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

CLASS: B.TECH **SEMESTER : V**
BRANCH: BIOTECHNOLOGY **SESSION : MO/2025**

SUBJECT: BE304 REACTION ENGINEERING

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**

Q.NO	QUESTIONS	MARKS	CO	BL
Q.1(a)	State a condition under which a bimolecular reaction with two reactants is kinetically a first-order reaction.	[1]	1,2	3,4
Q.1(b)	Concentration *vs* Rate data for the decomposition of N_2O_5 at 67^0 K is given below:	[4]	1,2	3,4

$$2N_2O_5 \longrightarrow 4\,NO_2 + O_2$$

Conc, mol/*l*	0.113	0.080	0.056	0.040
Rate mol/ *l*min	0.039	0.028	0.020	0.014

a. What is the rate expression for the reaction?
b. Calculate the value of rate constant.

Q.2(a)	Why does the rate of the reaction not remain constant throughout the reaction process?	[1]	1,2	3,4
Q.2(b)	The reaction $NO_2 + CO \rightarrow NO + CO_2$ occurs in two steps. Write the rate law. What is the order of the reaction? $2NO_2 \rightarrow NO + NO_3$ (k_1) – slow $NO_3 + CO \rightarrow CO_2 + NO_2$ (k_2) – fast	[1.5]	1,2	3,4
Q.2(c)	For the reaction, A → products, a graph of [C_A] versus time [t] is a curve. What can be concluded about the order of this reaction? Justify your answer by referring to all the integrated rate expressions you considered for analysis.	[2.5]	1,2	3,4
Q.3(a)	Show that the decomposition of N_2O_5 at 67 °C is a first-order reaction. Calculate the value of the rate constant. ***Data:***	[2.5]	1,2	3,4

Time, min	0	1	2	3	4
C_{N2O5}, mol / *l*	0.16	0.113	0.08	0.056	0.040

Q.3(b)	In the case of a first-order reaction, show that the time required for 75% conversion is double the time required for 50 % conversion.	[2.5]	1,2	3,4
Q.4(a)	A polymerization reaction occurs at constant temperature in a homogeneous phase. For initial monomer concentration of 0.3, 0.5 & 0.9 mol / *l* , 30% of the monomer reacts in 40 minutes. Find the reaction rate.	[2.5]	1,2	3,4
Q.4(b)	The following liquid-phase series reaction is taking place in a constant volume batch reactor. $A \xrightarrow{k_1} B \xrightarrow{k_2} C$ The first reaction is first order, and the second reaction is zero order. Determine the concentrations of A, B and C as functions of time.	[2.5]	1,2	3,4
Q.5(a)	Why is drug metabolism preferred to follow zero-order kinetics?	[2.5]	1,2	3,4
Q.5(b)	The concentrations of a compound undergoing chemical change were 5.72, 3.23, and 1.96 at times 0, 20 and 50 minutes from the commencement of the reaction. Find the order of the reaction.	[2.5]	1,2	3,4

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