Register No : _____

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, APRIL-MAY 2025

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.	Can you recall the Arrhenius Equation?	L1	1	2
2.	Define half-life of a reaction. How is it related to rate constant for a first-order reaction	L2	1	2
3.	What is the main assumption in the design of a PFR?	L2	2	2
4.	How is space time calculated in a flow reactor?	L1	2	2
5.	What is a consecutive reaction? Give one example.	L1	3	2
6.	Define Recycle ratio in a recycle reactor. Under what conditions the recycle reactor will behave as a mixed flow reactor?	L2	3	2
7.	What is mean by optimum temperature progression?	L1	4	2
8.	Define Reactor stability.	L1	4	2
9.	Define the E(t) function in RTD	L1	5	2
10.	Define E curve and C Curve.	L1	5	2

PART – B (ANSWER ALL QUESTIONS) (Marks 5*16 = 80)

Q.No			*Questions*	*BLT*	*CO*	*Marks*
11.	a	i	Determine the value of first order reaction rate constant for the disappearance of A in the gas reaction 2A→P if, On holding the pressure constant, the volume of the reaction mixture, starting with 80 mole% A and 20 mole% inert, decreases by 20%in 3 minutes.	L2	1	8
		ii	At 500 K the rate of bimolecular reaction is 10 times the rate at 400 K, find the activation energy using Arrhenius law and collision theory. Explain the integral and differential method of analysis for finding the reactor volume.	L2	1	8
			Or			
	b	i	How would you compare elementary and non-elementary reactions?	L2	1	6

	ii	How would you classify the theories of reaction rate with emphasis on Collision Theory and Transition State Theory?	L2	1	10
12.	a i	What approach would you used to design the equation for a Continuous Stirred Tank Reactor (CSTR).	L3	2	8
	ii	An elementary reaction A→ R → S, takes place in a mixed flow reactor. Find the condition for maximum concentration of R. What is its value? (Assume no R and S initially)	L3	2	8
		Or			
	b	What approach would you used for steady state Plug flow reactor for homogenous reactions stating the assumption made? Give its characteristic and its merits	L3	2	16
13.	a i	Can you distinguish between parallel, consecutive, and mixed reactions With suitable examples,	L4	3	8
	ii	Define selectivity, yield, and reactivity in the context of multiple reactions.	L4	3	8
		Or			
	b	We are planning to operate a batch reactor to convert A into R .This is a liquid reaction, the stoichiometry is A →R, and the rate of reaction is given below. How long must we react each batch for the concentration to drop from CA_o =1.3 mol/lit to CA_f =0.3 mol/lit?	L4	3	16

CA= mol/lit	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.3	2.0
-rA= mol/lit. min	0.1	0.3	0.5	0.6	0.5	0.2	0.1	0.06	0.5	0.04	0.04

14.	a	A homogenous liquid phase reaction, with stoichiometry and kinetics, A→S, $-rA = k\,CA^2$ takes place in a mixed flow reactor and results in 50% conversion. (a) Find the conversion if this reactor is replaced by another mixed flow reactor having volume 6 times that of the original reactor - all else remain unchanged. (b). Find the conversion if the original reactor is replaced by a plug flow reactor of the same size - all else remain unchanged.	L5	4	16
		Or			
	b	Explain the graphical design procedure for finding the reactor size of Adiabatic Operations of Plug Flow and Mixed Flow reactors	L5	4	16

15.	a	Discuss in detail about the Tanks In Series Model and Axial Dispersion Model for the non-ideality in a reactors.	L4	5	16
		Or			
	b	The continuous response to a pulse input into a chemical reactor is given below	L4	5	16

Time (t)	0	5	10	15	20	25	30	35
Tracer Concn g / lit	0	3	5	5	4	2	1	0

A liquid decomposing reaction is carried out in the reactor with rate, $-r_A = KC_A$, K = 0.307 min^{-1}. Find the fraction of the reactant unconverted in the real reactor and compare this with the fraction unconverted in a plug flow reactor of the same size?