Reg. No. : | | | | | | | | | | | |

# J 3095

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2009.

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. Define Peclet number.

2. What is meant by exit age distribution in a non ideal flow bioreactor?

3. List the different methods of controlling fermenter process conditions.

4. Give the reasons for genetic instability.

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

6. What is critical oxygen concentration?

7. Define single cell model.

8. What type reactor will be preferred for cultivating plant cells?

9. What is effectiveness factor?

10. Define Thiele modulus.

PART B — ($5 \times 16 = 80$ marks)

11. (a) A first order reaction $A \xrightarrow{K_1} B$ was carried out in a tubular reactor (Length 6.4 m and diameter 0.1 m) for which $K_1 = 0.25 min^{-1}$. The results of the tracer test are given below. Tracer output data.

| T (min) : | 0 | 2 | 4 | 6 | 8 | 10 | 12 | 14 |
|---|---|---|---|---|---|---|---|---|
| C (mg / 1) : | 0 | 5 | 10 | 6 | 3 | 1.5 | 0.6 | 0 |

Calculate the conversions by

(i) Dispersion model (8)

(ii) Tanks in series model and compressed with a PFR or CSTR. (8)

Or

(b) (i) Derive the design equation for holding section in a continuous sterilization. (10)

(ii) Describe the continuous sterilization by plate type heat exchanger. (6)

12. (a) Explain the design consideration and operation of packed bed and bubble column reactors. (16)

Or

(b) (i) List out the steps involved in the transfer of oxygen from the air bubble to the cells in fermentation broth. (10)

(ii) Explain the various mass transfer resistances involved in oxygen transfer from gas bubble to the microorganisms. (6)

13. (a) (i) Derive an expression for power requirement in an aerated bioreactor. (8)

(ii) A 50 L stirred fermenter is used to culture *Torula utilis* at 28°C. The dissolved oxygen concentration was measured after initially shutting off the oxygen supply and then restarting, for calculating $K_La$ using dynamic gassing out method.

The steady state oxygen concentration is 7.05ppm. (8)

| Time (S) : | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 37 |
|---|---|---|---|---|---|---|---|---|
| DO Conc. (ppm) : | 0.5 | 2.5 | 3.7 | 4.4 | 5.1 | 5.5 | 6.0 | 6.3 |

Or

(b) Discuss in detail about various methods for determination of mass transfer coefficients. Compare its advantages and disadvantages. (12 + 4)

14. (a) What are the various postulates of a two compartment model and derive an expression to determine the rate of cell mass formation? (16)

Or

(b) (i) Describe the design considerations to be taken in to account during the bio processing of animal cell culture. (8)

(ii) What is meant by plasmid stability and explain it with reference to recombinant cell cultures? (8)

15. (a) (i) Explain in detail the estimation of diffusion and intrinsic kinetic parameters for an immobilized enzyme reaction. (12)

(ii) List out the advantages of enzyme immobilized system over immobilized enzyme reaction. (4)

Or

(b) (i) Derive the effectiveness factor for a flat biofilm as a function of $\beta$, the dimensionless initial substrate concentration and $\Phi$ the thiele modulus. (12)

(ii) Write a note on membrane reactors. (4)

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