Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 2019

Course Code: CH305

Course Name: CHEMICAL REACTION ENGINEERING-I

Max. Marks: 100 Duration: 3 Hours

Graph sheets may be provided

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) Define the molecularity and order of a chemical reaction. (2)

b) The rate constants of a certain reaction are 1.6×10^{-3} and 1.625×10^{-2} $(s)^{-1}$ at 10°C and 30°C. Calculate the activation energy in KJ/mol. (5)

c) For the gas phase decomposition of azo methane, develop a mechanism and from it, derive a rate law. (8)

2 a) Differentiate between elementary and non-elementary reaction with examples. (4)

b) List the various factors affecting the rate of a chemical reaction. (3)

c) Give detailed classifications of chemical reactions. Write examples for each classification (8)

3 a) The decomposition of nitrous oxide is found to proceed as follows: (12)

$N_2O \rightarrow N_2+\frac{1}{2}O_2, \quad -r_{N_2O} = \frac{k_1[N_2O]^2}{1+k\prime[N_2O]}$

Suggest a mechanism to explain this rate. What is the order of this reaction with respect to N_2O?

b) Explain Pseudo Steady State Hypothesis and write its applications (3)

PART B

Answer any two full questions, each carries 15 marks.

4 a) Derive the integral equation for a second order reaction with equimolar concentrations of the reactants. (5)

b) The half-life period for a certain first order reaction is 2.5×10^{3}s. Determine the time taken for ¼ of the reactant to be left behind. (5)

c) After 8 minutes in a batch reactor, reactant (C_{A0}= 1 mol/liter) is 80% converted; after 18 minutes, conversion is 90%. Find a rate equation to represent this reaction. (5)

5 a) Define an autocatalytic reaction. Give an example. (2)

b) The first-order reversible liquid reaction (7)

$$A \rightleftarrows R, \quad C_{A0} = 0.5 \text{ mol/liter}, \quad C_{R0} = 0$$

takes place in a batch reactor. After 8 minutes, conversion of A is 33.3% while equilibrium conversion is 66.7%.Find the rate equation for this reaction.

c) Find the first order rate constant for the disappearance of A in the gas reaction A→1.6R if the volume of the reaction mixture, starting with pure A increases by 50% in 4 minutes. The total pressure within the system stays constant at 1.2 atm and the temperature is 25^0C. (6)

6 a) Define space time and space velocity. (3)

b) Derive the performance equation of a Mixed Flow Reactor. (5)

c) A plug flow reactor (2 m^3) processes an aqueous feed (100 liter/min) containing reactant A (C_{A0} = 100 mmol/liter). This reaction is reversible and represented by (7)

$$A \leftrightarrow R, -r_A = (0.04min^{-1})C_A - (0.01min^{-1})C_R$$

First find the equilibrium conversion and then find the actual conversion of A in the reactor.

PART C

Answer any two full questions, each carries 20 marks.

7 a) Define recycle ratio and explain a recycle reactor. (3)

b) Explain the graphical method of determining the conversion in the case of unequal size mixed flow reactors connected in series. (7)

c) An aqueous reactant stream (4 mol A/liter) passes through a mixed flow reactor followed by a plug flow reactor. Find the concentration at the exit of the plug flow reactor if in the mixed flow reactor C_A = 1mol/liter. The reaction is second-order with respect to A, and the volume of the plug flow unit is three times that of the mixed flow unit. (10)

8 a) Write a note on bioreactors (5)

b) Derive the Michaelis – Menton equation for enzymatic reactions. (15)

9 a) With neat sketch, explain membrane Reactors. Write the different types of membrane reactors. (8)

b) Explain the phases of bacterial cell growth. (5)

c) Cell growth rate is expressed in terms of Monod Equation. Write the equation and specify each term on the equation. (4)

d) Explain reactive distillation with an example. (3)

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