



(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 151407

Roll No.

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B. Tech.

(SEM. IV) THEORY EXAMINATION, 2014-15
CHEMICAL REACTION ENGINEERING - I

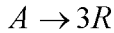
Time : 3 Hours]

[Total Marks : 100

- Note :**
1. Attempt ALL questions.
 2. Assume suitable data, if required.
 3. All question carry equal marks.

- 1 Attempt any four parts of the following : 5×4
- (a) Describe collision state theory with the help of suitable example.
 - (b) Differentiate between elementary and non-elementary reactions with suitable examples.
 - (c) What do you mean by Rate of a chemical reaction? Explain with suitable examples.
 - (d) The rate constant of a reaction at 27°C is $2.5 \times 10^{-4}(\text{s})^{-1}$. Determine the frequency factor for this reaction. Take Energy of Activation is equal to 3.0×10^5 cal/mol.
 - (e) Explain the term 'Activation Energy' with suitable examples.
 - (f) Write a short note on 'Search of Mechanism' of a chemical reaction.

- 2 Write short notes on any four parts of the following : 5×4
- (a) Adiabatic reaction
 - (b) Holding time and space time
 - (c) Autocatalytic reactions
 - (d) Half life period
 - (e) Semi batch reactors
 - (f) Third order reactions.
- 3 Attempt any two parts of the following : 10×2
- (a) Describe Batch and PFR reactors with suitable diagrams. Also derive the performance equation of CSTR.
 - (b) Explain the integral method of analysing the kinetic data. Justify the statement that "differential method for analysing kinetic data is preferred over integral method for fractional order reactions".
 - (c) A liquid reactant stream (1 mol/liter) passes through two mixed flow reactors in a series. The concentration of A in the exit of the first reactor is 0.5 mol/liter. Find the concentration in the exit stream of the second reactor. The reaction is second-order with respect to A and $V_2/V_1 = 2$.
- 4 Attempt any two parts of the following : 10×2
- (a) Pure gaseous A at about 3 atm and 30°C (120 mmol/liter) is fed into a 1-liter mixed flow reactor at various flow rates. There it decomposes, and the exit concentration of A is measured for each flow rate. From the following data find a rate equation to represent the kinetics of the decomposition of A. Assume that reactant A alone affects the rate.



$v_0, (\text{liter} / \text{min})$	0.06	0.48	1.5	8.1
$C_A (\text{mmol} / \text{litre})$	30	60	80	105

(b) What is the effect of recycle in the performance of a reactor?

(c) For a series reaction $A \xrightarrow{K_1} R \xrightarrow{K_2} S$, obtain an expression for C_R and also prove that time taken to obtain the maximum concentration of $R(C_{Rmax})$, equals the log mean kinetic constant difference.

5 Attempt any two parts of the following : **10×2**

(a) Describe E and F curves in detail. Also discuss the effect of axial dispersion on conversion in a PFR.

(b) What is the effect of temperature and pressure on a single reaction? Also write a short note on 'Optimal temperature progression'.

(c) Define the term RTD. Also explain 'Tanks-in-series' model with neat diagram.
