B.TECH DEGREE EXAMINATIONS: MAY/JUNE 2013

Sixth Semester

BIOTECHNOLOGY

BTY118 : Bioprocess Engineering

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

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. F-curve is drawn for

    a) Step input   b) Pulse input

    c) Both step and pulse input   d) Only pulse input

2. ---------------described the RTD studies for chemical reactions in chemical reactors suffering from non-ideality.

    a) Nauman   b) Levenspiel

    c) Langmuir   d) Damkohler

3. Polarographic electrode is used to measure the oxygen concentration in

    a) Dynamic gassing out technique   b) Direct measurement

    c) Sodium sulphite oxidation   d) Dynamic method

4. At which temperature the solubility of O_2 drops significantly

    a) Below 10 ℃   b) Between 10 ℃ and 40 ℃

    c) Above 10 ℃   d) Not affected

5. Which of the following models are the most realistic models?

    a) Segregation and structured   b) Unsegregation and unstructured

    c) Non-segregation and structured   d) Unsegregation and structured

6.   Packed cell volume is used to measure the

    a) Cell size in a broth   b) Cell density in a broth

    c) Cell volume in a broth   d) Cell concentration in a broth

7. The specific growth rate of plasmid free cells and plasmid containing cell are 1.4 h^{-1} and 1.2 h^{-1} respectively. The no. of generation is ------after 20 h growth if the inoculum contains only cells with plasmid

    a) 40.39   b) 20.15

    c) 10.45   d) 15.26

8. Assuming all the cells having 40 plasmid at random distribution during division, to generate the plasmid free cells, then the probablity of forming a plasmid-free is

a) 1.8×10^{12} plasmid free cells per division

b) 1.8×10^{-12} plasmid free cells per division

c) 18×10^{-12} plasmid free cells per division

d) 18×10^{12} plasmid free cells per division

9. Which equation has a saturation constant proportional to cell concentration?

a) Blackmann equation

b) Tessier equation

c) Moser equation

d) Contois equation

10. During balance growth, the net specific growth rate is determined by

a) Cell number

b) Cell mass would be the same

c) Both (a) and (b)

d) Optical density of the broth

PART B (10 x 2 = 20 Marks)

11. Mention the two models used to predict the behavior of non-ideal characteristics of bioreactors

12. Draw the diagram of velocity distributions for flow in pipes

13. List any three factors affecting cellular oxygen demand.

14. Justify whether constant $K_L a$ concept is a better approach for scale up.

15. List the use of microbial calorimetric method.

16. What are the parameters responsible for dispersion in FIA?

17. Why the plasmid free cells have high specific growth rate compared to plasmid containing cells?

18. List the two limitation of Saccharomyces cerevisiae as used host vector system.

19. Mention the difference between structured models and unstructured models with examples.

20. What is metabolic engineering?

PART C (5 x 14 = 70 Marks)

21. a) Describe how the ills of a flow bioreactor can be diagnosed using tracer studies. Substantiate your answer with neat diagram

(OR)

b) Describe how do you estimate the conversion in a bioreactor with non-ideal flow behavior using dispersion and tank-in-series model. Also give the assumption for each model.

22. a) A value of $K_La=30h^{-1}$ has been determined for a fermenter at its maximum practical agitator rotational speed and with air being sparged at 0.51 gas/l reactor volume-min. *E.coli* with a qO_2 of 10 mmol O_2/g-dry wt-h are to be cultured. The critical dissolved oxygen concentration is 0.2 mg/l. The solubility of oxygen from air in the fermentation broth is 7.3 mg/l at 30°C.

    a) What maximum concentration of *E.coli* can be sustained in this fermenter under aerobic conditions?

    b) What concentration could be maintained if pure oxygen was used to sparge the reactor?

(OR)

b) *E.coli* have a maximum respiration rate, qO_{2max}, of about 120-mg O_2 /g-dry wt-h. It is desired to achieve a cell mass of 12.20g dry wt/l. The K_La is 240 h^{-1} in a 1000-1 reactor (800 l working volume). A gas stream enriched in oxygen is used (i.e., 80% O_2) which gives a value of $C^* = 28$ mg/L. If oxygen becomes limiting, growth and respiration slow; for example,

$$qO_2 = \frac{qO_{2\ max}\ C_L}{0.2\ \frac{mg}{L}+C_L}$$

where C_L is the dissolved oxygen concentration in the fermenter. What is C_L when the cell mass is at 20g/l?

23. a) With an example, explain in detail about Flow in Injection analysis (FIA)

(OR)

b) With an example, explain in detail about microbial calorimetry with its applications.

24. a) With a neat diagram, discuss in detail about the various host - vector systems available in r-DNA technology

(OR)

b) Assume you scale up from 1 L of 1×10^{10} cells/ml of 100% plasmid-containing cells to 9,000 L of 5×10^9 cells/ml, at which point over production of the target protein is induced. You harvest five hours after induction. The value of P is 0.0005. Before induction $\mu_+ = 0.75$ h^{-1} and $\mu_- = 0.90$ h^{-1}. After induction μ_+ is 0.12 h^{-1}. What is the fraction of plasmid-containing cells at induction? What is the fraction of plasmid-containing cells at harvest?

25. a) What are the various postulates for the compartment model and derive an expression to determine the rate of cell mass formation.

(OR)

b) Discuss in detail about the various structured models available in bioprocess system.

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