BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION SP2023)

CLASS: B.TECH **SEMESTER : IV**
BRANCH: CHEMICAL ENGG **SESSION : SP2023**

SUBJECT: CL223 CHEMICAL REACTION ENGINEERING - I

TIME: 02 Hours **FULL MARKS: 25**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**

			CO	BL
Q.1(a)	Differentiate between elementary and non-elementary reactions.	[2]	CO1	2
Q.1(b)	Define the following terms: (i) molecularity (ii) order of reaction (iii) heterogeneous non catalytic reactions with example	[3]	CO1	1
Q.2(a)	Derive the following expression for a series reaction. $A \xrightarrow{k_1} R \xrightarrow{k_2} S$ $C_R = C_{A0} k_1 \left(\frac{e^{-k_1 t}}{k_2 - k_1} + \frac{e^{-k_2 t}}{k_1 - k_2} \right)$	[3]	CO1	3
Q.2(b)	What are the factors on which rate constant depends?	[2]	CO1	2
Q.3	Pure gaseous reactant A (C_{AO} = 100 millimole/liter) is fed at a steady rate into a mixed flow reactor (V = 0.1 liter) where it dimerizes (2A → R). For different gas feed rates, the following data are obtained:	[5]	CO3	3

Run number	1	2	3	4
vo, liter/hr	30.0	9.0	3.6	1.5
CAf, millimole/liter	85.7	66.7	50	33.4

Find a rate equation for this reaction.

Q.4(a)	Derive the expression of Half-life for a n-th order irreversible reaction	[2]	CO3	2
Q.4(b)	For the reaction $A \rightarrow R$, second-order kinetics and $C_{A0} = 1 mol/litre$, 50% conversion achieved after 1 hour in a batch reactor. What will be the conversion and concentration of A after 1hour if $C_{A0} = 10 mol/litre$.	[3]	CO3	5
Q.5(a)	Reactant *A* decomposes to products *B* and *C* in the presence of an enzyme in a well-stirred batch reactor. The kinetic rate expression is given by $-r_A = \frac{0.01 C_A}{0.05 + 0.01 C_A} (mol.L^{-1}.\min^{-1})$ If the initial concentration of *A* is 0.02 mol/litre, find the time taken to achieve 50% conversion of *A*.	[2]	CO2	5
Q.5(b)	Gaseous reactant A decomposes as follows: $A \rightarrow 3R$, $-r_A = (0.6 \min^{-1}) C_A$. Find the conversion of A in a 50%- 50% inert feed ($v_o = 180 litre/\min$, $C_{A0} = 300 mmol/litre$), to a one m^3 mixed flow reactor.	[3]	CO2	5

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