**M.E. CHEMICAL ENGINEERING FIRST YEAR SECOND SEMESTER EXAM 2018**

**BIOENERGETICS AND BIOPROCESS ENGINEERING**

**Time: Three hours** **Full Marks: 100**

**Answer all questions**

1. a) What are the different models for specific growth rate prediction using unstructured non-segregated model?
   b) What is the Hanes-Woolf plot?
   c) What do you mean by saturation constant in Monod equation for cellular system?
   d) What do you mean by electrophoresis of cell?
   e) What is an enzyme entrapment?
   f) What do you mean by uncompetitive inhibitors?
   g) What is an allostery binding?
   h) What is a chemostat?
   i) What is the Damkohler number?
   j) What is a grid counts for determination of cell number density? 2x10=20

2. a) Describe briefly with the help of a neat sketch the various section of cell growth curve.
   b) In his (Monod) thesis which was published Monod was proposed equation with his name. As experimental support for this equation from his presented results from 4 batch reactor run on the growth of a pure bacteria culture in a lactose solution. One of his runs produced:

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

   Fit the Monod equation to this data. 10+10=20

3. a) Derive the rate equation for a homogeneous enzyme-catalyzed reaction using the rapid equilibrium assumption.
   b) 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, γ[g/(l.min)] | 0.67 | 0.51 | 0.41 | 0.31 | 0.29 |

   Estimate using Hanes-Woolf plot: 1) Forward reaction velocity ($V_m$), 2) Michaelis-Menten constant ($K_m$), and 3) Rate constant ($k_2$). 10+10=20

P.T.O.

4. a) 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.

b) Briefly write the design and operation of a typical aseptic, aerobic fermentation process.

10+10=20

5. a) Briefly describe the non-competitive inhibition kinetics.
b) Explain the different methods of enzyme immobilization?
c) Explain electrical cell quantification?
d) Describe the non-mechanical methods of cell disruption.
e) Show the effectiveness factor (η) vs Thiele modulus (φ) value curves for different values of dimensionless Machealis-Menten constant. 5+5+3+5+2=20