

**C 3095**

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

Sixth Semester

Biotechnology

BT 1352 — CHEMICAL REACTION ENGINEERING

(Regulation 2004)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

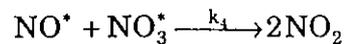
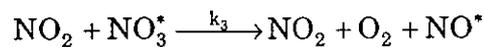
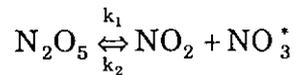
PART A — (10 × 2 = 20 marks)

1. Define rate constant of a reaction. Give the unit of reaction rate constant for zero order reaction.
2. What are the steps to be followed in the development of kinetic models for non-elementary reactions?
3. When do you go for semi-batch reactors?
4. Distinguish instantaneous fractional yield from overall fractional yield.
5. What are the characteristics of tracer material?
6. What is Peclet number?
7. What do you mean by Type – I and Type – II catalysts?
8. Write the equation for Langmuir's adsorption isotherm and explain the terms involved.
9. What is the physical significance of Hatta number?
10. Give examples for gas-liquid reactions on solid catalyst.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Explain the effect of temperature on reaction rate according to the transition-state theory. (6)

- (ii) Show that the following scheme.

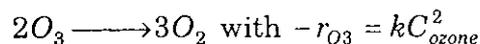


Proposed by Ogg is consistent with the observed first order decomposition of  $\text{N}_2\text{O}_5$ . (10)

Or

- (b) Develop an integrated rate expression for the third order reaction of the type  $2A + B \longrightarrow$  products. Also give examples for third order reactions. (16)

12. (a) One liter per second of a 20% ozone and 80% air mixture at 1.5 atm. Pressure and temperature of  $93^\circ\text{C}$  passes through a plug flow reactor. Under these conditions, the ozone decomposes as the reaction.



Where  $k = 0.05 \text{ l/mol.s}$ .

Find the size of reactor required for 50% decomposition of ozone. (16)

Or

- (b) For the irreversible series reaction  $A \xrightarrow{k_1} R \xrightarrow{k_2} S$  derive an expression for the maximum concentration of the intermediate product  $R$ . (16)

13. (a) A first order liquid phase reaction is carried out in a reactor for which the results of (pulse) tracer test are given below.

t, s	0	1	2	3	4	5	6	7	8	9	10	12	14
C, mg/l	0	1	5	8	10	8	6	4	3	2.2	1.5	0.6	0

Calculate conversion using (i) ideal plug flow reactor, (ii) ideal mixed flow reactor and (iii) the tanks in-series-model. Reaction rate constant =  $0.25 \text{ min}^{-1}$ . (16)

Or

- (b) A sample of the tracer hytane was injected as a pulse to a reactor and the effluent concentration measured as a function of time, resulting in the following data :

t, s	0	1	2	3	4	5	6	7	8	9	10	12	14
C, mg/l	0	1	5	8	10	8	6	4	3	2.2	1.5	0.6	0

Construct C and E curves and determine the fraction of material leaving the reactor that has spent between 3 and 6 min. in the vessel and the fraction of material leaving that has spent between 7.75 and 8.25 min. in the reactor. (16)

14. (a) Derive the equation of find out conversion when ash layer and chemical reaction controls the rate of reaction. (16)

Or

- (b) Two small samples of solids are introduced into a constant environment oven and kept there for one hour. Under these conditions 4 mm particles are 58% converted, the 2 mm particles are 87.5% converted. Find the rate controlling mechanism for the conversion of solids and also find time needed for complete conversion of 1 mm particles in this oven.

15. (a) Derive the design equation for fixed bed reactor (catalytic). (16)

Or

- (b) (i) Explain the operation of fluidized bed reactor.  
(ii) Derive the design equation of fluidized bed reactor based on two-phase fluidized bed model. (16)