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T 3109

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2008.

Sixth Semester

Biotechnology

BT 1353 — BIOPROCESS ENGINEERING

(Regulation 2004)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Give a method to experimentally determine the Residence Time distribution of a CSTR?
2. What are the advantages of two chemostats in series?
3. What is role of draft tube in an airlift reactor?
4. What are the main assumptions in the dispersion model?
5. Calculate the oxygen transport rate required to maintain 5 g/L of microbial cells if the specific oxygen uptake rate is 5 mmol/L-g-h?
6. Explain why simple geometric scale-up is not a satisfactory approach?
7. Explain the meaning of unsegregated model and a structured model?
8. Give at least 3 factors which affects plasmid stability.
9. What is the significance of Damkohler number in design of enzyme reactors?
10. What is the advantages of membrane bioreactors over other reactors?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Explain Dynamic gassing method of K_{La} determination. (8)

(ii) Calculate the volumetric mass transfer coefficient (K_{La}) for a stirred tank reactor containing 8 g/L of cells (specific oxygen uptake rate = 10 mmol/L-g-h). Data from the dynamic gassing out method is given. The saturation dissolved oxygen concentration (DO) is assumed to be 8 ppm

Time (sec)	0	2	5	7	8	9	11	13	15
DO (ppm)	3.3	1.3	0	0.3	1.0	1.6	2.4	2.9	3.1

Or

(b) Explain the resistances involved in transport of oxygen from a bubble to the biochemical reaction site. Explain clearly the assumptions made and explain the importance of oxygen mass transfer determination for aerobic fermentations with suitable examples?

12. (a) With help of neat sketches explain the parts of various impeller-less bioreactors with application areas for each?

Or

(b) With help of a neat labeled sketch explain the important parts of stirred tank reactor with radial impellers? Briefly compare radial flow impellers with axial flow impellers?

13. (a) Give a neat labeled sketch of a continuous sterilizer design and explain the advantages and disadvantages of HTST compared to Batch sterilization? Also explain why plug flow is desired in continuous sterilizers?

Or

(b) For production of a secondary metabolite, two stirred tank reactors (volume of each = 100 L) are to be connected in series. The feed flow rate is kept at 2 L/hr and contains 1% w/v of the substrate. Growth of the cells occurs only in the first reactor with a yield factor (Y_{xs}) of 0.5 at Steady state. In the second reactor, growth is negligible and specific product formation rate is 0.25 h^{-1} . Calculate the following for this system (i) dilution rate (ii) biomass concentration in the reactors (iii) biomass and product Productivity for 24 hours (iv) residual substrate (if any).

14. (a) Explain the various factors which affect the performance of immobilized enzyme systems? Explain the relationship between Damkohler number, effectiveness factor and Thiele modulus in such systems?

Or

- (b) Immobilized lactase in resin particles is packed into a 0.5 m^3 column. The effectiveness factor the system is close to unity, $K_m = 1.32 \text{ kg/m}^3$ and $V_{max} = 45 \text{ kg/m}^3\text{h}$. The lactose concentration in the feed stream 9.5 kg/m^3 and a substrate conversion of 99% is required. The column is operated as a plug flow for 320 days per year. Calculate the flow rate required, tones of lactose consumed and tones of glucose produced per year?

15. (a) Explain structure model of Williams compartment model and its advantages.

Or

- (b) Write in detail about cybernetic modelling with an example.
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