

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

**SUMMER - 2018**

**SUBJECT: CHEMICAL REACTION ENGINEERING – I**

Day: **Tuesday**  
Date: **22/05/2018**

**S-2018-2320**

Time: **10.00 AM TO 01.00 PM**  
Max. Marks: 60

**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** Explain the following terms with example: **(10)**
- |                      |                         |
|----------------------|-------------------------|
| i) Order of reaction | ii) Rate constant       |
| iii) Half life       | iv) Elementary reaction |
| v) Molecularity      |                         |

**OR**

- Q.1** Write short note on: **(10)**
- i) Temperature dependency from Arrhenius law
  - ii) Temperature dependency from Collision theory

- Q.2** For the reaction:  $A \rightarrow \text{Product}$ . The following data were obtained at  $25^\circ\text{C}$  in which concentration of A is given at different intervals of time: **(10)**

t (min)	0	10	20	30	40
$C_A$ (mol/L)	0.86	0.74	0.635	0.546	0.405

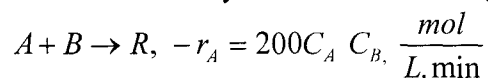
Find the order of reaction, rate constant, and half life period.

**OR**

- Q.2 a)** After 8 minutes in a batch reactor, reactant is 80% converted and after 18 minutes the conversion is 90%. Find a rate expression for this reaction if  $C_{A0} = 1 \text{ mol/L}$ . **(06)**
- b)** In case of a first order reaction show that the time required for 75% conversion is double the time required for 50% conversion. **(04)**
- Q.3 a)** Derive the performance equation for ideal mixed flow reactor. **(05)**
- b)** A homogenous gas reaction  $A \rightarrow 3R$  proceeds with  $-r_A = 10^{-1} C_A$ , (mol/L. s) at  $200^\circ\text{C}$ . Find the space time required to achieve 80% conversion of 50% A and 50% inerts feed to a PFR operating at  $200^\circ\text{C}$  and 5 atm pressure. The initial concentration of A is 0.0625 mol/L. **(05)**

**OR**

- Q.3 a)** Derive the performance equation of ideal plug flow reactor. **(05)**
- b)** An aqueous feed of A and B (400 L/min) with  $C_{A0} = 100 \text{ mmol/L}$  and 200 mmol/L is to be converted into product in a mixed flow reactor. The kinetics and stoichiometry of the reaction are given as follows: **(05)**



Estimate the volume of MFR required to achieve 99% conversion of A to product.

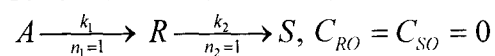
**P. T. O.**

- Q.4 a)** Derive the performance equation of recycle reactor. (06)
- b)** Derive an expression for the concentration of reactant in the exit stream from a series of mixed reactors of different sizes. Assume that the reaction follows first order kinetics and the holding time in the  $n^{\text{th}}$  reactor is  $\tau_n$ . (04)

**OR**

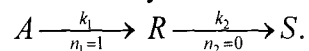
- Q.4** Presently 90% of reactant A converted into product by a second order reaction in a single mixed flow reactor. We propose to place second reactor similar to one being used in series with it. (10)
- i) For the same treatment rate as that used presently, how will this addition of reactor affect the conversion of reactant?
- ii) For the same 90% conversion, by how much can the treatment rate be increased in the latter case?

- Q.5** Derive the equation for  $\tau_{m\text{opt}}$  and  $C_{R\text{max}}$  for irreversible first order reactions in series carried out into mixed flow reactor: (10)



**OR**

- Q.5** Derive the equation for  $t_{R\text{max}}$  and  $C_{R\text{max}}$  for irreversible first order reaction followed by zero order reaction in plug flow reactor: (10)



- Q.6** Write a short note on: (10)
- i) Optimum temperature progression
- ii) Adiabatic operations

**OR**

- Q.6** Explain in detail temperature and conversion profiles for exothermic and endothermic reactions. (10)

\* \* \* \*