

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER-VII (NEW) EXAMINATION – WINTER 2020

Subject Code:2170501

Date:19/01/2021

Subject Name:Chemical Reaction Engineering - II

Time:10:30 AM TO 12:30 PM

Total Marks: 56

Instructions:

1. Attempt any FOUR questions out of EIGHT questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

MARKS

- Q.1**
- | | | |
|-----|--|-----------|
| (a) | Draw the figures for various ways of studying the flow pattern in vessels. | 03 |
| (b) | Explain: 1) Residence time distribution 2) Dirac delta function 3) Early mixing 4) Micro fluid | 04 |
| (c) | Explain Step experiment to study the RTD in non- ideal reactor. | 07 |

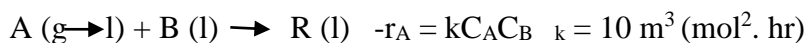
- Q.2**
- | | | |
|-----|--|-----------|
| (a) | Discuss closed vessel boundary condition. | 03 |
| (b) | Derive the equation for E_{θ} for single stirred tank reactor. | 04 |
| (c) | A sample of tracer was injected as a pulse to a reaction vessel and the effluent concentration was measured as a function of time resulting in following data If the reaction vessel is used to carry out liquid decomposition reaction with rate $-r_A = kC_A$, $k = 0.1 \text{ min}^{-1}$, Find the mean conversion. | 07 |

T, min	0	1	2	3	4	5	6	7	8	9	10	12	14
C, gm/m ³	0	1	5	8	10	8	6	4	3	2.2	1.5	0.6	0

- Q.3**
- | | | |
|-----|--|-----------|
| (a) | Write about C pulse curve. | 03 |
| (b) | What is Knudson equation? Explain the mechanism of solid catalyzed Gas phase reactions using LHHW model. | 04 |
| (c) | Derive BET equation for surface area of catalysts. | 07 |

- Q.4**
- | | | |
|-----|--|-----------|
| (a) | Discuss the effect of Henry's constant value on the solubility of gas in liquid. | 03 |
| (b) | Write on 'Film conversion parameter'. | 04 |
| (c) | Define: 1) Catalysts 2) Promoters 3) Inhibitors 4) Poisons 5) Accelerator 6) Coking 7) Sintering | 07 |

- Q.5**
- | | | |
|-----|--|-----------|
| (a) | Give examples for various fluid fluid reactions. | 03 |
| (b) | Draw diagram for various contacting pattern in two phase system | 04 |
| (c) | Air with gaseous A bubbles through a tank containing aqueous Reaction occurs as follows: | 07 |



For this system

$$k_{Ag} a = 0.1 \text{ mol/hr} \cdot \text{m}^3 \cdot \text{Pa}$$

$$f_l = 0.01 \text{ m}^3 \text{ liquid/m}^3 \text{ reactor}$$

$$k_{Al} a = 100 \text{ m}^3 \text{ liquid/m}^3 \text{ reactor} \cdot \text{hr}$$

$$H_A = 10^5 \text{ Pa} \cdot \text{m}^3/\text{mol}, \text{ very low solubility}$$

$$D_{Al} = D_{Bl} = 10^{-6} \text{ m}^2/\text{hr}$$

$$a = 100 \text{ m}^2/\text{m}^3$$

For a point in the reactor where

$$p_A = 100 \text{ Pa and}$$

$$C_B = 1 \text{ mol/m}^3$$

For $M_H < 0.02$, we have infinitely slow reaction.

(a) calculate the rate of reaction ($\text{mol/m}^3 \text{ hr}$)

(b) Resistance offered by the main body of liquid

- | | | |
|------------|--|-----------|
| Q.6 | (a) Write in detail about Progressive conversion model. | 03 |
| | (b) Discuss the significance of Effectiveness factor for solid catalysed reaction. | 04 |
| | (c) Discuss in brief about slurry reaction kinetics. | 07 |
| Q.7 | (a) Write about mean time and variance. | 03 |
| | (b) Write the significance of Thiele Modulus. | 04 |
| | (c) For chemical reaction controls, derive expression for relation for time required for unreacted core model for spherical particles of unchanging size. Also find time required for complete conversion. | 07 |
| Q.8 | (a) Give names for the different fluid particle contactors. | 03 |
| | (b) Discuss about various types of nonideality exists in non-ideal flow reactors. | 04 |
| | (c) Write in brief about catalysts deactivation. | 07 |
