

Reg.No.: 

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

**Question Paper Code: 90028**

B.E. / B.Tech. DEGREE END-SEMESTER EXAMINATIONS – JAN. 2025

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.	Define Rate Constant.	2	K1	CO1
2.	Distinguish between Elementary and Non-Elementary reaction.	2	K1	CO1
3.	Given the reaction $2\text{NO}_2 + 1/2 \text{O}_2 \rightarrow \text{N}_2\text{O}_5$ . What is the relation between the rate of formation and disappearance of these three components?	2	K1	CO2
4.	How would Temperature of the system affect the rate of reaction?	2	K2	CO2
5.	Write the performance equation of mixed flow reactor.	2	K2	CO3
6.	Calculate the fractional volume change in the reaction $\text{A} \rightarrow 4\text{R}$ with 30% inert project is start.	2	K2	CO3
7.	Define overall fractional field.	2	K2	CO4
8.	Define selectivity.	2	K1	CO4
9.	What is the function of Residence time distribution?	2	K1	CO5
10.	Compare the relation between E curve and F curve.	2	K2	CO5

PART – B

(5 x 13 = 65 Marks)

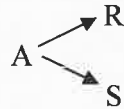
Q.No.	Questions	Marks	KL	CO
11. a.	i. On doubling the concentration of reactant, the rate of reaction triples. Find the reaction order.	7	K2	CO1
	ii. A rocket engine burns a stoichiometry mixture of fuel in oxidant combustion chamber n cylindrical, 75 cm long and 60 cm in diameter, and the combustion process produces 108 kg/s of Exhaust gas. If the combustion is complete find the rate of reaction of hydrogen and oxygen.	6	K2	CO1
(OR)				
b.	i. A Certain reaction has a rate given by $-r_A = 0.005C^2A$ , mol/cm <sup>3</sup> .min. If the concentration is expressed in mol/l and time in hours, what would be the value and units of rate constant.	7	K2	CO1
	ii. Explain activation energy with neat diagram.	6	K2	CO1
12. a.	i. Derive the performance equation of batch reactor with neat graphical representation.	7	K3	CO2
	ii. For irreversible first order series reaction $A \xrightarrow{k_1} R \xrightarrow{k_2} S$ . The values of rate constant K1 and K2 are 0.17/min and 0.11/min respectively. Calculate the i) time at which the concentration of R is minimum and ii) maximum concentration of R take $CA_0 = 1.25$ mol/ lit.	6	K3	CO2
(OR)				
b.	i. Calculate the first order rate constant for the disappearance of A as per the gas phase reaction $A \rightarrow R$ . If the volume of the reaction mixture, starting with pure A, increases by 50% in 4 minutes. The total pressure of the system remains constant at 1.2 atm and the temperature is (298) 25°C.	7	K3	CO2
	ii. Derive the material balance and energy balance over the reactor under isothermal operation.	6	K3	CO2
13. a.	Substance A reacts according to second order Kinetics 95% conversion of A is achieved in a single conversion of a A is achieved in a single flow reactor. We buy a second reactor identical to the first reactor. For the same conversion (95%) by how much is capacity increased if we operate this reactor in parallel or in series.	13	K3	CO3

(OR)

- b. Derive the design equation of Mixed flow reactor. 13 K3 CO3
14. a. Derive the equation for Quantitate treatment of Mixed flow reactor and Plug flow reactor. 13 K4 CO4

(OR)

- b. Reactant A is the liquid phase reacts to produce R & S by the following reaction in parallel 13 K4 CO4



A feed with  $CA_0 = 1$ ,  $CR_0 = 0$  &  $CS_0 = 0$  enters in two mixed flow reactors in series ( $\tau_1 = 2$ mins;  $\tau_2 = 5$  mins). The composition with in the first reactor is  $CA_1 = 0.40$ ,  $CR_1 = 0.40$  &  $CS_1 = 0.2$ . Find the composition at the exit stream from second reactor.

15. a. The data given below represent a continuous response to a pulse input in to a closed vessel which is to be used as a chemical reactor. Calculate the mean residence time of fluid in the vessel  $t$  and tabulate and construct E curve 13 K4 CO5

t, min	0	5	10	15	20	25	30	35
C Pulse g/l	0	3	5	5	4	2	1	0

(OR)

- b. Derive the relation between E curve and F curve with neat graphical representation. 13 K4 CO5

### PART – C

(1 x 15 = 15 Marks)

- | Q. No. | Questions  | Marks | KL | CO  |
|--------|--|-------|----|-----|
| 16. a) | Derive the design equation for reactor of different types in series. | 15    | K3 | CO2 |

(OR)

- b) Presently 90% of reactant A is converted into product by a second order reaction in a single mixed flow reactor. We propose to use a second reactor similar to the one being used in series with it. 15 K3 CO4
- For the same treatment rate as that used presented, find the effect this addition of reactor.
  - For the same 90% Conversion, find the increase in the treatment rate.