Register No : ________________

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

BE/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, NOV /DEC 2024

Sixth Semester

Chemical Engineering

CH3601 - CHEMICAL REACTION ENGINEERING- I

Regulations - 2021

Duration : 3 Hrs — *Maximum : 100 Marks*

*PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)*

Q.No	Questions	BLT	CO	Marks
1.	Distinguish between homogeneous and heterogeneous reactions.	RE	1	2
2.	What is elementary reaction and non-elementary reactions?	UN	1	2
3.	Write the design equation for CSTR and PFR?	RE	2	2
4.	Give the basis on which chemical reactions and reactors are classified.	UN	2	2
5.	Write the classification of chemical reactors based on the method of operation and the number of phases in the reaction mixture.	RE	3	2
6.	Distinguish between holding time and space time for flow reactors.	UN	3	2
7.	What do you mean by optimum recycle operation?	UN	4	2
8.	Define optimum temperature progression?	UN	4	2
9.	Differentiate space time and mean holding time.	UN	5	2
10.	What are the factors responsible for deviations from ideal plug flow in a tubular reactor?	UN	5	2

*PART – B (ANSWER ALL QUESTIONS) (Marks 5*13 = 65)*

Q.No		Questions	BLT	CO	Marks
11.	a	At 500 K the rate of a bimolecular reaction is ten times the rate at 400 K. Find the activation energy for this reaction (i). From Arrhenius law (ii). From Collision theory (iii). What is the % difference in rate of reaction at 600 K predicted by these two methods?	UN	1	13
		Or			
	b	Explain the kinetic models for non-elementary reactions.	UN	1	13
12.	a	Derive the performance equation for Plug flow reactor with schematic representation and write the assumptions made.	AP	2	13
		Or			
	b	Derive the performance equation for steady state continuous stirred tank reactor with schematic representation and write the assumptions made.	AP	2	13

13. a Liquid reactant A produces R and S by the following reactions: AP 3 13

$A \rightarrow R$, $r_R = k_1 CA^2$, $k_1 = 0.4\ m^3/(mol.min)$

$A \rightarrow S$, $r_S = k_2 CA$, $k_2 = 2$ (min)-1

A feed of aqueous A with C_{Ao} =40 mol/m^3, enters a reactor, reacts to produce R and S, and a mixture of A, R and S leaves. Find C_R, C_S and τ for 90% conversion of A in a MFR.

Or

b Reactant A in a liquid produces R and S by the following scheme: AP 3 13

$A \rightarrow R$, $A \rightarrow S$

Both these reactions are first order. A feed with C_{Ao} =1, C_{Ro} =0 and C_{So} =0, enters in two MFRs in series (τ_1 = 2 min; τ_2 = 5 min). The composition in the first reactor is C_{A1} =0.40, C_{R1} =0.40 and C_{S1} =0.20. Find the composition leaving the second reactor.

14. a Explain irreversible first order reaction in series and derive the maximum concentration of intermediates and products. AN 4 13

$A \longrightarrow R \longrightarrow S$ with k_1 and k_2 are rate constants for two reactions respectively.

Or

b Examine the effect of temperature and pressure on equilibrium conversion? AN 4 13

15. a i) Plot C(t) and E(t). AP 5 13

(ii) Determine the fraction of material leaving the reactor that has spent time between 3 and 6 minutes in the reactor and the fraction of material leaving that has spent 7.75 and 8.25 minutes in the reactor.

t, min	0	1	2	3	4	5	6	7	8	9	10	12	14
E, min-1	0	0.02	0.10	0.16	0.20	0.16	0.12	0.08	0.06	0.44	0.03	0.012	0

Or

b The concentration reading in the table represents a continuous response to a pulse input; AP 5 13

t, min	0	5	10	15	20	25	30	35
C, gm/lit	0	3	5	5	4	2	1	0

This vessel is used as a reactor for a liquid decomposing with rate
$-r_A = k\ C_A$ & $k = 0.307\ min^{-1}$. Find the conversion expected in the reactor and compare it with the PFR
by

(i) Direct use of Tracer curve.

(ii) Using Dispersion model.

*PART – C (Marks 1*15 = 15)*

Q.No			*Questions*	*BLT*	*CO*	*Marks*
16.	a		A homogenous liquid phase reaction $A \rightarrow R$, $-r_A = k\, C_A^2$, takes place with 50 % conversion in mixed flow reactor. i) What will be conversion if reactor is replaced by 6 times as large as the reactor, all other remaining unchanged? ii) What will be conversion if original reactor is replaced by PFR of same size?	AP	3	15
			Or			
	b	i)	What are the factors affecting choice of reactors? Write its important significance of each reactor.	AP	3	10
		ii)	Explain selectivity and reactivity in detail.	AP	3	5