Roll No. | | | | | | | | | | |

M. Tech. (Biotechnology)

SECOND SEMESTER EXAMINATION, 2009-10

FERMENTATION TECHNOLOGY

Time : 3 Hours Total Marks : 100

Note : (i) Attempt any Five questions.
(ii) Marks are indicated against each question.
(iii) Use of calculator is permitted.
(iv) Refer to η Vs ϕ and Φ Plots.

1. (a) Derive an expression for continuous fermentor when production is directly linked with energy metabolism. 10

(b) A strain of Escherichia coli has been genetically engineered to produce human protein. A batch culture is started by inoculating 12g cells into a 100 litre bubble column fermenter containing 10g/l glucose. The maximum specific growth rate of the culture is $0.9h^{-1}$; the biomass yield from glucose is $0.575gg^{-1}$. 10

(i) Estimate the time required to reach stationary phase.

(ii) What will be final cell density if the fermental ion is stopped after only 70% of the substrete is consumed?

2. (a) Derive the substrate concentration profile in a spherical bead for first and zero order kinetics. 10

(b) Baby hamster kidney cells are immobilised in alginate beads. The average particle diameter is 5mm. Rate of oxygen consumption at bulk concentration of 8×10^{-3} Kg O_2 m^{-3} is 8.4×10^{-5} Kg s^{-1} m^{-3} catalyst. The effective diffusivity of oxygen in the beads is 1.88×10^{-9} m^2 s^{-1}. Assume that the oxygen concentration at the surface of the catalyst is equal to the bulk concentration, and that

oxygen uptake follows zero order kinetic : 10

(i) Are internal mass transfer effects significant?

(ii) What reaction rate would be observed if diffusional resistance were eliminated?

3. (a) Discuss the kinetics of batch culture for substrate utilization, product formation and biomass generation. 10

(b) In a fed batch culture operating with intermittent addition of glucose solution, values of the following parameters are given at time t = 2h, when the system is at quasi steady state, v = 1000ml, (Flow rate) F = 200 ml/h, S_o = 100g glucose/l, μ_m = 0.3 h^{-1}, K_s = 0.1g glucose/l, $Y_{X/S}$ = 0.5 gg^{-1} cells/g glucose, X_0 = 30g.

(i) Find V_0 (the initial volume of the culture).

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

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

4. (a) What do you understand by solid state fermentation? Discuss the factors which affect solid state fermentation. 10

(b) A solution polymerization is to be carried out to 95% conversion in a series of stirred tank reactors, all operating at the same temperature. Batch tests show that the reaction is first order to monomer, and 95% conversion is reached in 6 hours. 10

(i) If four reactors of equal size are used, what total residence time is needed?

(ii) What fraction of the total heat released is generated in each vessel?

5. (a) Comment on medium formulation. Discuss the major component of fermentation media. 10

(b) Discuss the industrial production of ethanol. Comment on the factors which affect the production of ethanol. 10

6. (a) What do you mean by scale up? Discuss the physical or biological parameters of scale up in detail. 10

(b) Let us have a bubble column with an H/D ratio of 3, diameter 0.5m and a gas flow rate of 0.1 $m^3 h^{-1}$, which gives a superficial gas velocity of 0.25m s^{-1}. What would be the liquid media flow rate? 10

OR

Explain the principle and working of commonly used sensors in bioprosessing industry. 20

7. Write short notes on any Four : 20

(a) Biosensors

(b) L-Lysine production

(c) Rules of thumb for scale up

(d) Fed batch culture

(e) Effectiveness factor (internal and external)

(f) On line controllers

(g) Scale down