

# 314309

**12526**

**3 Hours / 70 Marks**

Seat No. 

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- Instructions* – (1) All Questions are *Compulsory*.
- (2) Answer each next main Question on a new page.
- (3) Illustrate your answers with neat sketches wherever necessary.
- (4) Figures to the right indicate full marks.
- (5) Assume suitable data, if necessary.
- (6) Use of Non-programmable Electronic Pocket Calculator is permissible.
- (7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

**Marks**

- 1. Attempt any FIVE of the following :** **10**
- a) Define catalysis.
- b) Compare elementary reaction and non-elementary reaction (Any two).
- c) List any two types of reactor.
- d) Define constant volume and variable volume reaction system.
- e) Discuss chain and non-chain reactions.
- f) Draw CSTR-PFR-CSTR in series.
- g) Define catalyst poisoning.

P.T.O.

2. Attempt any THREE of the following :

12

- a) Explain the general procedure for integral method of analysis of rate data for the constant volume reaction system.
- b) A certain reaction has a rate given by  
 $(-r_A) = 0.005 C_A^2$ , mole/(cm<sup>3</sup>.min)  
 If the concentration is expressed in mol/l and time in hours, what would be the value and units of rate constant.
- c) Describe the integrated rate equation for first order reaction in terms of concentration at constant volume reaction system.
- d) Distinguish between fixed bed reactor and fluidized bed reactor (Any four).

3. Attempt any THREE of the following :

12

- a) Show that decomposition of N<sub>2</sub>O<sub>5</sub> at 67°C is a first order reaction. Calculate the value of rate constant.

Time (min)	C <sub>N<sub>2</sub>O<sub>5</sub></sub> (mol/l)
0	0.16
1	0.113
2	0.08
3	0.056
4	0.040

- b) Derive performance / design equation for ideal batch reactor.
- c) Explain the classification of catalytic reactions with suitable example.
- d) The rates of reaction at concentrations 0.15 mol/l and 0.05 mol/l are  $2.7 \times 10^{-3}$  and  $0.3 \times 10^{-3}$  mol/l.min. Calculate the order of reaction with respect to the reactant.

4. Attempt any THREE of the following : 12

- a) Draw reactors of different types in series (CSTR-PFR-CSTR) with graphical design procedure for the same.
- b) Explain the characteristics of catalytic reactions (Any four).
- c) Define space time and space velocity with mathematical equation.
- d) Explain half-life method to determine order of reaction.
- e) The rate constants of a certain reaction at  $27^{\circ}\text{C}$  is  $1.3 \times 10^{-3}\text{s}^{-1}$ . Determine the frequency factor. Take  $E = 12817\text{cal/mol}$ .

5. Attempt any TWO of the following : 12

- a) It is proposed to operate a batch reactor for converting A into R. This is a liquid phase reaction with the stoichiometry  $\text{A} \rightarrow \text{R}$ . Find the time required to drop the concentration of A from  $C_{\text{AO}} = 1.3\text{ mol/l}$  to  $C_{\text{AF}} = 0.30\text{ mol/l}$ . the rate v/s concentration data are as given below.

$C_{\text{A}}$ (mol/l)	$-r_{\text{A}}$ (mol/l.min)
0.1	0.1
0.2	0.3
0.3	0.5
0.4	0.6
0.5	0.5
0.6	0.25
0.7	0.10
0.8	0.06
1.0	0.05
1.3	0.045
2.0	0.042

- b) Explain the procedure to determine the best system for achieving desired conversion for different size mixed flow reactors in series.
- c) Derive the integrated rate equation for second order reaction for variable volume reaction system.

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**Marks**

**6. Attempt any TWO of the following :**

**12**

- a) Derive the equation for conversion of reactant in equal size CSTR in series.
  - b) A polymerisation reactor occurs at constant temperature in a homogeneous phase. 30% of the monomer reacts in 40 minutes for the initial monomer concentrations of 0.3, 0.5, and 0.9 mol/l. find the reaction rate.
  - c) Draw graphical representation of performance equation for CSTR and PFR.
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