

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VII(NEW) EXAMINATION – SUMMER 2019

Subject Code: 2170501
Date: 10/05/2019
Subject Name: Chemical Reaction Engineering - II
Time: 02:30 PM TO 05:00 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) | Mention the procedure for tracer experiment for step response. | 03 |
| | (b) | Estimate the vessel E curve equation. We suspect that the tanks-in series model reasonably represents the flow in the vessel. $t_{in} = 220$ s and $\sigma^2_{in} = 100$ s ² ; $t_{out} = 280$ s and $\sigma^2_{in} = 1000$ s ² | 04 |
| | (c) | Describe construction and working of fixed bed reactor with neat diagram. | 07 |
| Q.2 | (a) | Define: 1) Accelerator 2) Promoter 3) Inhibitor | 03 |
| | (b) | Write brief about Micro fluid and Macro fluid. | 04 |
| | (c) | Discuss segregation model with equation of conversion. | 07 |
| OR | | | |
| | (c) | A sample of tracer is injected to get pulse response of closed vessel. The effluent concentration is measured with respect to time as per following table. | 07 |

Time, min	0	1	2	3	4	5	6	7	8	9	10	12	14
Conc, gm/cc	0	1	1	5	8	10	8	6	4	3	2.2	1.5	0.6

Estimate the E curve.

- | | | | |
|------------|-----|---|----|
| Q.3 | (a) | Draw the sketches for Various ways of studying the flow pattern in vessels. | 03 |
| | (b) | Dilute A diffuses through a stagnant liquid film onto a plane surface consisting of B, reacts there to produce R which diffuses back into the mainstream. Derive the overall rate expression for the L/S reaction. $A(l) + B(s) \rightarrow R(l)$. | 04 |
| | (c) | The concentration of undesirable impurity in air (at 1 bar = 10^5 Pa) is to be reduced from 0.1% (or 100 Pa) to 0.02% (or 20 Pa) by absorption in pure water. Find the height of tower required for counter-current operations. | 07 |

Data

For consistency let us use SI units throughout.

For Packings

$$k_{Aga} = 0.32 \text{ mol/hr. m}^3 \cdot \text{Pa}$$

$$k_{Ala} = 0.1 \text{ /hr}$$

The solubility of A in water is given by Henry's law constant

$$H_A = p_{Ai}/C_{Ai} = 12.5 \text{ Pa. m}^3/\text{mol}$$

The flow rates per meter squared cross section of tower are

$$F_g/Acs = 1 \times 10^5 \text{ mol/hr m}^2$$

$$F_l/Acs = 7 \times 10^5 \text{ mol/hr. m}^2$$

The molar density of liquid under all conditions is

$$C_T = 56,000 \text{ mol/m}^3$$

OR

- Q.3 (a) Write in brief about trickle bed reactor. **03**
 (b) Give significance of film conversion parameter. **04**
 (c) Discuss slurry reactor kinetics in series. **07**
- Q.4 (a) Give examples for fluid fluid reactions. **03**
 (b) Discuss various non ideality that can occur in real reactor. **04**
 (c) For diffusion through chemical reaction control, derive relation for time required for unreacted core model for spherical particles of unchanging size; deduce relation for complete conversion also. **07**
- OR**
- Q.4 (a) Discuss the various types of tower and tank contactors for gas – liquid reaction. **03**
 (b) Explain Shrinking core model for spherical particles of unchanging size. **04**
 (c) Discuss various regimes for fluid fluid reaction for mass transfer and chemical reaction both having effect on the rate. **07**
- Q.5 (a) Discuss the effect of Henry's constant value on the solubility of gas in liquid. **03**
 (b) From the first principle prove that for a back mix reactor **04**
 (i) $E_\theta = e^{-\theta}$
 (c) State and explain the steps in heterogeneous catalytic reaction with schematic diagram. **07**
- OR**
- Q.5 (a) Discuss the effectiveness factor for solid catalyzed reaction. **03**
 (b) Explain the mechanism of solid catalysed reactions. **04**
 (c) Discuss various method for preparation of catalysts. **07**

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