P P SAVANI UNIVERSITY

Seventh Semester of B. Tech. Examination

November 2022

SECH4021 Chemical Reaction Kinetics-II

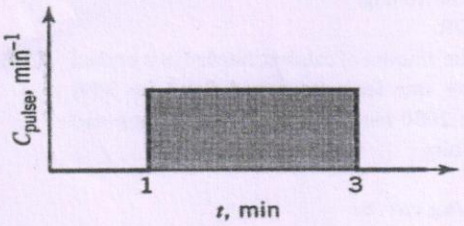
21.11.2022, Monday **Time: 10:00 a.m. To 12:30 p.m.** **Maximum Marks: 60**

Instructions:

1. The question paper comprises of two sections.
2. Section I and II must be attempted in separate answer sheets.
3. Make suitable assumptions and draw neat figures wherever required.
4. Use of scientific calculator is allowed.

SECTION – I

			CO	BTL
Q - 1	Draw the various ill graphs for plug flow and mixed flow reactors.	**[05]**	**1**	**6**
Q - 2	In a reactor, some droplets (C_{Ao} = 2 mol/liter) react (A→ R, $-r_A=KC_A^2$, k = 0.5 liter/mol.min) as they pass through a reactor. Find the average concentration of A remaining in the droplets leaving the reactor if their RTD is given by the curve.	**[10]**	**1**	**5**



OR

Q - 2	Drive the time required for complete conversion and fractional conversion for shrinking core model assuming chemical reaction is rate controlling.	**[10]**	**3**	**4**
Q - 3	Uniform-sized spherical particles UO, are reduced to UO, in a uniform environment with the following results:	**[10]**	**3**	**5**

t, hr	0.180	0.347	0.453	0.567	0.733
X_B	0.45	0.68	0.80	0.95	0.98

If reaction follows the SCM, find the controlling mechanism and a rate equation to represent this reduction.

OR

Q - 3	Gaseous A absorbs and reacts with B in liquid according to $A(g \rightarrow l) + B(l) \rightarrow R(l), \quad -r_A = kC_AC_B$ in a packed bed under conditions where $k_{Ag}a = 0.1$ mol/hr · m^2 of reactor · Pa $k_{Al}a = 100$ m^3 liquid/m^3 reactor · hr $a = 100$ m^2/m^3 reactor At a point in the reactor where P_A = 100 Pa and C_B = 100 mol/m^3 liquid, E is 1 $H_A=10^5$ and K= 10, f_l = 0.1 m^3 liquid/m^3 reactor and $D_{Al} = D_{Bl} = 10^{-6}$ m^2/hr. (a) calculate the rate of reaction in mol/hr. m^3 of reactor.	**[10]**	**4**	**5**

(b) location of the major resistance (What % in gas film, liquid film, main body of liquid).

Q - 4	Attempt any one	[05]		
(i)	RTD with E and F curve		1	1
(ii)	Non ideal reactors		1	1

SECTION – II

Q - 1	Explain the various unit operations used for the preparation of catalyst.	[05]	4	2
Q - 2	Explain various catalytic reactors in detail.	[10]	4	2

OR

Q - 2	For catalytic reaction, the following rate concentration data are available;	[10]	5	5

$$A \rightarrow 4R$$

C_A, mol/liter	0.039	0.0575	0.075	0.092
$-r'_A$, mol A/hr·kg cat	3.4	5.4	7.6	9.1

Directly from this data, and without using a rate equation, find the size of packed bed needed to treat 2000 mol/hr of pure A at 117°C (or CAo = 0.1 mol/liter, ϵ_A = 3) to 35% conversion, all at 3.2 atm.

Q - 3	Drive the overall or global rate equation for catalytic reaction (LHHW model) assuming surface reaction step is rate controlling.	[10]	5	4

OR

Q - 3	For the reaction (A----4R), determine the amount of catalyst needed in a packed bed reactor with a very large recycle rate (assume mixed flow) for 35% conversion of A to R for a feed rate of 2000 mol/hr of pure A at 3.2 atm and 117°C. For the reaction at this temperature	[10]	5	5

$$A \rightarrow 4R, \quad -r'_A = 96\,C_A, \quad \text{mol/kg cat} \cdot \text{hr}$$

, $C_{A0} = 0.1$ mol/liter and $\varepsilon_A = 3$.

Q - 4	Attempt any one	[05]		
(i)	Steps involved in solid catalytic reaction		4	2
(ii)	Catalyst components		4	2

****

CO : Course Outcome Number BTL : Blooms Taxonomy Level

Level of Bloom's Revised Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create