

**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 reactor 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.

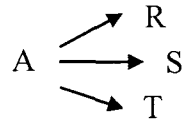
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- Q.4** Explain in detail: **(10)**
 (a) Optimum recycle ratio for auto-catalytic (recycle) reactors.
 (b) Size comparison of reactor performance

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 reactor. **(05)**

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



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

OR

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

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

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

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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