}$ sec$^{-1}$ and its frequency factor is $2.785 \times 10^6$ sec$^{-1}$. Determine its entropy of activation and enthalpy of activation. Given: Planck's constant h = $6.024 \times 10^{-27}$ erg sec and Boltzmann constant $k_B = 1.38 \times 10^{-16}$ erg/K | **07** |
| | | **OR** | |
| | **(b)** | Discuss about variable volume reactor. Derive the relation for irreversible first order reaction in terms of variable volume reactor. | **07** |
| **Q.3** | **(a)** | In a homogeneous isothermal liquid polymerization, 20% of the monomer disappears in 34 minutes for initial monomer concentration of 0.04 and also for 0.8 mol/liter. What rate equation represents the disappearance of the monomer? | **07** |
| | **(b)** | In case of a first order reaction, show that the time required for 75% conversion is double the time required for 50% conversion. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Discuss the advantages and disadvantages of various types of reactors used to carry out the reactions. | **07** |
| | **(b)** | Define space time and space velocity. Derive the performance equation for CSTR. | **07** |
| **Q.4** | **(a)** | Derive the performance equation for equal size CSTR's arranged in parallel. | **07** |
| | **(b)** | Derive the design equation for autocatalytic reactor. | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | A liquid reactant stream with $C_{A0}$ = 1 mol/lit passes through two mixed flow reactors in series. The concentration of A in the exit stream from the first reactor is 0.5mol/lit. Find the concentration of A in the exit stream of the second reactor. The reaction A → R follows second order kinetics and $V_2/V_1 = 2$ | **07** |

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|---|---|---|---|
| | **(b)** | In an isothermal batch reactor the conversion of a liquid reactant A is 70% in 13 min. Find the space time and space velocity necessary to effect this conversion in a plug flow reactor and in a mixed flow reactor. Consider the first order kinetics. | **07** |
| **Q.5** | **(a)** | With necessary equations write short note on qualitative discussion about product distribution in parallel reactions. | **07** |
| | **(b)** | Differentiate between contacting patterns in continuous flow operations and non continuous operations for various combination of high and low concentration of reactants for maximizing the desired product. | **07** |

**OR**

| | | | |
|---|---|---|---|
| **Q.5** | **(a)** | Compare plug flow reactor and mixed flow reactor for finding the size of reactor for adiabatic operations with graphs. | **07** |
| | **(b)** | Explain briefly about equilibrium constants from thermodynamics clearly mentioning the all possible states of species. | **07** |

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