Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
(GIET University)

B. Tech (Fifth Semester - Regular) Examinations, November – 2024

22BCHPC35002 - Chemical Reaction Engineering-I

(Chemical Engineering)

Time: 3 hrs Maximum: 70 Marks

Answer ALL questions

(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

	Q.1. Answer ***ALL*** questions	CO #	Blooms Level
a.	Given the reaction $2NO_2 + \frac{1}{2} O_2 = N_2O_5$, what is the relation between the rates of formation and disappearance of the three reaction components?	CO1	K1
b.	On doubling the concentration of reactant, the rate of reaction triples. Find the reaction order.	CO2	K4
c.	Define pseudo first order reaction.	CO1	K2
d.	Differentiate batch reactor and continuous reactor.	CO1	K2
e.	How can you keep the concentration of the reactant high for a single reactant parallel reaction?	CO2	K3

PART – B **(15 x 4 = 60 Marks)**

	Answer ***All*** the questions	Marks	CO #	Blooms Level
2. a.	The irreversible reaction A+B=AB has been studied kinetically, and the rate of formation of product has been found to be well correlated by the following rate equation $r_{AB} = k [A]^2$ ……is independent of [B]. What reaction mechanism is suggested by this rate expression if the chemistry of the reaction suggests that the intermediate consists of an association of reactant molecules and that a chain reaction does not occur?	8	CO1	K1
b.	The data for the first order decomposition of Benzene diazonium chloride to Chlorobenzene & nitrogen are as follows.	7	CO2	K3

K (Sec -1)	0.00043	0.00103	0.00180	0.00355	0.00717
T (K)	313	319	323	328	333

What is the activation energy & complete rate expression for this reaction?

(OR)

c.	For the following stoichiometry, find the overall order of the reaction $A + B = Products$ Given	8	CO2	K3

C_A (mol/lit)	4	1	1
C_B (mol/lit)	1	1	8
$-r_A$ (mol/lit.min)	2	1	4

d.	Describe about the different intermediates used in chemical reaction with examples	7	CO2	K2

3.a.	Derive the performance equation of the reaction of second order $A + B \rightarrow$ Product having initial concentration C_{A_O} and C_{B_O} of A and B respectively for a constant volume batch reactor. Draw free hand graphs for Conc vs time.	8	CO3	K3
b.	Liquid A decomposes by first-order kinetics, and in a batch reactor 50% of A is converted in a 5-minute run. How much longer would it take to reach 75% conversion?	7	CO2	K3
	(OR)			
c.	Derive the performance equation for irreversible first order reaction of variable volume batch reactor.	7	CO2	K2
d.	Calculate the first order rate constant for the disappearance of A as per the gas phase reaction $A \rightarrow 1.6\ R$, if the volume of the reaction mixture, starting with pure A increases 50% in 4 minutes. The total pressure of the system remains constant at 1.2 atm and the temperature is 25^0C.	8	CO2	K3
4.a.	Derive the performance equation of ideal batch reactor from material balance expression.	8	CO3	K2
b.	Gaseous reactant A decomposes as follows. $A \rightarrow 3R$, $-r_A = 0.6\ \text{min}^{-1} C_A$ Find the space time and conversion of A in 50% A-50% inert feed having flow rate 180 lit/min and C_{A_O}=300 mol/lit, to a 1 m^3 mixed flow reactor.	7	CO2	K3
	(OR)			
c.	A homogeneous gas phase reaction with stoichiometry and the kinetics $A \rightarrow S$, $-r_A = kC_A^2$, takes place with 50% conversion in a mixed flow reactor. Find the conversion if this reactor is replaced by another MFR having volume six times the first MFR all remain unchanged. .	8	CO2	K5
d.	Write the advantages, disadvantages and application of mixed flow reactor.	7	CO1	K2
5.a.	Discus about the quantitative treatment of product distribution for unimolecular type first order reaction $A \rightarrow R \rightarrow S$ in a batch reactor.	7	CO3	K3
b.	The desired liquid phase reaction A+B $\longrightarrow$ R+T, $-r_R = -r_T = k1 C_A^{1.5}\ C_B^{0.3}$ Is accompanied by the unwanted side reaction A+B $\longrightarrow$ S+U, $r_S = r_U = k_2\ C_A^{0.5}\ C_B^{1.8}$ From the stand point of favourable product distribution, order the contacting pattern of continuous flow operation, from the most desirable to the least desirable.	8	CO3	K3
	(OR)			
c.	Derive the expression of C_A, C_R and C_S for quantitative product distribution of an unimolecular type first order reaction $A \rightarrow R \rightarrow S$ in a mixed flow reactor. Evaluate its $C_{R,max}$ and space time for attaining $C_{R,max}$. Draw the concentration-time graph.	12	CO2	K2
d.	What is the importance of product distribution in multiple reactions with respect to single reaction for designing?	3	CO1	K3

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