Register No : ____________________

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)*

Q.No	Questions	BLT	CO	Marks
1.	Phosphine decomposes when heated according to the following reaction $4PH_3 \rightarrow P_4 + 6H_2$ at a given instant the rate at which Phosphine decomposes 3.6 X 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)*

Q.No		Questions	BLT	CO	Marks
11.	a	The reaction $H_2+Br_2 \rightarrow 2HBr$ with experimental rate as given below. Develop the below rate equation assuming a suitable scheme of mechanism. $$r_{HBr} = \frac{k_1[H_2][Br_2]^{1/2}}{k_2 + [HBr]/[Br_2]}$$	L3	1	16
		Or			
	b	A zero order Homogenous gas phase reaction with stoichiometry $A \rightarrow rR$ 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

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→R. Decide the duration that we must react each batch in order to drop the concentration from C_{A0} = 1.3 mol/L to C_{AF} = 0.30 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

$$A + B \xrightarrow{k_1} R\ (desired), \frac{dC_R}{dt} = 1.0\ C_A^{1.5} C_B^{0.30}\ \frac{mol}{l.min};$$

$$A + B \xrightarrow{k_2} S(undesired), \frac{dC_S}{dt} = 1.0\ C_A^{0.5} C_B^{1.8}\ \frac{mol}{l.min}.$$

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→ 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 kmol/m^3; C_{pA} = C_{pB}=15 cal/(mol.K), C_{pc}= 30 kcal/mol, k=0.01 (l/mol.s) at 300K, E=10000 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.