Reg.No.:												

VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN
[AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY, CHENNAI]
Elayampalayam – 637 205, Tiruchengode, Namakkal Dt., Tamil Nadu.

Question Paper Code: 9007

B.E. / B.Tech. DEGREE END-SEMESTER EXAMINATIONS – MAY / JUNE 2024
Sixth Semester
Biotechnology
U19BT622 – CHEMICAL REACTION ENGINEERING
(Regulation 2019)

Time: Three Hours | Maximum: 100 Marks

Answer ALL the questions

Knowledge Levels (KL)	K1 – Remembering	K3 – Applying	K5 - Evaluating
	K2 – Understanding	K4 – Analyzing	K6 - Creating

PART – A

(10 x 2 = 20 Marks)

Q.No.	Questions	Marks	KL	CO
1.	Distinguish Order and Molecularity of chemical reaction.	2	K1	CO1
2.	What type of reaction one can go for variable volume and constant volume reactor?	2	K2	CO1
3.	What are the characteristic of ideal batch reactor?	2	K2	CO2
4.	Differentiate space time and space velocity.	2	K2	CO2
5.	Why plug flow is viewed as series of MFR in series?	2	K2	CO3
6.	What are the criteria for connecting reactors in parallel?	2	K1	CO3
7.	What are the basic criteria for parallel reaction to achieve a desired product for constant temperature?	2	K1	CO4
8.	What are fractional and overall yield?	2	K1	CO4
9.	What is role of tracer material requirement for RTD study?	2	K1	CO5
10.	List out the relationship between E curve and F curve & E curve and C curve?	2	K2	CO5

PART – B

(5 x 13 = 65 Marks)

Q.No.		Questions	Marks	KL	CO
11.	a)	Discuss the classification of chemical reaction based on the reaction types.	13	K2	CO1
		(OR)			
	b)	Explain the temperature dependency of a rate equation using Arrhenius theory and collision theory and transitionstate theory.	13	K3	CO1
12.	a)	Derive the design equation for i. MFR ii. PFR	6 7	K2	CO2
		(OR)			
	b)	At room temperature sucrose is hydrolyzed by the catalytic action of the enzyme sucrose as follows:	13	K3	CO2

$$\text{sucrose} \xrightarrow{\text{sucrase}} \text{products}$$

Starting with a sucrose concentration C_{A0} = 1.0 millimol/liter and an enzyme concentration C_{E0} = 0.01 millimol/liter, the following kinetic data are obtained in a batch reactor (concentrations calculated from optical rotation measurements):

C_A milli mol/ liter	0.84	0.68	0.53	0.38	0.27	0.16	0.09	0.04	0.018	0.006	0.0025
t, hr	1	2	3	4	5	6	7	8	9	10	11

Determine whether these data can be reasonably fitted by a kinetic equation of the Michaelis-Menten type, or

$$-r_A = \frac{k_3 C_A C_{E0}}{C_A + C_M} \quad \text{where} \quad C_M = \text{Michaelis constant}$$

If the fit is reasonable, evaluate the constants k_3 and C_M. Solve by the integral method

13.	a)	i. Derive the design equation for a first order liquid phase reaction being in a system consisting of MFR of equal volume connected in series	7	K2	CO3
		ii. Derive the design equation for a first order liquid phase reaction being in a system consisting of MFR of different volume connected in series	6		
		(OR)			

b) We wish to treat 10 liters/min of liquid feed containing 1 mol A/liter to 95% conversion using two mixed flow reactors in series. The stoichiometry and kinetics of the reaction are given by — 13 K3 CO3

$$A \rightarrow R, \qquad -r_A = \frac{C_A}{0.2 + C_A}\,\frac{\text{mol}}{\text{liter}\cdot\text{min}}$$

Find the size of the two (mixed flow reactors) units needed

14. a) Derive the equation for quantitative treatment of MFR and PFR. — 13 K2 CO4

(OR)

b) Under appropriate conditions A decomposes as follows: — 5+8 =13 K3 CO4

$$A \xrightarrow{k_1 = 0.1/\text{min}} R \xrightarrow{k_2 = 0.1/\text{min}} S$$

R is to be produced from 1000 literlhr of feed in which C_{A0} = 1 mol/liter, C_{R0}= C_{S0}= 0.

i. What size of plug flow reactor will maximize the concentration of R, and what is that concentration in the effluent stream from this reactor?

ii. What size of mixed flow reactor will maximize the concentration of R, and what is $C_{R,\,max}$ in the effluent stream from this reactor?

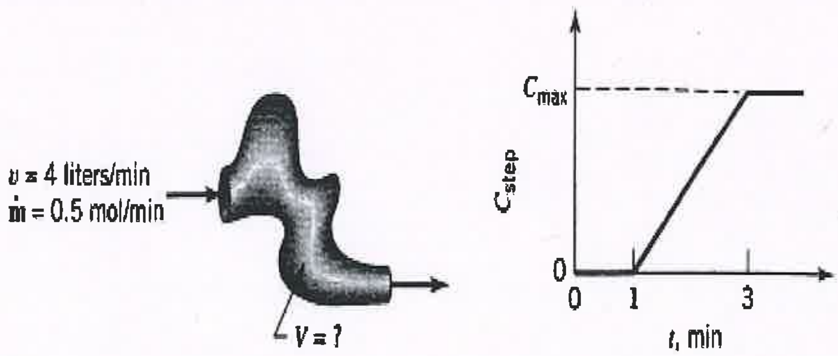
15. a) Explain what is residence time distribution? And how it is used to determine performance of non-ideal flow in reactors — 13 K2 CO5

(OR)

b) A step experiment is made on a reactor. The results are shown in figure given below — 5+8 =13 K3 CO5

i. Is the material balance consistent with the tracer curve?

ii. If so, determine the vessel volume *V*, 7, the F curve, and the E curve.



PART – C

(1 x 15 = 15 Marks)

Q.No.		Questions	Marks	KL	CO
16.	a)	Describe the comparison of size requirement for MFR /PFR for different type of reaction.	15	K2	CO3
		(OR)			
	b)	Substance A in the liquid phase produces R and S by the following reactions:	15	K3	CO3

$$A \rightarrow R, \quad r_R = k_1 C_A^2$$

$$A \rightarrow S, \quad r_S = k_2 C_A$$

A feed ($C_{A0} = 1$, $C_{R0} = 0$, $C_{S0} = 0.3$) enters two mixed flow reactors in series, ($\tau_1 = 2.5$ min, $\tau_2 = 10$ min). Knowing the composition in the first reactor ($C_{A1} = 0.4$, $C_{R1} = 0.2$, $C_{S1} = 0.7$), find the composition leaving the second reactor.