QP Code: RO20MTECH199 Reg. No | | | | | | | | | | | AR 19

GIET UNIVERSITY, GUNUPUR – 765022

M. Tech (Second Semester Examinations) – October' 2021

MPCCH2020 – ADVANCED REACTION ENGINEERING AND REACTOR DESIGN

(Chemical Engineering)

Time: 2 hrs Maximum: 50 Marks

(The figures in the right hand margin indicate marks)

PART – A

Q.1. Answer ***ALL*** questions (2 x 10 = 20)

a. Differentiate space time and space velocity.

b. The pyrolysis of ethane proceeds with an activation energy of about 300 kJ/mol. How much faster is the decomposition at 650°C than at 500^0C?

c. What is pseudo first order reaction?

d. What are the parameters to be considered for design of reactors?

e. Define activation energy and write its significance.

f. Draw the schematic graph of concentration vs time for zero order reaction.

g. Write the comparison of single reaction and multiple reaction in terms of product distribution.

h. What is the significance of Damkohler number?

i. What is effectiveness factor? Write its importance in cylindrical pore.

j. For the complex reaction with stoichiometry $A + 3B \rightarrow 2R + S$ and with second order rate expression $-r_A = k_1[A][B]$. What is the relation between r_A, r_B, r_R.

PART – B **(6 x 5 = 30 Marks)**

Answer ***ANY FIVE*** questions Marks

2. Derive the performance equation of irreversible first order reaction for constant volume batch reactor. Show in the graph to calculate rate constant by using this equation. (6)

3. In a certain Kinetic study, the rate constants were found to vary with temperature in the following manner. (6)

K x 10^3 (min $^{-1}$)	:	4.15	26.8	114	246
T (K)	:	573	600	623.5	635

Evaluate the activation energy & Arrhenius constant.

4. The partial pressure of Azomethane $CH_3N_2\ CH_3$ was observed as a function of time at 5000K, with results given below. Confirm that, the decomposition; (6)

$CH_3\ N_2\ CH_3 \longrightarrow CH_3\ CH_3 + N_2$ is 1^{st} order in $CH_3\ N_2\ CH_3$ and find the rate constant at this temperature.

Time (Sec)	0	1000	2000	3000	4000
Pressure (mm)	820	572	399	278	194

5. At 600 K the gas phase reaction; (6)

$$C_2H_4 + Br_2 \underset{K_2}{\overset{K_1}{\rightleftharpoons}} C_2H_4Br_2$$

, has rate constants

K_1 = 500 m^1 / K. mol – hr and K_2 = 0.032 hr^{-1}.

If a plug flow reactor is to be fed 600 m^3 / hr of a gas containing 60% Br_2 and 30%

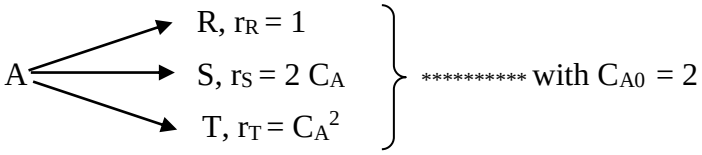
$C_2 H_4$ and 10% inerts by volume at 600 ^{0}K and 1.5 bar. Calculate

i. the maximum possible conversion of C_2H_4 in to $C_2H_4 Br_2$, make a trial around 0.977.

ii. the reactor volume required to obtain 60% conversion

6. Derive the performance equation for plug flow reactor for variable volume with first order kinetics. (6)

7. For the parallel decomposition of A, where S is desired, (6)



What maximum Cs we may expect in isothermal operations:

(a) In a mixed reactor.

(b) In a plug flow reactor.

8. The elementary liquid phase reaction is carried out in a system of two reactors in series having volume of PFR and CSTR are 2 lit and 3 lit respectively. Initial concentration of reactant is 0.6 mol/lit and molar flow rate of 1 mol / sec. Find out which combination is better either PFR followed by CSTR or CSTR followed by PFR. (6)

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