BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION SP2024)

CLASS: B.TECH **SEMESTER: IV**
BRANCH: CHEMICAL ENGG **SESSION: SP/2024**

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: Graph paper**

			CO	BL
Q.1(a)	Define the rate of reaction in different units.	[2]	CO1	1
Q.1(b)	In an isothermal reaction, the rate of reaction triples on doubling the concentration of reactant. Calculate the order of the reaction.	[3]	CO1	3
Q.2(a)	The gas-phase decomposition A→B+2C is carried out in a constant-volume batch reactor. Runs 1 through 5 were carried out at 100°C while run 6 was carried out at 110°C. (a) From the data in Table, determine the reaction order and specific reaction rate, (b) What is the activation energy for this reaction?	[5]	CO2	3

Run	1	2	3	4	5	6
Initial conc. (mol/l)	0.025	0.0133	0.01	0.05	0.075	0.025
Half-life (min)	4.1	7.7	9.8	1.96	1.3	2

Q.2(b)	For reaction A → 4R, with 60 mole% inert and 40 mole% of A, calculate the value of ε_A.	[2]	CO2	3
Q.2(C)	Show that half-life ($t_{1/2}$) of a zero-order irreversible reaction is $C_{AO}/2k$, where C_{AO} and k are the initial concentration of reactant A and rate constant, respectively.	[3]	CO2	3
Q.3(a)	Show that the performance equation for first order kinetics and $\varepsilon_A = 0$ for reversible reaction (A ↔ R with k_1 and k_2 are forward and backward rate constants, respectively) with zero initial product concentration in a Plug Flow Reactor (PFR) is $$\frac{k_1\tau}{X_{Ae}} = ln\left(\frac{X_{Ae}}{X_{Ae} - X_A}\right)$$	[5]	CO3	3
Q.3(b)	The laboratory measurements of rate versus conversion for reactant A are given below. Calculate the volume of a CSTR required to achieve 60% conversion. The feed molar flow rate of A entering to reactor is 10 kmol/s.	[5]	CO3	3

X_A	0	0.20	0.40	0.60	0.80
$-r_A$, (mol/(l.s))	0.182	0.143	0.10	0.0667	0.0357

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