CBCS SCHEME

USN | | | | | | | | | | |

18BT52

# Fifth Semester B.E. Degree Examination, Jan./Feb. 2023
## 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. Classify the chemical reactions and define the rate of reaction. **(10 Marks)**

b. Explain the temperature dependency from Arrhenius law and the method to find Activation energy. **(10 Marks)**

**OR**

2 a. At 500 K the rate of a bimolecular reaction in ten times the rate at 400 K. Find the activation energy for this reaction : (i) Arrhenius law (ii) From collision theory (iii) What is the percentage difference in rate of reaction at 600 K predicted by these two methods. **(10 Marks)**

b. Show that the decomposition of $N_2O_5$ at 67°C in a first order reaction. Calculate the value of the rate constant.

Data :

| Time/min | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| $C_{N_2O_5}$ mol/lit | 0.16 | 0.113 | 0.08 | 0.056 | 0.04 |

**(06 Marks)**

c. The half life period for a certain first order reaction in $2.5\times10^3$ s. How long will it take for $\frac{1}{4}$ of the reactant to be left behind? **(04 Marks)**

### Module-2

3 a. Derive a performance equation for plug flow reactor. **(10 Marks)**

b. In an isothermal batch reactor the conversion of a liquid reactant A is 70% in 13min. Find the space time and space velocity necessary to effect thin conversion in a plug flow reactor and in a mixed flow reactor. Consider first order reaction. **(10 Marks)**

**OR**

4 a. Compare mixed flow reactor with plug flow reactor for first order reaction. **(10 Marks)**

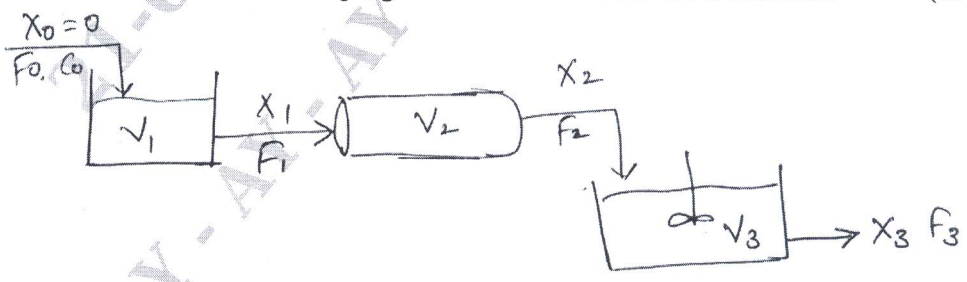


Fig. Q4 (b)

b. For the above reactor systems connected in series derive the performance equations to predict the intermediate conversions and overall conversions. **(10 Marks)**

## Module-3

5 a. Explain the methods for tear injection. **(10 Marks)**

b. Calculate the mean residence time and the variance for the vessel from the following data :

| t min | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $E(min^{-1})$ | 0 | 0.02 | 0.1 | 0.16 | 0.20 | 0.16 | 0.12 | 0.08 | 0.06 | 0.044 | 0.03 | 0.012 | 0 |

**(10 Marks)**

**OR**

6 a. Explain the relationship between E curve and F curve. **(08 Marks)**

b. A sample of tracer hytane was injected as pulse into a vessel to be used as reactor and the effluent concentrations are measured as a function of time. The data collected is given below:

| t min | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $C (g/m^3)$ | 0 | 1 | 5 | 8 | 10 | 8 | 6 | 4 | 3 | 2.2 | 1.5 | 0.6 | 0 |

Construct C and E curve and determine the fraction of material leaving the reactor that has spent between 3 and 6 min in the vessel and the fraction of material that has spent between 7.75 and 8.25 min in the vessel. **(12 Marks)**

## Module-4

7 a. Explain the enzyme specificities and active site of an enzyme. **(08 Marks)**

b. Derive Michaelis – Menton equation and discuss the significance of $K_m$ and $V_{max}$. **(12 Marks)**

**OR**

8 a. What is Enzyme inhibition. Explain uncompetitive and non competitive inhibition. **(12 Marks)**

b. Write a note on :

(i) Lineweaver Burk plot
(ii) Eadie-Hofstee plot
(iii) Enzyme activity
(iv) Enzyme substrate complex **(08 Marks)**

## Module-5

9 a. Describe Monod model for growth of Filamentous organism. **(10 Marks)**

b. Explain the growth associated and non-growth associated production. **(10 Marks)**

**OR**

10 Explain the media requirements for fermentation process. **(20 Marks)**

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