EX/ FTBE / T / 826 /2018

BACHELOR OF ENGINEERING IN FOOD TECHNOLOGY &

BIOCHEMICAL ENGINEERING EXAMINATION, 2018

(Third Year – Second Semester)

Chemical Engineering Kinetics

Time: Three hours Full Marks: 100

Use separate Answer Script for each Part

PART-I (50 Marks)

Different parts of the same question should be answered together.

Answer any One from (a) and (b), and also any One from (c) and (d) in this block.

1. (a) Describe with two suitable examples, the relation between rate expression and stoichiometric equation.

(b) Describe the units of rate constant. (5)

(c) Describe a reaction having two step mechanism to explain the rate for over aa order of reaction.

(d) Describe the term activation energy of a reaction using collision theory and Arrhenius theory . (10)

[Turn over

2. Answer any Two from (a), (b) ,and (c) , and also

any One from (d) and (e) in this block :

(a) Differentiate with suitable examples between constant volume and constant pressure reaction.

(b) Differentiate between homogeneous and non homogeneous reactions .

(c) Differentiate between first order and second order reaction. (5*2 =10)

(d) Differentiate between disappearance of reactant and product formation.

(e) Differentiate between catalytic and non catalytic reactions . (5*1 =5)

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3. Answer any Two from (a), (b), and (c) in this block (10 *2 = 20)

(a) Explain the rate equation for a bimolecular irreversible type second order reaction of type

A + B = Product .

(b) Explain the relationship between the concentrations of products in terms of rate constants for an irreversible reaction in parallel of type

$A \xrightarrow{k_1} R$ and $A \xrightarrow{k_2} S$.

(c) Explain the principle of designing of a plug flow reactor.

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B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING THIRD YEAR SECOND SEMESTER EXAM 2018
CHEMICAL ENGINEERING KINETICS

Time -3hr PART-II FM: 100

Group-1
Answer any one from the followings

1. Develop the overall rate expression for the following liquid solid reaction.
Dilute A is diffuse through a stagnant liquid film onto a plane surface consisting of B, reacts there to produce R which diffuses back into the mainstream. 10

2. Develop an overall rate expression for the following situation
Air bubbles through a tank of liquid which contains dispersed microbes and is taken up by the microbes to produce product material. 10

Group-II
Answer any one from the followings

3. Discuss different factors which influence the rate of Reaction of a porous catalyst particle. Deduce a rate equation for surface kinetics of a catalytic reaction. 8+12=20

4. Develop a performance equation for reactor containing porous catalytic particles For both plug plow and mixed flow reactor. 20

Group-III
Answer any one from the followings

5. How can you solve the difficulties of interpretation of experiments when more than one resistance affects the rate? Derive an expression for the instantaneous fractional yield for parallel path decomposition when strong resistance to pore diffusion is there. 12+8=20

6. A experimental rate measurement on the decomposition of A is made with a particular catalyst
a) Is it likely that film resistance to mass transfer influence the rate?
b) Could this run have been made in the regime of strong pore diffusion?
c) Would you expect to have temperature variations with in the pallet or across the gas film?
Data: for spherical particle d_p = 2.4 mm, effective mass conductivity=$5x10^{-5}$ m^3/hr.m cat, k_{eff}=1.6 kJ/hr. m cat.K
For gas film, h=160kJ/hr.m^2 cat.K, k_g=300 m^3/hr.m^2 cat
For the reaction, ΔH_r= -160 kJ/mol A, C_{Ag}=20 mol/m^3, $-r'''_{A.obs}$=10^5 mol/hr.m^3cat
Assume the reaction is first order. 20