Reg. No. :

Question Paper Code : Q 2092

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 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. What is a non ideal reactor?

2. Define axial dispersion coefficient.

3. What is meant by gas hold — up?

4. Distinguish between a bubble column reactor and fluidized bed reactor.

5. What should be the value of impeller Reynolds number for turbulent regime in a bioreactor?

6. What is critical oxygen concentration?

7. What is a single cell model?

8. What is meant by modeling and simulation?

9. What is Thiele modulus?

10. What is effectiveness factor?

PART B — (5 × 16 = 80 marks)

11. (a) (i) What are the problems that have to be solved during scale down operation of bioreactor design? Explain. (8)

(ii) Discuss the features of continuous sterilizing equipments in detail. (8)

Or

(b) Derive the design equation for continuous sterilization process. (16)

12. (a) Derive an expression for determining the rate of product formation with respect to substrate and product concentration in a plug flow packed bed reactor. (16)

Or

(b) (i) Discuss the design and operation of air – lift reactor. (8)

(ii) Write briefly about the factors which influence mass transfer in bubble column reactors. (8)

13. (a) (i) Estimate the mass transfer coefficient for the oxygen dissolution in water 25°C in a mixing vessel equipped with flat – blade disk turbine and sparger by using Calderbank and Moo-Youngs correlations. (8)

(ii) Discuss the various types of resistances occur in the transfer of oxygen from gas bubble to cell. (8)

Or

(b) (i) To measure kLa, a fermenter was filled with 10 L of 0.5 M sodium sulfite solution containing 0.003 M Cu^{++} ion and the air sparger was turned on. After exactly 10 minutes, the air flow was stopped and a 10 ml sample was taken and titrated. The concentration of the sodium sulfite in the sample was found to be 0.21 mol/L. The experiment was carried out at 25°C and 1 atm. Calculate the oxygen uptake and kLa. (8)

(ii) Discuss in detail the various methods for determination of mass transfer coefficients. (8)

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

Or

(b) In a fed – batch culture operating with intermittent addition of glucose solution, values of the following parameters are given at time $t = 2\ h$, when the system is at quasi steady state.

$V = 1000$ ml $F = 0.5$ V/V/h = 250 ml/h $S_0 = 100$ g glucose/L

$\mu_m = 0.5\ h^{-1}$ Ks = 0.1 g glucose/L $Y^M{}_{X/S} = 0.5$ gdw cells/g glucose

$X_0' = 30$ g

(i) Find Vo (the initial volume of the culture)

(ii) Determine the concentration of growth – limiting substrate in the vessel at Quasi – steady state.

(iii) Determine the concentration and total amount of biomass in the vessel at t = 2h (at Quasi – steady state).

(iv) If $q_p = 0.2$ g product/g cells, $P_0 = 0$, determine the concentration of product in the vessel at $t = 2h$. (16)

15. (a) Explain in detail the estimation of diffusion and intrinsic kinetic parameters for an immobilized enzyme reactions. (16)

Or

(b) Derive the expression for the effectiveness factor for the enzymes immobilized in porous matrix. (16)