Registration No.										

Total number of printed pages - 02

B.TECH
PCCH4305

6th Semester Regular / Back Examination 2016 - 17
CHEMICAL REACTION ENGINEERING
BRANCH : Chemical Engineering
Time : 3 Hours
Max Marks : 70
Question Code :Z173

Answer Question No. 1 which is compulsory and any FIVE from the rest.
The figures in the right-hand margin indicate marks.
Assume suitable notations and any missing data wherever necessary.
Answer all parts of a question at a place.

1. **Answer the following questions :** **2 x 10**

(a) Define rate of reaction.
(b) Define elementary and non-elementary reactions.
(c) For a reaction, $H_2 + O_2 \rightarrow H_2O$, what is the relation between $-r_{H2} and - r_{O2}$?
(d) Under what conditions the performance of PFR is equal to that of CSTR ?
(e) Define mean residence time or holding time.
(f) Define autocatalytic reaction.
(g) For a reaction whose rate-concentration curve rises monotonically (n>0), the reactors should be connected in parallel. TRUE/FALSE. Justify.
(h) For which reaction kinetics if the arrangement of reactors of different volumes (CSTR/PFR-CSTR/CSTR-PFR) is altered, the conversion remains same.
(i) Define overall and instantaneous fractional yield.
(j) For autocatalytic reaction which reactor is best for lower conversion?

2. The data for the 1st order decomposition of a reaction is given below. Find the activation energy and frequency factor. **10**

K(sec^{-1})	0.00043	0.00103	0.0018	0.00355	0.00717
T(K)	313	319	323	328	333

3. **(a)** Enzyme E catalyses the fermentation of substrate A (the reactant) to product R. Find the size of mixed flow reactor needed for 95% conversion of reactant in a feed stream (25 lit/min) of reactant (2 mol/lit) and enzyme. The kinetics of the fermentation at this enzyme concentration are given by:

$A \xrightarrow{enzyme} R, \qquad -r_A = \dfrac{0.1\, C_A}{1 + 0.5 C_A}, \dfrac{mol}{lit.min}$ **08**

(b) $A + B \rightarrow R, \quad r_R = 10\, C_A^{1.5} C_B^{1.0}$

$A + B \rightarrow S, \quad r_S = 10\, C_A^{2.0} C_B^{1.5}$

What should be the contacting pattern for maximum yield of R? **02**

4. **(a)** Explain the methods of size comparison between CSTR and PFR. **06**

(b) Derive performance equation of CSTR in terms of space time for a second order reaction, $-r_A = K C_A C_B$. **04**

5. **(a)** Draw the concentration profiles of *A, R,* and *S* for the parallel reactions, $A \overset{10}{\rightarrow} R, \quad A \overset{5}{\rightarrow} S$. **03**

(b) Derive an expression relating conversion and space time, for N number of equal size reactors in series for 1st order irreversible reaction. **07**

6. Derive an expression for C_{Rmax}, for a series reaction, $A \overset{K_1}{\rightarrow} R \overset{K_2}{\rightarrow} S$, assuming the reactions are all first order. **10**

7. **(a)** Explain how to find final conversion for a known kinetics graphically, when three different volume CSTRs operate in series. **04**

(b) The concentration readings represent a continuous response to a pulse input into a closed vessel which is to be used as a chemical reactor. Calculate the mean residence time of fluid in the vessel, and tabulate E for the plot of exit age distribution.

t, time	0	5	10	15	20	25	30	35
C_{pulse},*gm/lit*	0	3	5	5	4	2	1	0

06

8. **Write short notes on any TWO:** **5 x 2**

(a) Batch reactor

(b) Plug flow reactor

(c) Continuous stirred tank reactor

(d) Recycle reactor
