

M.E. CHEMICAL ENGINEERING FIRST YEAR SECOND SEMESTER EXAM 2019

BIOENERGETICS AND BIOPROCESS ENGINEERING

Time: Three hours

Answer all questions

Full Marks: 100

- What do you mean by saturation constant in Monod equation for cellular system?
 - What is the Lineweaver-Burk (double-reciprocal) plot?
 - What do you mean by microencapsulation?
 - What is an allosteric binding?
 - Write the Monod equation with the meanings of all symbols?
 - What is the non-competitive inhibitor?
 - What do you mean by sterilization of cell?
 - What is a chemostat?
 - What do you mean by electrophoresis of cell?
 - What is the antibiotic method of cell disruption?

10x2=20
- Derive the rate equation for a homogeneous enzyme-catalyzed reaction using Briggs-Halden theory. What is its basic difference with Michaelian concept?
 - The following data have been obtained from an enzyme catalyzed reaction using enzyme concentration ($[E_0]=0.00875$ g/L).

Substrate concentration, [s](g/L)	20	10	6.7	5.0	4.0
Rate of reaction, v [g/L.min]	0.67	0.51	0.41	0.31	0.29

Estimate using Hanes-Woolf plot

- Forward reaction velocity (v_m)
 - Michaelis-Menten constant (K_m)
 - Rate constant (k_2)
- 10+10=20**
- Derive the optimum cell concentration using MFR,

$$C_{C,opt} = Y_{C/A} [C_{A0} - \frac{C_{A0}}{1+N}]$$
, where $N = \sqrt{1 + \frac{C_{A0}}{K_s}}$, and $Y_{C/A}$ = Yield of cell concentration.
 - Briefly write the design and operation of a typical aseptic, aerobic fermentation process.

10+10=20
 - Write the different methods of enzyme immobilization?
 - Briefly explain the different methods for quantifying cell concentration.
 - E-coli lives and grows on manitol (Carbon-source) with the following kinetics.

$$\tau_c = \frac{1.2 C_A C_C}{2 + C_A} \text{ g cell. m}^{-3} \cdot \text{hr}^{-1} \text{ with } Y_{C/C_A} = 0.1 \text{ g cell / g manitol.}$$

It is required to produce 1 kg cell/day in a batch fermenting. Start with 1 kg/m^3 and 0.1 g cell/m^3 and continue fermentation until substrate becomes 10 g/m^3 . The time of filling, empty and cleaning may be taken 0.23 hr. Find the volume of the fermental needed.

5+5+10=20

5. (a) Describe briefly with the help of a neat sketch the various section of cell growth curve.

(b) Part of the experimental data relating to a single batch run on bacterial growth in a lactose solution presented by Monod while proposing the equation named after him is as follows:

Time(hr)	0	0.54	0.90	1.23	1.58	1.95	2.33	2.70
$C_A(\text{mg.L}^{-1})$	147	125	104	70	38	18	3	1
$C_C(\text{mg.L}^{-1})$	15.5	23	30	38.8	48.5	68.3	61.3	62.5

Fit the Monod equation to this data.

10+10=20