No. of Printed Pages – 4

MTBT-201

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

M. Tech. (Biotechnology)

SECOND SEMESTER EXAMINATION, 2010-11

FERMENTATION TECHNOLOGY

Time : **3 Hours** Total Marks : **100**

Note : **(i)** Attempt any **Five** questions.
(ii) Marks are indicated against each question.

1. **(a)** What do you understand by scale-up, discuss some of the common problems associated with scaling-up? **10**

(b) Write short notes on the following: **10**

(i) Thiele Modulus Vs Weisz's Modulus

(ii) Total effectiveness factor.

2. **(a)** Determine the relationship explaining the concentration profile of substrate concentration within a spherical pellet assuming first order and zero order kinetics? **10**

(b) An enzyme is immobilized in spherical pellets of average diameter 2.5mm. Density of enzyme inside the pellet is 0.035kg m^{-3} .25 cm^{-3} beads are packed into a small column reactor; 100ml sucrose solution of concentration 25mM is pumped rapidly through the bed. In another reactor an identical quantity of free enzyme is mixed into the same volume of sucrose solution of equal concentration. Assuming that the kinetic parameters for free and immobilized enzymes are equal i.e. K_m=6mM turnover number=$3x10^{-3}$ gmol sucrose (g enzyme)$^{-1}s^{-1}$. D_{Ae}=$1.5x10^{-6}cm^2s^{-1}$.

(i) What is the rate of reaction by free enzyme?

(ii) What is the rate of reaction by Immobilized enzyme?

Use the following relationship to calculate effectiveness factor $\eta_{im} = (\varphi_0 + \beta\varphi_1)/1 + \beta$. **10**

3. (a) Discuss the significance of role of various media components, explain placket-burman design for screening of critical media components? **10**

(b) Explain any **Two** of the following: **5 x 2 = 10**

(i) Scale up window

(ii) Plug flow reactors

(iii) CSTR's

4. Attempt any **Two** of the following: **10 x 2 = 20**

(a) Explain the following:

(i) Air-lift reactors

(ii) Difference between turbidostat and chemostat

(iii) Scale down

(b) Explain the advantages and disadvantages of solid state fermentation. Also discuss the types of fermenters used for solid state fermentation.

(c) Explain the following with reference to a Continuous Stirred Tank Reactor:

(i) $D_{critical}$ and D_{opt}.

(ii) Biomass generation

(iii) Product formation

5. (a) Plant cells are cultured to high density for the production of gum.

The reactor used is a stirred tank, containing initially 75 L of medium. The maximum specific growth rate of the culture is 0.16 d^{-1} and the yield of biomass from substrate is 0.45g/g. The concentration of growth limiting substrate in the medium is 5%. The reactor is inoculated with 1.5g/l cells and operated in batch until the substrate is virtually exhausted; medium flow is then started at a rate of 41 d^{-1}. Fed-batch operation occurs under quasi-steady-state conditions. **10**

(i) Estimate the batch culture time and final biomass concentration.

(ii) Fed-batch operation is carried out for 50 days. What is the final mass of cells in the reactor?

(iii) How much plant cell biomass is produced annually if the fermenter is available for only 270 days per year with a downtime of 24 hours?

(b) A bacteria producing human protein is cultured in batch mode by inoculating 10g cells into a 100L medium containing 10g/l glucose. The maximum specific growth rate of the culture is 0.8 h^{-1} and the yield of biomass from glucose is 0.57g/g. **10**

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

(ii) What will be the final cell density if the fermentation is stopped after only 75% of the substrate is consumed?

6. (a) Explain the response time profile of the following controllers: **10**

(i) Two-Position (ON/OFF) controllers

(ii) Proportional controllers

(iii) Integral controllers

(iv) Derivative controllers

(v) PID controllers

(b) What is quasi-steady state in the case of Fed-batch operation? Determine the behaviour of Fed batch reactor with respect to biomass, substrate and product concentrations at quasi-steady state? **10**

7. Discuss in detail about raw materials, fermentation method and downstream processing applied in the industrial production of any **Two** of the following: **20**

(a) Acetic Acid

(b) Ethanol

(c) Pencillin

(d) Lysine