Sub Code: NCH503

Paper Id: 151510 Roll No: | | | | | | | | | | | | | |

B. Tech.
(SEMESTER- V) THEORY EXAMINATION, 2019-20
CHEMICAL REACTION ENGINEERING-I

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

Note:-Attempt **all** questions.

SECTION-A

1. Attempt all parts and answer of each part in very short. (2x10=20)

a) Differentiate between elementary and non elementary reactions.
b) Define molecularity and order of reaction.
c) Define selectivity and yield of reaction.
d) What do understand by the reaction rate?
e) Explain space time and holding time.
f) Describe the constant volume batch reactor.
g) Define Exit age distribution.
h) Explain recycle ratio.
i) What do you mean by activation energy?
j) What are the auto catalytic reactions?

SECTION-B

2. Attempt any *three* of the following: 10 x 3 = 30

a) The homogeneous gas decomposition of reactant A is 4 A(g) →R(g) + 6S(g) proceeds at 600° C with the first order rate $(-r_A) = (15/hr)C_A$. What size of plug flow reactor operating 600° C and 400 kPa can produce 80% conversion of a feed consisting of 60 mol of pure A per hour?

b) Find the conversion after 1 hour in a batch reactor for

$A \rightarrow R, \quad (-r_A) = 3\ C_A^{0.5}$ mol/lit.hr, C_{A0}=1 mol/liters

c) A rocket engine burns a stoichiometric mixture of fuel (liquid hydrogen) in oxidant (liquid oxygen). The combustion chamber is cylindrical, 75 cm long and 60 cm in diameter and the combustion process produces 108 kg/s of exhaust gases. If combustion is complete, find the rate of reaction of hydrogen and of oxygen.

d) After 8 minutes in a batch reactor, reactant (C_{A0} = 1 mol/liters) is 80% converted, after 18 minutes conversion is 90%. Find a rate equation to represent this reaction.

e) Milk is pasteurized if it is heated to 63^0C for 30 min, but if it is heated to 74^0C it needs only 15 sec for the same result. Find the activation energy of this sterilization process.

SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

a) Gaseous reactant A decomposes as A→3R, $-r_A$= (0.6 /min) C_A Find the conversion of A in a 50% A-50% inert feed (v_0=180 liter/min, C_{Ao}= 300 mmol/liter) to a 1 m^3 mixed flow reactor.

b) Derive performance equation for PFR. Also write down the assumptions for design of PFR.

4. Attempt any *one* part of the following: 10 x 1 = 10

a) The kinetics of the aqueous phase decomposition of A is investigated in two mixed flow reactors in series, the second unit having twice the volume of the first one. At steady state with a feed composition of 1 mol/lit and mean residence time of 96 sec in the first reactor, the concentration in the first reactor is 0.5mol /lit and in the second reactor is 0.25mol/ lit. Find the kinetic equation that represents this decomposition.

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b) Describe the differential method and integral method for analysis of data.

5. Attempt any *one* part of the following: 10 x 1 = 10

a) Derive the expression for bi molecular second order reaction.

b) For the elementary reactions in series $A \rightarrow R \rightarrow S$, $k1 = k2$, at $t = 0$, $C_A = C_{A0}$, $C_{R0} = C_{S0} = 0$, find the maximum concentration of R and when it is reached.

6. Attempt any *one* part of the following: 10 x 1 = 10

a) Show that N Plug Flow Reactors in series with a total volume V give the same conversion as a single PFR of volume V.

b) Explain in detail C, E and F curve.

7. Attempt any *one* part of the following: 10 x 1 = 10

a) The reaction between CO and NO_2 at low temperature proceeds with a rate

$-r_{NO2} = k C_{NO2}^2$

Suggest a mechanism to explain this rate law.

b) For the given reactor data, calculate the mean residence time of fluid in the vessel t, and find the exit age distribution E.

Time t, min	0	5	10	15	20	25	30	35
C_{pulse} gm/l	0	3	4	5	4	3	1	0