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ECH403

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

PAPER ID : 151407

Roll No.

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 $2.5\times10^{-4}(s)^{-1}$. 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.

$A \rightarrow 3R$

$v_0, (liter/\min)$	0.06	0.48	1.5	8.1
$C_A (mmol/litre)$	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.