B.TECH. SEM -V (CHEMICAL 2014 COURSE (CBCS) : WINTER - 2017

SUBJECT: CHEMICAL REACTION ENGINEERING – I

Day: **Saturday**
Date: **13/01/2018**

Time: **02.30 PM TO 05.30 PM**
Max. Marks: 60

W-2017-2112

N.B.:

1) All questions are **COMPULSORY**.
2) Figures to the right indicate **FULL** marks.
3) Draw neat diagrams **WHEREVER** necessary.
4) Assume suitable data if necessary.

Q.1 a) On doubling the concentration of reactant, the rate of reaction triples. Find the reaction order. **(05)**

b) At 500K, the rate of a bimolecular reaction is ten times the rate at 400K. Find the activation energy for this reaction. **(05)**

i) From Arrhenius law
ii) From collision theory
ii) What is the percentage difference in rate of reaction at 600K, predicted by these two methods?

OR

Q.1 The following table shows how the concentration of reactant A varies with time in a particular experiment. **(10)**

Time (min)	0	18	31	55	79	157	∞
$C_A \times 10^4$ (mol/L)	2.77	2.32	2.05	1.59	1.26	0.58	0

a) Plot the graph of concentration of A against time
b) Draw tangents to the curves at 10, 50, 100, and 150 minutes and calculate their slopes.
c) Plot a graph of rate of reaction against concentration of A.

Q.2 a) Explain in detail differential method of analysis of batch rector data. **(06)**

b) The half life period of a reaction of the first order is 240 s. Calculate its rate constant in seconds and minutes. **(04)**

OR

Q.2 Explain in detail integral method of analysis of batch reactor data. **(10)**

Q.3 a) Derive the performance equation for batch reactor. **(04)**

b) Assuming a stoichiometry $A \rightarrow R$, for a first order gas phase reaction, the size (volume) of a plug flow reactor for 99% conversion of pure A is calculated to be 32 lL. In fact, however, the stoichiometry of the reaction is $A \rightarrow 3R$. For this corrected stoichiometry, find the required volume of a reactor. **(06)**

OR

Q.3 A homogeneous liquid phase reaction with stoichiometry and the kinetics $A \rightarrow S$, $-r_A = K\ C_A^2$ takes place with 50% conversion in a mixed flow reactor. **(10)**

i) Find the conversion if this reactor is replaced by another MFR having volume 6 times that of the original reactor, all else remain unchanged.
ii) Find the conversion if the original reactor is replaced by a PFR of the same size, all else remain unchanged.

P. T. O.

Q.4 Explain in detail: **(10)**

(a) Optimum recycle ratio for auto- catalytic (recycle) reactors.
(b) Size comparison of reactor performance

OR

Q.4 a) Your company has two MFRs of unequal size for producing a specified product according to first order kinetics. How should these reactors be connected to obtain a maximum production rate? **(05)**

b) Derive the performance equation for recycle rector. **(05)**

Q.5 Liquid reactant a decomposes as per the following reactions in parallel: **(10)**

$$A \rightarrow R, \quad A \rightarrow S, \quad A \rightarrow T$$

With $r_R = 1,\ r_S = 2C_s \ and\ r_T = C_A^2$. Determine the maximum concentration of desired product (C_S) that in be obtained: i) in a mixed flow reactor, and ii) in a PFR

OR

Q.5 The desired liquid phase reaction: **(10)**

$A + B \rightarrow R + T,\ \dfrac{dC_R}{dt} = \dfrac{dC_T}{dt} = K_1\ C_A^{1.5}\ C_B^{0.30}$ is accompanied by the undesired side reaction.

$A + B \rightarrow S + U,\ \dfrac{dC_s}{dt} = \dfrac{dC_U}{dt} = k_2\ C_A^{0.50}\ C_B^{1.8}$

What contacting schemes (reactor types) would you use to these reactions to minimize the concentration of undesired products?

Q.6 Write a short note on:

a) Adiabatic Operation **(05)**
b) Non- adiabatic operation **(05)**

OR

Q.6 Explain in detail:

a) Optimum temperature progression **(05)**
b) Temperature and conversion profiles for exothermic and endothermic reactions. **(05)**

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