

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

CLASS: BTECH
BRANCH: CHEMICAL ENGG.

SEMESTER: IV
SESSION: SP/2025

SUBJECT: CL223 CHEMICAL REACTION ENGINEERING-I

TIME: 02 Hours

FULL MARKS: 25

INSTRUCTIONS:

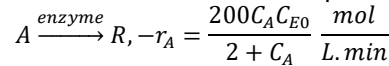
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates: Graph paper

- | | | CO | BL |
|---|-----|-----|----|
| Q.1(a) Discuss the effects of temperature, pressure, and composition on the rate of reaction with examples. | [2] | CO1 | 2 |
| Q.1(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 cal/mol. | [3] | CO1 | 3 |

- Q.2 Show that the decomposition of N₂O₅ at 67°C is a first-order reaction. Calculate the value of the rate constant.
Data:

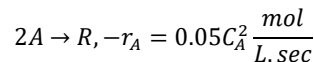
Time (min)	0	1	2	3	4
C _{N₂O₅} (mol/l)	0.16	0.113	0.08	0.056	0.040

- Q.3 Enzyme E catalyzes the transformation of reactant A to product R as follows: [5] CO2 3



If we introduce enzyme ($C_{E0} = 0.001$ mol/liter) and reactant ($C_{A0} = 10$ mol/liter) into a batch reactor and let the reaction proceed, find the time needed for the concentration of reactant to drop to 0.025 mol/liter. Note that the concentration of enzymes remains unchanged during the reaction.

- Q.4(a) Show that the volume of the mixed flow reactor is higher than the plug flow reactor to achieve the same conversion. [2] CO3 2
- Q.4(b) A gaseous feed of pure A (1 mol/L) enters a mixed flow reactor (4 L) and reacts as follows: [3] CO3 3



Find what feed rate (L/min) will give an outlet concentration $C_A = 0.5$ mol/L.

- Q.5 A gas phase reaction $2A \rightarrow 3B + C$ is carried out in a variable volume batch reactor. [5] CO3 3
The reaction follows second-order kinetics with a rate constant of 0.05 m³/kmol.s and an initial concentration of 0.05 kmol/m³. Calculate the time required for 50% conversion of A.

:27/02/2025:::E