

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VII (NEW) EXAMINATION – WINTER 2018

Subject Code: 2170501

Date: 15/11/2018

Subject Name: Chemical Reaction Engineering - II

Time: 10:30 AM TO 01:00 PM

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

		MARKS
Q.1	(a) What is the role of catalysts in reaction system? How will it enhance the rate of reaction?	03
	(b) Explain: 1. RTD 2. Micro fluid 3. Macro fluid 4. Early mixing	04
	(c) Derive LHHW model with surface reaction as the rate controlling mechanism for the reaction $A \rightleftharpoons R$	07
Q.2	(a) Explain Dirac delta function for RTD for ideal plug flow reactor.	03
	(b) Discuss mean time and variance in brief.	04
	(c) Write in detail about the various methods for preparation of catalysts.	07

OR

- (c) A reactor with a number of dividing baffles is to be used to run the reaction

$$A \rightarrow R \text{ with } -r_A = 0.05 C_A \text{ mol/liter. min}$$

A pulse tracer test gives the following output curve:

Time, t min	0	10	20	30	40	50	60	70
Tracer output conc. gm/litre	35	38	40	40	39	37	36	35

- Find the area under the C versus t curve.
- Calculate the variance of the E curve.
- How many tanks in series are equivalent to this vessel?

Q.3	(a) Explain Pulse experiment and E curve in detail.	03
	(b) Discuss in detail about the deviations from ideal flow pattern with examples.	04
	(c) Write in brief about the criteria for rate controlling steps in fluid particle reaction.	07

OR

Q.3	(a) What is Thiele Modulus. Give significance of it.	03
	(b) Derive equation for conversion using segregation model for non ideal reactor.	04
	(c) Air with gaseous A bubbles through a tank containing aqueous Reaction occurs as follows:	07

$$A(g \rightarrow l) + 2B(l) \rightarrow R(l) \quad -r_A = K C_A^2 C_B \quad K = 10^6 \text{ mol}^6 \text{ mol}^2 \cdot \text{hr}$$

For this system

$$k_{Ag} a = 0.01 \text{ mol/hr. m}^3 \text{ Pa}$$

$$f_l = 0.98$$

$$k_{Al} a = 20 \text{ hr}^{-1}$$

$$H_A = 105 \text{ Pa. m}^3/\text{mol}, \text{ very low solubility}$$

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

$$a = 20 \text{ m}^2/\text{m}^3$$

For a point in the absorber-reactor where

$$p_A = 5 \times 10^3 \text{ Pa and}$$

$$C_B = 100 \text{ mol/m}^3$$

(a) Locate the resistance to reaction (what % is in the gas film, in the liquid film, in the main body of liquid)

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

- Q.4**
- | | | |
|-----|---|-----------|
| (a) | Give name of the type of reactor used for fluid-fluid reactions. | 03 |
| (b) | Give examples of fluid particle reactions (Noncatalytic). | 04 |
| (c) | State various experimental methods for determining rates in solid catalyzed reaction. | 07 |

OR

- Q.4**
- | | | |
|-----|--|-----------|
| (a) | Explain Progressive Conversion model for fluid particle reaction. | 03 |
| (b) | A feed consisting
30% of 50- μm -radius particles
40% of 100- μm -radius particles
30% of 200- μm -radius particles
is to be fed continuously in a thin layer onto a moving grate crosscurrent to a flow of reactant gas. For the planned operating conditions, the time required for complete conversion is 5, 10, and 20 min for the three sizes of particles. Find the conversion of solids on the grate for a residence time of 8 min in the reactor. | 04 |
| (c) | Explain the enhancement factor and Hatta modulus. | 07 |

- Q.5**
- | | | |
|-----|---|-----------|
| (a) | Give significance of Effectiveness factor for solid catalysed reaction. | 03 |
| (b) | Derive rate equation for fluid-fluid reaction for straight mass transfer. | 04 |
| (c) | Discuss in detail about slurry reactor kinetics. | 07 |

OR

- Q.5**
- | | | |
|-----|---|-----------|
| (a) | Explain Turn over frequency and Selectivity of catalysts. | 03 |
| (b) | Describe contacting patterns for two phase systems. | 04 |
| (c) | Discuss advantages and disadvantages of fluidized bed reactor over fixed bed reactor. | 07 |
