

# CBCS SCHEME

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Acharya Institute of Technology

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022

18BT52

## 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. State and explain the temperature dependency of rate and rate constant of a reaction by Arrhenius Law and Collision theory. (14 Marks)
- b. Liquid A decomposes by first order kinetics and in a batch reactor 50% of A is converted in 5 min. How much longer it will take to reach 75% conversion? (06 Marks)

OR

- 2 a. Derive an integrated rate equation for bimolecular irreversible second order reaction. (10 Marks)
- b. Milk is pasteurized if it is heated to 63°C for 30 min. But if it is heated to 74°C, it only needs 15 sec for the same result. Find the activation energy of this Sterilization process. (10 Marks)

### Module-2

- 3 a. Derive the design equation of CSTR. (10 Marks)
- b. At room temperature, sucrose is hydrolysed by catalytic action of sucrose  $\xrightarrow{\text{sucrose}}$  product, starting with sucrose concentration of 2 moles/lit and feed rate of 25 lit/min. The kinetics of reaction is given by  $-r_A = \frac{0.10 C_A}{1 + 0.50 C_A}$  moles/lit. min. Find the volume of reactor to achieve a conversion of 95% in PFR. (10 Marks)

OR

- 4 a. Derive design equations for steady state plug flow reactor with graphical representation for general case and constant density system. (12 Marks)
- b. In an isothermal batch reactor, the conversion of liquid reactant is 70% in 13 minutes. Find the space time and space velocity necessary to affect this conversion in a MFR and PFR. (08 Marks)

### Module-3

- 5 a. With neat diagrams, explain the reasons for non – ideality in bioreactors. (08 Marks)
- b. The concentration readings in the table represents a continuous response to a delta function (pulse input) in to a reactor. Find average time and tabulate 'E' V/s 't' plot (exit age distribution). (12 Marks)

Time 't' in min	0	5	10	15	20	25	30	35
Traces input concentration (g/l) of fluid	0	3	5	5	4	2	1	0

OR

- 6 a. Derive an expression for RTD in CSTR. (10 Marks)
- b. Derive expressions for batch reactor and plug flow reactor with respect to conversion of first order reaction. (10 Marks)

Module-4

- 7 a. Derive equation for Michaeli's – Menton equation. Add a note on significance of  $K_m$  and  $V_{max}$ . (12 Marks)  
 b. Explain in detail about the types of enzyme specificities. (08 Marks)

OR

- 8 a. Explain Non – Competitive inhibition. (10 Marks)  
 b. An experiment was carried out to study the hydrolysis of lactose by lactase to glucose and galactose from milk. Initial rate data obtained in the experiment are given in the data table given below. Calculate  $K_m$  and  $V_{max}$  values. (10 Marks)

[S] in mol	2.5	2.3	1.8	1.4	1.3	0.8	0.5	0.2
$V_o$ in mol/min	1.95	1.90	1.85	1.80	1.75	1.50	1.20	0.80

Module-5

- 9 a. Explain Primary and Secondary product formation kinetics. (10 Marks)  
 b. Write a note on different medium requirements for Fermentation process. (10 Marks)

OR

- 10 a. Using Monod Model, how do you evaluate  $L_m$  and  $K_s$ . (10 Marks)  
 b. Write a note on growth of Filamentous Organisms. (10 Marks)

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