Qualification examination on Biochemical Engineering

Department of Chemical Engineering

National Taiwan University of Science and Technology

Spring 2006

1. (10%) The specific growth rate of a biological population is 0.1 h^{-1}. What is the doubling time of this population? How long would it take to reach 24 times its original population size?

2. (30%) (a) Define and describe the mechanism of competitive inhibition in Enzyme kinetics. (b) Derive its kinetics equation. (c) Show both its representative Michaelis-Menton and Lineweaver-Burk plots.

3. (30%) Suppose you have a microorganism whose growth obeys the Monod equation with $\mu_{max} = 0.7\ h^{-1}$ and $K_S = 5$ g/L. The cell yield ($Y_{X/S}$) is 0.65. You plan to cultivate it in either one fermentor or two in series. The flow rate and the substrate concentration of the inlet stream are set at 500 L/h and 85 g/L, respectively, and the substrate concentration of the outlet stream is 5 g/L.
   (a) If you use only one CSTF for cultivation, what should be the size of the fermentor? What is the cell concentration of the outlet stream?
   (b) If you use two CSTFs in series, what sizes of the two fermentors will be most productive? What are the concentration of cells and substrate in the outlet stream of the first fermentor?

4. (15%) What is the function role of IPTG in regulating the expression of a recombinant protein? Briefly explain its regulation mechanism.

5. (15%) Give your reason why the following statement is true.
   "*Small-scale bioprocess systems are kinetically limited. Large-scale bioprocess systems are transfer limited.* "