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B.TECH DEGREE EXAMINATIONS: APRIL 2011

Sixth Semester

BIOTECHNOLOGY

U07BT601: Chemical Reaction Engineering

Time: Three Hours **Maximum Marks: 100**

Answer ALL Questions:

PART A (10 x 1 = 10 Marks)

1. The rate of reaction of any component is a function of

   a) Temperature of the system only b) Pressure of the system only

   c) Composition of the component only d) Temperature, pressure and composition

2. The dimensions of the rate constant for n^{th} order homogeneous reaction are

   a) Time $^{-n}$ b) Time $^{-1}$ Concentration $^{1-n}$ c) Time $^{-n}$ Concentration $^{n-1}$ d) Time Concentration $^{n-1}$

3. For constant density systems, the performance equation are identical for

   a) Batch reactor and plug flow reactor

   b) Batch reactor and back mix reactor

   c) Plug flow reactor and back mix reactor

   d) Batch reactor, plug flow reactor and back mix reactor.

4. Which of the following are example of autocatalytic reaction

   a) Enzyme fermentation reactions b) Microbial fermentation reactions

   c) Photochemical reactions d) Synthesis of ammonia

5. The exit age distribution of fluid leaving a vessel is used

   a) To study the reaction mechanism b) To study the extent of non ideal flow in the vessel

   c) To know the reaction rate constants d) To know the activation energies of a reaction

6. The dimensionless (D/uL) is called the vessel dispersion number. For plug flow

   a) D/ uL = ∞ b) D/ uL =0 c) D/ uL =2100 d) D/ uL =400

7. If a solid gas non catalytic reaction occurs at very high temperature, the rate controlling step is

   a) Film diffusion b) Chemical reaction c) Ash layer diffusion d) Pore diffusion

8. During the course of a chemical reaction, the rate of a reaction

   a) Increases as the reaction proceeds b) Decreases as the reaction proceeds

   c) Cannot be predicted d) Remains constant throughtout the reaction

9. For a solid catalyzed first order reaction A→ P, the pore diffusion offers negligible resistance to reaction if the Thiele modulus of the reaction is

a) Greater than 5 b) Greater than 1 c) Greater than 10 d) Greater than 0.5

10. When high volume fractions of biomass particles are preferred, the reactor used is

a) Plug flow reactor b) Trickle bed reactor

c) Fluidized bed reactor d) Continuous flow stirred tank reactor

PART B (10 x 2 = 20 Marks)

11. What are the types of multiple reactions? Give examples.
12. At 500 K the bimolecular reaction is ten times the rate at 400 K. Find the activation energy of this reaction using Arrhenius law.
13. Write the application of flow reactors.
14. Define recycle ratio.
15. What are conditions for non-ideal behavior of a reactor?
16. What are the kinds of tracer input imposed on the fluid steam for RTD analysis?
17. What are the various type of heterogeneous reactions.
18. What are the various controlling regimes in a catalytic reaction?
19. Name few models for fluidized bed reactors.
20. What is Thiele modulus?

PART C (5 x 14 = 70 Marks)

21. (a) Write the common procedure for

(i) Integral analysis of batch reactor data. (7)

(ii) Differential method of analysis of batch reactor data. (7)

(OR)

(b) For the reaction in series A $\xrightarrow{k1}$ R $\xrightarrow{k2}$ S, k1=k2 find the maximum concentration of R and when it is reached.

22. (a) Derive the performance equation for the recycle reactor in terms of conversion and concentration. Using the relation find expressions for optimum recycle ratio for an auto catalytic reaction

(OR)

(b) A high molecular weight hydrocarbon gas A is fed continuously to a heated high temperature mixed flow reactor where it thermally cracks(homogeneous gas reaction) into lower molecular weight materials, collectively called R, by a stoichiometry approximated by A→5R. By changing the feed rate different extents of cracking are obtained as follows:

$F_{A0,}$ millimol/hr	300	1000	3000	5000
$C_{A,out}$, millimol/liter	16	30	50	60

The internal void volume of the reactor is V=0.1 liter, and at the temperature of the reactor the feed concentration is C_{AO} = 100 millimol/liter. Find a rate equation to represent the cracking reaction.

23. (a) Discuss in detail

(i) Dispersion model (7)

(ii) Tanks in series model. (7)

(OR)

(b) Form a pulse input into a vessel we obtain the following output signal.

Time, min	1	3	5	7	9	11	13	15
Concentration (arbitrary)	0	0	10	10	10	10	0	0

We want to represent the flow through the vessel with the tanks-in-series model. Determine the number of tanks to use.

24. (a) Explain in detail about the Progressive conversion model and shrinking core model.

(OR)

(b) Summarize in detail about the gas solid and gas liquid reactions.

25. (a) Explain in detail about the trickle bed reactors with neat diagram.

(OR)

(b) Summarize in detail about reactors for fluid- fluid reactions.

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