PAPER ID-310760

Subject Code: KCH504

Roll No: | | | | | | | | | | | | | |

B. TECH.
(SEM V) THEORY EXAMINATION 2020-21
CHEMICAL REACTION ENGINEERING

Time: 3 Hours ***Total Marks: 100***

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. **2 x 10 = 20**

Q no.	Question	Marks	CO
a.	Differentiate molecularity and order of reaction.	2	1
b.	Discuss variables affecting the rate of reaction.	2	1
c.	Explain irreversible reaction in parallel and series with examples.	2	2
d.	Give examples for series, parallel and autocatalytic reactions.	2	2
e.	Liquid A decomposes by first-order kinetics, and in a batch reactor 50% of A is converted in a 5-minute run. How much longer would it take to reach 75% conversion?	2	3
f.	Differentiate between plug flow and back-mix flow.	2	3
g.	Explain Plug Flow Reactors in Series and in Parallel with equation	2	4
h.	Explain holding time and space velocity.	2	4
i.	Explain (i) RTD (ii) E and C curve	2	5
j.	What do you understand by term 'heat duty'?	2	5

SECTION B

2. Attempt any *three* of the following:

Q no.	Question	Marks	CO
a.	Write in brief about thermodynamic equilibrium constant. Write physical significance of activation energy. Also discuss temperature dependency of activation energy using Arrhenius theory.	10	1
b.	State the various methods to analyze the kinetic data and explain any one in detail.	10	2
c.	Discuss about variable volume reactor. Derive the relation for irreversible first order reaction in terms of variable volume reactor.	10	3
d.	Derive the performance equation for equal size CSTR's arranged in parallel.	10	4
e.	Water is drawn from a lake, flows through a pump and passes down a long pipe in turbulent flow. A slug of tracer (not an ideal pulse input) enters the intake line at the lake, and is recorded downstream at two locations in the pipe L meters apart. The mean residence time of fluid between recording points is 100 sec, variance of the two recorded signals is $\sigma_1^2 = 800\ sec^2$ $\sigma_2^2 = 900\ sec^2$ What would be the spread of an ideal pulse response for a section of this pipe, free from end effects and of length L/5?	10	5

SECTION C

3. Attempt any *one* part of the following:

Q no.	Question	Marks	CO
a.	Give detail classification of reactions.	10	1
b.	The reaction between CO and NO_2 at low temperature proceeds with a rate $-r_{NO2} = kC^2_{NO2}$ Suggest a mechanism to explain this rate law.	10	1

4. Attempt any *one* part of the following:

Q no.	Question	Marks	CO
a.	Derive the design equation for autocatalytic reactor.	10	2
b.	Derive an equation for determination of overall order of irreversible reactions from half-life method.	10	2

5. Attempt any *one* part of the following:

Q no.	Question	Marks	CO
a.	Discuss the advantages and disadvantages of various types of reactors used to carry out the reactions.	10	3
b.	In an isothermal batch reactor the conversion of a liquid reactant A is 70% in 13 min. Find the space time and space velocity necessary to effect this conversion in a plug flow reactor and in a mixed flow reactor. Consider the first order kinetics.	10	3

6. Attempt any *one* part of the following:

Q no.	Question	Marks	CO
a.	A liquid reactant stream with C_{A0} = 1 mol/lit passes through two mixed flow reactors in series. The concentration of A in the exit stream from the first reactor is 0.5mol/lit. Find the concentration of A in the exit stream of the second reactor. The reaction A →R follows second order kinetics and $V_2/V_1 = 2$.	10	4
b.	Compare plug flow reactor and mixed flow reactor for finding the size of reactor for adiabatic operations with graphs.	10	4

7. Attempt any *one* part of the following:

Q no.	Question	Marks	CO
a.	Write short note on; i. Optimum temperature progression ii. Axial dispersion	10	5
b.	Tubular reactors for thermal cracking are designed on the assumption of plug flow. On the suspicion that non ideal flow may be an important factor now being ignored, let us make a rough estimate of its role. For this assume isothermal operations in a 2.5 cm ID tubular reactor, using the Reynolds number of 10000 for the flowing fluid. The cracking reaction is approximately first order. If calculation shows that 99% decomposition can be obtained in a PFR 3 m long, how much longer must the real reactor be if non-ideal flow is taken into account?	10	5