



KUMARAGURU
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Register Number:.....

B.TECH DEGREE EXAMINATIONS: NOV / DEC 2014

(Regulation 2009)

Sixth Semester

BIOTECHNOLOGY

BTY120: Chemical Reaction Engineering

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. The minimum amount of energy which the colloidal molecules must have in order to bring about the reaction is known as
 - a) activation energy
 - b) potential energy
 - c) kinetic energy
 - d) chemical potential
2. A reaction in which the formation of product from the original reactants occur through a series of steps are called
 - a) elementary reaction
 - b) non-elementary reaction
 - c) unimolecular reaction
 - d) identical reaction
3. One reactant is charged initially and the other reactant is added continuously to the reactor over a certain time period against agitation in
 - a) batch reactor
 - b) CSTR
 - c) CSTR in series
 - d) semi batch reactor
4. The ratio of volume of the reactor and volumetric flow rate of the feed entering the reactor is called
 - a) space time
 - b) space velocity
 - c) steady state time
 - d) steady state velocity
5. In RTD studies, the known quantity of tracer is suddenly injected in one shot into the fluid entering the vessel in a very short time period is

20. Define Hatta number.

PART C (5 x 14 = 70 Marks)

21. a) For a gas reaction at 400K, the rate is reported as $\frac{-dp_A}{dt} = 3.66 p_A^2$, atm/h

- (i) What are the units of rate constant?
- (ii) What is the value of the rate constant for this reaction if the rate equation is written as

I. $-r_A = \frac{-1}{V} \frac{dN_A}{dt} = kC_A^2$, mol/(l.h)

II. $-r_A = kC_A^2$, mol/(m³.h)

(OR)

b) The irreversible reaction; $A + B \rightarrow AB$ has been studied kinetically, and the rate of formation of product has been found to be well correlated by the following rate equation:

$$-r_{AB} = kC_A^2 \dots \dots \dots \text{independent of } C_B$$

What reaction mechanism is suggested by this rate expression if the chemistry of the reaction suggests that the intermediate consists of an association of reactant molecules and that a chain reaction does not occur?

22. a) Derive the design equation for ideal mixed flow and batch reactor.

(OR)

b) For a liquid phase reaction with the stoichiometry $A \rightarrow R$, determine the size of PFR required to achieve 80% conversion of a fed stream of 1000 mol A/h at $C_{A0} = 1.5$ mol/l. the rate vs concentration data are as given below:

C_A , mol/l	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.3	2.0
$-r_A$ $\frac{mol}{(l.min)}$	0.1	0.3	0.5	0.6	0.5	0.2 5	0.1	0.0 6	0.0 5	0.04 5	0.04 2

23. a) Evaluate E as a function of time up to $t = 180\text{s}$ for a vessel using the tanks in series model.

Given: C_{in} with $(\bar{t}) = 220\text{s}$ and $\sigma^2 = 100\text{s}^2$

C_{out} with $(\bar{t}) = 280\text{s}$ and $\sigma^2 = 1000\text{s}^2$

(OR)

- b) The data given below represent a continuous response to a pulse input into a closed vessel which is to be used as a chemical reactor. Calculate the mean residence time of fluid in the vessel (\bar{t}) , and tabulate and construct the E curve.

t, min	0	5	10	15	20	25	30	35
C_{pulse} , g/l (tracer output Conc.)	0	3	5	5	4	2	1	0

24. a) Discuss in detail about progressive conversion model and shrinking core model in a fluid particle reactions.

(OR)

- b) With a neat sketch, discuss various contacting patterns in contactors for carrying out fluid-fluid reactions.

25. a) A first order reaction $A \rightarrow B$ takes place on a catalyst particle under isothermal condition. For a single cylindrical pore of length L and Diameter 'D' in the catalyst pellet, derive the mathematical equation for the calculation of reactant conversion ' C_A ' along the pore length. Calculate the effectiveness factor.

(OR)

- b) Write a short note on the reaction mechanism carried in the following
- (i) Trickle bed reactor
 - (ii) Slurry reactor
