Printed Pages: 4 **ECH 403**

(Following Paper ID and Roll No. to be filled in your Answer Books)	
Paper ID : 151407	**Roll No.**

B.TECH.

Theory Examination (Semester-IV) 2015-16

CHEMICAL REACTION ENGINEERING-I

Time : 3 Hours ***Max. Marks : 100***

Note : Attempt all Sections.

Section-A

1. Attempt all parts. Write answer of each part in short. (2×10 = 20)

(a) Define Elementary & Non-elementary reactions.

(b) Define Series & Parallel reactions.

(c) Define molecularity and order of reaction.

(d) Define selectivity and yield of reaction.

(e) Define Single & Multiple reactions.

(f) Define rate of reaction.

(g) Define space time and space velocity.

(h) Define Exit age distribution.

(i) Give the design equation of PFR.

(j) Define expansion factor in a variable volume reactor

Section-B

2. Attempt any five questions from this section. [10×5=50]

(a) (i) For the elementary reactions in series $A \rightarrow R \rightarrow S$, $k_1 = k_2$, at t=0, $C_A = C_{A0}$, $C_{R0} = C_{S0} = 0$, find the maximum concentration of R and when it is reached.

(ii) Liquid A decomposes by second order kinetics and in a batch reactor 60% of A is converted in 15 min. How much time would it take to reach 90% conversion?

(b) (i) For the decomposition $A \rightarrow R$, C_{A0} = 1mol/litre, in a batch reactor, conversion is 75% after 1 hour. Find a rate equation to represent this kinetics.

(ii) A homogeneous liquid phase reaction $A \rightarrow R$, $-r_A = k C_A^2$ takes place with 50% conversion in a mixed reactor. what will be the conversion if the original reactor is replaced by a plug flow reactor of equal size , all else remaining unchanged?

(c) (i) Derive the design equation for Mixed flow reactor.

(ii) A gaseous feed of pure A (1 mol/l) enters a mixed flow reactor (2 litres) and reacts as follows: $2A \rightarrow R$, $-r_A = 0.05\ C_A^2$ mol/l.sec. Find what feed rate (l/min) will give an outlet concentration C_A=0.5 mol/l.

(d) Discuss the performance and size comparison of Plug flow reactor Vs Mixed flow reactor for first order reaction.

(e) A gaseous feed of pure A (2mol/liter, 100 mol/min) decomposes to give variety of products in the plug flow reactor. The kinetics of conversion is represented by : $A \rightarrow 2.5$ (products), $-r_A = .(10\ min^{-1})\ C_A$. Find the expected conversion in 22 liter reactor.

(f) A liquid reactant stream (1mol/lit) passes through two mixed flow reactors in series. The concentration of A in the exit of the first reactor is 0.5mol/lit. Find the concentration A in the exit of the second reactor. The reaction is second order with respect to A and V_2/V_1=2.

(g) (i) Show that N Plug Flow Reactors in series with a total volume V give the same conversion as a single PFR of volume V.

(ii) A reactor set up consisting of two parallel branches D and E. Branch D has a reactor of volume 80 liters and branch E has a reactor of volume 40 liters. What fraction of feed should go to these branches?

(h) For the given reactor data, calculate the mean residence time of fluid in the vessel t, and find the exit age distribution E.

Time t, min	0	5	10	15	20	25	30	35
C_{pulse} gm/l	0	3	5	5	4	2	1	0

Section-C

Note: Attempt any two parts of the following: (15×2=30)

3. Explain C, E and F curves for Non-ideal flow.

4. Derive the expression $X_A = C_P \Delta T/(-\Delta Hr)$ for an Adiabatic operation.

5. A stream of pure gaseous reactant A with initial concentration 660 m mol/l enter into a plug flow reactor at a 540 m mol / l min molar flow rate and polymerizes as per reaction $3A \rightarrow R$, $-r_A = 54\ C_A$ m mol/ l min. How large a reactor is required to lower the concentration of A in the exit stream C_{Af} = 330 m mol/l ?