QP Code: RM21BTECH467 | Reg. No | | | | | | | | | | | AY 21

GIET UNIVERSITY, GUNUPUR – 765022

B. Tech (Sixth Semester Regular) Examinations, May – 2024

21BCHPC36003 - Chemical Reaction Engineering-II

(Chemical)

Time: 3 hrs | Maximum: 70 Marks

(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

Q.1. Answer ***ALL*** questions	CO #	Blooms Level
a. How can you differentiate micro mixing and macro mixing?	CO1	K2
b. Write the properties of a tracer.	CO2	K3
c. What is the advantage of heterogeneous catalysis over homogeneous catalysis?	CO2	K2
d. What is the function of a catalyst?	CO1	K2
e. What are the assumptions of Langmuir-Henshelwood approach to find rate limiting step?	CO3	K3

PART – B **(15 x 4 = 60 Marks)**

<u>Answer ***ALL*** questions</u> — Marks | CO # | Blooms Level

2. a. Write the advantages and disadvantages of step input method for calculating RTD. — 5 | CO3 | K3

b. A pulse of tracer was injected into a reactor and the effluent concentration was measured as a function of time. The resulting data are given in the table below: — 10 | CO2 | K3

t, min	0	1	2	3	4	5	6	7	8	9	10	12	14
C, g/ m3	0	1	5	8	10	8	6	4	3	2.2	1.5	0.6	0

Construct C-curve and E-curve and calculate the following:

(i) Fraction of material leaving the reactor that has spent between 3 and 6 minutes in the reactor

(ii) Mean residence time of the reactor.

(iii) Fraction of material leaving the reactor that has spent 3 min or less in the reactor.

(OR)

c. Prove that Space time is equal to Mean Residence time for constant volumetric flow. — 5 | CO2 | K4

d. A first order liquid phase reaction is carried out in a reactor for which the results of (pulse) tracer data are given in the table below: — 10 | CO2 | K3

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

Calculate the conversion using

(i) Ideal PFR

(ii) Ideal CSTR

(iii) Tanks in series model

3.a. Find the rate expression for coal combustion process $C + O_2(g) \rightarrow CO_2(g)$ assuming first order irreversible reaction. — 5 | CO3 | K4

b.	The decomposition of Cumene results Benzene and Propylene in the presence of Pt as catalyst. Write the mechanism steps for non diffusion-limited reaction. Develop the rate law for the above reaction assuming adsorption rate controlling.	10	CO3	K4
	(OR)			
c.	Derive the expression of surface concentration of sites occupied by A for the following adsorption process. $A+S \leftrightharpoons A.S$	7	CO3	K3
d.	Describe the mechanisms of surface reaction in solid catalyzed reaction.	8	CO3	K4
4.a.	Derive the expression for the concentration profile inside the porous catalyst considering cylindrical pore and first order reaction	8	CO3	K4
b.	Derive the performance equation for first order kinetics of (i) batch solid, mixed constant flow of fluid and (ii) batch solid, mixed changing flow of fluid for concentration independent deactivation. Draw the graph of concentration term vs time.	7	CO2	K3
	(OR)			
c.	Differentiate differential reactor and integral reactors for finding the rates from experimental data of solid catalyzed reaction.	7	CO1	K2
d.	Consider a catalytic reaction $-r'_A = 96\ C_A\ \frac{\text{mole}}{\text{kg catalyst.hr}}$. Determine the amount of catalyst needed in packed bed reactor (assume plug flow) for 35% conversion of A to R for a feed of 2000 mol/hr of pure A at 3.2 atm and 117 0C.	8	CO2	K3
5.a.	Differentiate Progressive Conversion Model and Shrinking Core Model.	5	CO2	K3
b.	Derive the performance equation relating time with radius and conversion, considering diffusion through ash layer control in shrinking core model of unchanging size for spherical particle.	10	CO3	K4
	(OR)			
c.	Derive the performance equation relating time with radius and conversion, considering diffusion through gas film control in shrinking core model of unchanging size for cylindrical particle.	10	CO3	K3
d.	Write the limitations of Shrinking Core Model.	5	CO2	K3

--- End of Paper ---