Register Number: ………………..

B.TECH DEGREE EXAMINATIONS: MAY 2015

(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. A substance that does not take part in reaction is called _____.

    a) Catalyst   b) Inhibitor

    c) Promoter   d) Reactant

2. A reaction with stoichiometric equation ½ A + B → R + ½ S has the following rate expression $-r_A = k\, C_A^{0.5}C_B$. The rate expression for this reaction if the stoichiometric equation is written as A + 2B → 2R + S is _____.

    a) $-r_A = k^1\, C_A C_B^2$ b) $-r_A = k^{111}C_A C_B^{0.5}$

    c) $-r_A = k^{11}\, C_A^5 C_B$ d) $-r_A = k\, C_A^{0.5}C_B$

3. Industrially, _____ is used when relatively small amounts of material are to be treated.

    a) Mixed Flow reactor   b) Batch reactor

    c) Plug Flow reactor   d) Recycle reactor

4. Recycle ratio for mixed flow reactor is _____.

    a) Zero   b) Two

    c) One   d) ∞

5. The vessel dispersion number for plug flow is _____.

    a) 0   b) 1

    c) 3   d) ∞

6. Higher free energy of activation of a chemical reaction (at a given temperature) implies _____.

    a) Slower rate of reaction   b) Higher equilibrium conversion

    c) Higher rate of reaction   d) Both (b) and (c)

7. Conversion is high in _____ reactor when compared with bubble fixed bed reactor.

    a) Trickle bed   b) Air lift

    c) Slurry   d) Fluidized bed

8. Coal liquefaction involves _____ phase(s).

    a) 1   b) 2

    c) 3   d) 0

9. Hydrolysis of starch in the presence of α - amylase is _____ reaction.

    a) Liquid-Solid   b) Liquid-Gas

    c) Solid-Gas   d) None of the above

10. According to basic principles of chemical engineering, _____ is defined as ratio between driving force and resistance.

    a) Rate   b) Heat

    c) Mass   d) Momentum

PART B (10 x 2 = 20 Marks)

11. What are the variables affecting rate of heterogeneous reactions?

12. Milk is pasteurized if it is heated to 63°C for 30 min, but if it is heated to 74°C it only needs 15 s for the same result. Find the activation energy of this pasteurization process.

13. After 8 minutes in a batch reactor, reactant (C_{AO} = 1 mol/l) is 80% converted; after 18 minutes, conversion is 90%. Find a rate order.

14. List the similarities and differences between mixed and plug flow reactors.

15. What are the characteristics of tracer material?

16. List out the different methods of injection to study the RTD characteristics.

17. Mention the advantages of slurry reactors over fixed beds.

18. Give a brief account on parallel and counter flow of contacting reactant streams.

19. What are the advantages of PCM over SCM?

20. Write short notes on trickle bed reactor.

PART C (5 x 14 = 70 Marks)

21. a) Derive an expression to calculate concentrations of A, B and C for a series reaction A → B → C. The rate constants of two reactions are different but reaction order remains same.

(OR)

b) (i) Aqueous A reacts to form R (A → R) and in the first minute in a batch reactor (7) its concentration drops from 2.03 mol/l to 1.97 mol/l. Find the rate equation for the reaction if the kinetics are second order with respect to A.

(ii) Derive performance equation for Recycle reactor. (7)

22. a) The following data are obtained at 0°C in a constant-volume batch reactor using pure gaseous A:

Time, min	:	0	2	4	6	8	10	12
Partial pressure of A , mm Hg	:	760	600	175	390	320	275	240

The stoichiometry of the decomposition is A → 2.5 R. Find a rate equation which satisfactorily represents this decomposition.

(OR)

b) Pure gaseous reactant A (C_{Ao} = 100 millimol/l) is fed at a steady rate into a mixed flow reactor (V = 0.1 liter) where it dimerizes (2A → R). For different gas feed rates the following data are obtained:

v_o, l/h	:	10.0	3.0	1.2	0.5
C_A, millimol/l	:	85.7	66.7	50.0	33.4

Find a rate equation for this reaction.

23. a) Show that there is no difference in RTD between CSTR + PFR and PFR + CSTR.

(OR)

b) Briefly discuss about tank in series model for non-ideal reactors.

24. a) Describe the operation of a slurry reactor and its applications.

(OR)

b) Explain about the applications of Gas – Liquid – Solid reactions.

25. a) Elaborate in detail about rate determining steps in heterogeneous reactions.

(OR)

b) Summrize on the resistances involved in heterogeneous reactions.

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