Register No : _____

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

UG/PG DEGREE END SEMESTER THEORY EXAMINATIONS, APRIL/MAY 2026

Sixth Semester

Chemical Engineering

CH3601 - CHEMICAL REACTION ENGINEERING-I

Regulations - 2021

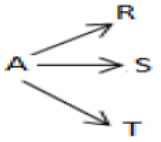
Duration : 3 Hrs *Maximum : 100 Marks*

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

Q.No	*Questions*	*BLT*	*CO*	*Marks*
1.	Define order and molecularity of reaction.	L1	1	2
2.	Outline the important variables which affecting the rate of reaction.	L2	1	2
3.	Define Space time Space Velocity.	L1	2	2
4.	List the criteria for best Arrangement of a Set of Ideal Reactors.	L1	2	2
5.	Define fractional yield and selectivity.	L1	3	2
6.	Compare series, parallel and autocatalytic reactions with suitable examples.	L2	3	2
7.	Define multiple steady states in exothermic CSTR operations.	L1	4	2
8.	Summarize the effect of temperature on conversion for adiabatic reactions.	L2	4	2
9.	Show the RTD curve for ideal Plug flow and ideal batch reactor.	L2	5	2
10.	Find the conversion If τ= 5 s, first order rate constant, k = 0.25 sec^{-1} and the number of tanks, N is 5.	L1	5	2

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

Q.No			*Questions*	*BLT*	*CO*	*Marks*
11.	a	i	Explain in detail about the classification of Chemical Reaction based on Thermodynamics and Stoichiometry with suitable examples of each.	L2	1	8
		ii	The pyrolysis of ethane proceeds with an activation energy of about 300 kJ/mol. How much faster is the decomposition at 650°C than at 500°C?	L2	1	8
			Or			
	b	i	Explain in detail about the integral and differential method of analyzing kinetic data.	L2	1	8
		ii	Experiment shows that the homogeneous decomposition of ozone proceeds with a rate. $-r_{O3=} K [O_3]^2 [O_2]^{-1}$ (i) Suggest a two-step mechanism to explain this rate and state how you would further test this mechanism. (ii) What is the overall order of reaction?	L2	1	8

12.	a	i	Develop the performance equation for steady state mixed flow reactor for constant and variable density system and compare its graphical representation.	L3	2	8
		ii	An aqueous feed of A and B (44 liter/min, 100mmol A/liter, 200mmol B/liter) is to be converted to product in a plug flow reactor. The kinetics of the reaction is represented by $A + B \rightarrow R, \qquad -r_A = 200\, C_A C_B \frac{mol}{liter.min}$ Find the volume of reactor needed for 99.9% conversion of A to product.	L3	2	8
			Or			
	b	i	A CSTR and a PFR of equal volume V each are given for the conduct of a second order, isothermal, liquid phase reaction, A→B. The reactors are to be arranged in series. Find the overall conversion for the two possible reactor arrangements. Data given: k = 1 m^3/(kmol.s), C_{A0} = 0.1 kmol/$m^3$and ꚍ= 5 s (for volume V).	L3	2	8
		ii	Develop an expression for the concentration in the N-th reactor, if N equal sized stirred tank reactors are assembled in series. Assume first order reaction.	L3	2	8
13.	a	i	Explain the qualitative discussion about the product distribution for the reaction in parallel.	L2	3	8
		ii	For the parallel decomposition of A where R is desired and C_{A0}= 1  What is the maximum C_R, we may expect in an isothermal operation in Batch Reactor , where the value of r_R = 1, r_S = 2CA, r_T = CA^2	L3	3	8
			Or			
	b	i	Develop the equation in terms of concentration for irreversible reactions in series for uni-molecular type first-order reaction such as $A \xrightarrow{k_1} R \xrightarrow{k_2} S$	L3	3	8
		ii	Outline the effect of temperature and composition on single homogeneous reaction.	L2	3	8
14.	a	i	A homogeneous first order reaction is carried out in a batch reactor under adiabatic conditions. Develop a suitable method to examine the relation temperature-conversion-time. State the assumptions made.	L4	4	8
		ii	Sketch and analyze the different ways of representing the relationship of temperature, composition and rate of reaction	L3	4	8
			Or			
	b	i	Develop an expression for effects of temperature on heat of reaction from thermodynamics.	L3	4	8
		ii	What is meant by 'optimum temperature progression'? Illustrate with an example for a reversible exothermic reaction.	L4	4	8

15. a i Discuss in detail about the pulse and step input and their responses with suitable figures. L5 5 8

ii Estimate the mean conversion in a reactor for the first order liquid phase irreversible reaction in a completely segregated fluid: A→ Products. The reaction rate constant is 0.1 min^{-1} at 320 K L5 5 8

t,min	0	1	2	3	4	5	6	7	8
C,g/m^3	0	1	5	8	10	8	6	4	3
t,min	9	10	12	14					
C,g/m^3	2.2	1.5	0.6	0					

Or

b i From the response data for a pulse input of a reactor given below: L5 5 8

t,min	0	5	10	15	20	25	30	35
C_{out},g/L	0	3	15	5	4	2	1	0

(i) Estimate the mean residence time.
(ii) Tabulate and construct the E curve and also calculate the area under E curve.

ii With a figure briefly elaborate the basic concepts of tank in series model and derive an expression for the model parameter 'number of tanks (n)'. L5 5 8