Ref. No.: Ex/FTBE/PC/B/T/225/2022

BFTBE 2nd Year Even Semester Examination 2022

CHEMICAL ENGINEERING KINETICS

Time: 3 hrs **Full Marks: 100**

Use a separate Answer-script for each Part

Part I (50 marks)

Answer question no. 1 and any two from the rest.

1. In a microbial laboratory, three test tubes containing microbial cultures are placed in three hot baths, maintained at different temperatures 70^0C, 80^0C and 90^0C respectively. The following values of time-temp combination with respect to the no. of microorganisms (N) have been determined from the experiment. (20)

For 70^0C		**For 80^0C**		**For 90^0C**	
Time, t (s)	No. of microorganism, N	Time, t (s)	No. of microorganisms, N	Time, t (s)	No. of microorganisms N
0	10^6	0	10^6	0	10^6
30	10^5	30	10^4	30	10^5
60	10^4	60	10^3	60	10^3
120	10^3	120	10^2	120	550
180	500	180	50	180	150
300	10	300	1	300	1

Calculate how long it will take for the reduction of microorganisms to 1 in 10000 at 82^0C.

2. Reactant A decomposes in a batch reactor, A $\longrightarrow$ Products

The composition of A in the reactor is measured at various times with results shown in the following columns 1 and 2. Find a rate equation using the integral method to represent the data. (15)

Time (t, s)	**Concentration (C_A, mol/liter)**
0	**C_{A0} = 12**
30	**10**
50	**8**
70	**6**
90	**3**
110	**2**
130	**1**

[Turn over

3. Explain the reaction rate mechanism for the enzyme-substrate reaction. (15)
4. Equate an n^{th} order rate equation using the time-concentration combination data given below. (15)

Time (t, s)	Concentration (C_A, mol/liter)
0	$C_{A0} = 10$
5	8
10	6
15	4
25	3
50	2
100	1

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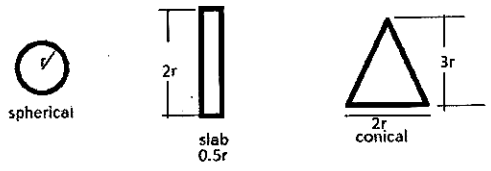
B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING SECOND YEAR SECOND SEMESTER EXAM 2022

Subject: **CHEMICAL ENGINEERING KINETICS**

Part - II (50 Marks)

Answer any four from the following questions

1. The rate of drop in concentration of a gaseous reactant A with the solid reactant B is found to be first order whereas the rate of reaction experimentally found in a stirred tank batch reactor to be of 2nd order with respect to the remaining concentration of A. Which is controlling the rate,
   a) Reaction b) Diffusion c) Both? 12.5
2. In a shrinking core model of a solid reactant B has its initial spherical diameter unchanged due to accumulation of ash while gaseous reactant A reacts. If the initial diameter of B is 1 cm and finally reaches diameter of core of 0.5 cm, what is the conversion of B? 12.5
3. From the following figures of solid particle reactant B as shown below, find where will be the maximum rate of reaction per unit surface occur during a reaction with A in gas phase?



12.5

4. A gm of solid spherical particle of specific gravity 2.5 is ground to a powder of fines of 10 angstrom particles, determine the surface area of powdered mass. 12.5
5. What will be the time required to reduce completely the slab of B as in the above figure of Q3, if the specific gravity and molecular mass of B are 1.5 and 20 respectively and the reaction is, A+B→products with r=0.2 cm? Assume ash diffusion control with De=0.08 cm^2/sec and oxygen (A) in air is taken as 21% at atmospheric pressure and 30^0c. 12.5