

THE KAVERY ENGINEERING COLLEGE*(An Autonomous Institution)***B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, NOV/DEC 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)**

<i>Q.No</i>	<i>Questions</i>	<i>BLT</i>	<i>CO</i>	<i>Marks</i>
1.	Phosphine decomposes when heated according to the following reaction $4\text{PH}_3 \rightarrow \text{P}_4 + 6\text{H}_2$ at a given instant the rate at which Phosphine decomposes 3.6×10^{-4} (mol/L.s). What is the rate of formation of P_4 and H_2 ?	L1	1	2
2.	Define half-life period calculations.	L2	1	2
3.	Define Damkohler number.	L1	2	2
4.	Illustrate the graphical representation of the performance equations for mixed reactor.	L2	2	2
5.	For parallel reactions with order of reaction to be same, how will you fix your product distribution?	L1	3	2
6.	Define selectivity.	L1	3	2
7.	Outline the characteristics of chemical equilibrium.	L2	4	2
8.	Define heat of reaction and how is it calculated.	L1	4	2
9.	Summarize any four reasons for the existence of non-ideal flow.	L2	5	2
10.	Show the sketch the earliness and lateness in mixing.	L2	5	2

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

<i>Q.No</i>	<i>Questions</i>	<i>BLT</i>	<i>CO</i>	<i>Marks</i>
11.	a The reaction $\text{H}_2 + \text{Br}_2 \rightarrow 2\text{HBr}$ with experimental rate as given below. Develop the below rate equation assuming a suitable scheme of mechanism. $r_{\text{HBr}} = \frac{k_1[\text{H}_2][\text{Br}_2]^{1/2}}{k_2 + \frac{[\text{HBr}]}{[\text{Br}_2]}}$ Or b A zero order Homogenous gas phase reaction with stoichiometry $\text{A} \rightarrow r\text{R}$ proceeds at a constant volume bomb with 20% mole inert, pressure raises from 1 to 1.3atm in 4 min. The same reaction is carried out in constant pressure batch reaction. Identify the fractional volume change in 4 minute, the feed is at 3atm & contains 40% mole inert.	L3	1	16
		L3	1	16

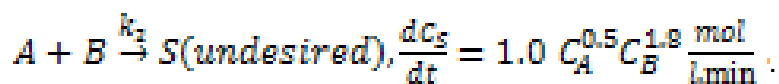
12. a Deduce the conversion for the reactor system with three CSTR's connected in series with volume V1, V2, and V3. L5 2 16

Or

- b It is proposed to operate a batch reactor for converting A into R. This is a liquid phase reaction with the stoichiometry $A \rightarrow R$. Decide the duration that we must react each batch in order to drop the concentration from $C_{A0} = 1.3 \text{ mol/L}$ to $C_{AF} = 0.30 \text{ mol/L}$? The rate versus concentration data are as follows: L5 2 16

C_A , mol/L	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.3	2.0
$-r_A$, mol/L.min	0.1	0.3	0.5	0.6	0.5	0.25	0.10	0.06	0.05	0.045	0.042

13. a Consider the following liquid phase reaction: L5 3 16



Equal volumetric flow rates of A and B streams with each stream of concentration of 20 mol/l of reactant are fed to the reactor. For 90% conversion of A, determine the concentration of R in the product stream if flow in the reactor follows a) Plug Flow, b) Mixed flow.

Or

- b Determine the optimum value for a space time and the maximum concentration of intermediate, when the reaction $A \xrightarrow{k_1} R \xrightarrow{k_2} S$ is carried out in a mixed flow reactor. L5 3 16

14. a Analyze the effect of temperature and pressure on Equilibrium conversion reaction in detail. L4 4 16

Or

- b The elementary irreversible liquid phase reaction $A+B \rightarrow C$ is carried out in a MFR. An equal molar feed in A and B enters the reactor at 27°C and the volumetric flow rate is 2 l/s. Analyze the volume of reactor to achieve 85% conversion when the reaction is carried out adiabatically. ΔH_f^0 for A = -20 kcal/mol, for B = -15 kcal/mol and for C = -41 kcal/mol, $C_{A0} = 0.10 \text{ kmol/m}^3$; $C_{pA} = C_{pB} = 15 \text{ cal/(mol.K)}$, $C_{pC} = 30 \text{ kcal/mol}$, $k = 0.01 \text{ (l/mol.s)}$ at 300K, $E = 10000 \text{ cal/mol}$. L4 4 16

15. a Deduce a generalized expression for Residence Time Distribution, when N tanks are connected in series of equal sizes. L5 5 16

Or

- b A reactor with dividing baffles is to be used to carry the reaction: $A \rightarrow R$, $-r_A = 0.05 C_A$, mol/l.min . Pulse test results are: L5 5 16

t,min	0	10	20	30	40	50	60	70
C	35	38	40	40	39	37	36	35

Evaluate the conversion i) assuming plug flow, ii) assuming tank-in series model.