B.TECH. SEM -V (CHEMICAL 2014 COURSE (CBCS) : SUMMER - 2018

SUBJECT: CHEMICAL REACTION ENGINEERING – I

Day: **Tuesday** | **S-2018-2320** | Time: **10.00 AM TO 01.00 PM**

Date: **22/05/2018** | | 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→ Product. The following data were obtained at 25^0C 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 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→ 3R proceeds with $-r_A = 10^{-1} C_A$, (mol/L. s) at 200^0C. Find the space time required to achieve 80% conversion of 50% A and 50% inerts feed to a PFR operating at 200^0C 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 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)**

$$A + B \rightarrow R,\ -r_A = 200 C_A\ C_{B,}\ \frac{mol}{L.\min}$$

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

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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[th] reactor is τ_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 $\tau_{m\,opt}$ and $C_{R\max}$ for irreversible first order reactions in series carried out into mixed flow reactor: **(10)**

$A \xrightarrow[n_1=1]{k_1} R \xrightarrow[n_2=1]{k_2} S,\ C_{RO} = C_{SO} = 0$

OR

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

$A \xrightarrow[n_1=1]{k_1} R \xrightarrow[n_2=0]{k_2} S.$

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)**

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