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18PC62

Sixth Semester B.E. Degree Examination, July/August 2022

Chemical Reaction Engineering

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. How do you classify chemical reactions? Briefly explain with example. (05 Marks)
- b. Define the following with example:
 - i) Molecularity
 - ii) Order
 - iii) Rate of reaction
 - iv) Mechanism. (08 Marks)
- c. Explain the temperature dependent term of rate equation given by collision theory. (07 Marks)

OR

- 2 a. Differentiate between elementary and non-elementary reaction. (05 Marks)
- b. Discuss different type of intermediates in chemical reaction. (06 Marks)
- c. Experimental analysis shows that the homogeneous decomposition of ozone ($2\text{O}_3 \rightarrow 2\text{O}_2$) proceeds with rate

$$-r_{\text{O}_3} = K[\text{O}_3]^2[\text{O}_2]^{-1}$$

$$-r_{\text{O}_3} = K C_{\text{O}_3}^2 / C_{\text{O}_2}$$
 - i) Suggest two-step mechanism to explain this rate.
 - ii) What is the overall order of reaction? (09 Marks)

Module-2

- 3 a. Explain integral and differential method of analyzing kinetic data. (10 Marks)
- b. Derive equation for second order reaction for $m \neq 1$. (10 Marks)

OR

- 4 a. Derive design equation for batch reactor. (08 Marks)
- b. In isothermal batch reactor, the conversion of liquid reactant A achieved in 13min is 70%. Find the space time and space velocity necessary to effect this conversion in plug flow reactor and in a mixed flow reactor. Consider first order reaction. (12 Marks)

Module-3

- 5 a. Derive equation for 'n' equal size mixed reactor in series and prove that as $n \rightarrow \infty$ the overall effect will be plug flow. (12 Marks)
- b. Explain the graphical procedure to find the exit concentration of the reactor. (08 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

OR

- 6 a. Explain the qualitative discussion of product distribution for multiple reaction of type
 $A \xrightarrow{K_1} R$ desired
 $A \xrightarrow{K_1} S$ undesired. (10 Marks)
- b. Write a note on:
 i) Effect of temperature on equilibrium constant.
 ii) Adiabatic reaction. (10 Marks)

Module-4

- 7 a. What are the main reasons for non ideal conditions? Explain. (06 Marks)
 b. The concentration reading in the table represents continuous response of delta function into the closed vessel.

time, min	0	5	10	15	20	25	30	35
tracer concentration gm/lit	0	3	5	5	4	2	1	0

- i) Tabulate and plot E and F curve. (08 Marks)
 ii) Calculate mean and variance. (06 Marks)

OR

- 8 a. Derive equation for time required for complete conversion for spherical particles, when gas film controls the reaction. (12 Marks)
 b. Explain the various kinetic regimes of fluid-fluid reaction. (08 Marks)

Module-5

- 9 a. Explain the characteristic of the catalyst. (06 Marks)
 b. Explain the methods of estimation of surface area using BET method. (10 Marks)
 c. Explain the properties of catalyst. (04 Marks)

OR

- 10 Write a note on:
 a. Promoters (05 Marks)
 b. Inhibitors (05 Marks)
 c. Deactivation of catalyst (mechanism). (10 Marks)

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