M.TECH FOOD TECHNOLOGY AND BIOCHEMICAL ENGINEERING
1ST YEAR 2ND SEMESTER EXAMINATION ,2017

ADVANCED ENZYME ENGINEERING   Time : Three hours   Full Marks : 100

Part I (50 Marks)

Answer Q.1 and any two from the rest

1. Explain the following: 4x5

a) Damkohler number

b) Effectiveness factor

c) Inhibition of enzyme activity by macromolecules

d) Double reciprocal plot

2. Experimental data on the hydrolysis of starch with α-amylase are given in the following table. Determine the values of the Michaelis constant K_m ; the equilibrium constant for the dissociation of the enzyme inhibitor complex, K_i ; the maximum reaction rate V_{max} and the types of inhibition involved in this hydrolysis.   15

Inhibitor(mg/ml)	substrate concentration(mg/ml)	Relative hydrolysis velocity
None (0.0)	11.24	98.2
	8.12	90.0
	5.61	79.1
	3.56	65.0
	2.34	51.7
Maltose (12.7)	10.0	77.0
	5.26	62.5
	3.33	51.4
	2.04	38.9
	1.89	37.0
α-dextrin (3.34)	33.30	116
	12.9	102
	6.06	71.5

	2.82	47.6
	1.60	32.2

3. What is an enzyme inhibitor? Explain the types of enzyme inhibitors. Comment on mode of action of enzyme inhibitors. Explain inhibition of enzyme activity by substrate analogs and cofactor analog.   2+3.5+3.5+6

4. D. Thornton and Co-workers studied the hydrolysis of sucrose at pH 4.5 and 25^{0} C,   using crude invertase obtained from Baker's Yeast in free and immobilised form. The following initial velocity data were obtained with 408 units of crude enzyme   (1 unit = quantity of enzyme hydrolyzing 1μ mol of sucrose/ min when incubated with o.29 M sucrose in a buffer at pH 4.5 and 25^{0} C).

   a) Determine K_m and V_m for this reaction using both free and immobilized enzyme.

   b) Do the data indicate any diffusion limitations in the immobilized enzyme preparation.

Free enzyme V_0 (m mol hydrolysed/lit.min)	Immobilized enzyme V_0 (m mol hydrolysed/lit.min)	S_0 (mol/lit)
0.083	0.056	0.010
0.143	0.098	0.020
0.188	0.127	0.030
0.222	0.149	0.040
0.250	0.168	0.050
0.330	0.227	0.100
0.408	0.290	0.290

5. Write short note on (any 3) of the following: 3x5

   a) Thiole module

   b) Turn over number

   c) medical uses of enzymes

   d) Hanes Woolf plot

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FIRST YEAR SECOND SEMESTER – 2017

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Part-II

Answer the question no. 1 and any two of the following

1. Glucose is converted to ethanol by immobilized *S.cerevisiae* cells entrapped in Ca-alginate beads in a packed column. The specific rate of ethanol production is $q_p = 0.2$g ethanol / g cell.h and the average dry weight cell concentration in the bed is $X = 25$ g/l bed. Assume that growth is negligible (i.e. almost all glucose is converted to ethanol) and the bed size is sufficiently small that $\eta = 1.0$. the feed flow rate is $F = 400$ l/h, and glucose concentration in the feed is $S_{oi} = 100$ g glucose/l. the diameter of the column is 1m, and the product yield coefficient is $Y_{P/S} = 0.49$ g ethanol / g glucose.

    (a) Write a material balance on the glucose concentration over a differential height of the column and integrate it to determine $S = S(z)$ at steady state.

    (b) Determine the column height for 98% glucose conversion at he exit of the column.

    (c) © Determine the ethanol concentration in the effluent.   10

2. (a) What are the considerable parameters for immobilized enzyme reactor design?

    (b) Give some examples of immobilized enzymes in food and pharmaceutical industries.

    © Define Damkohler number and effectiveness factor. Write their significance in immobilized enzyme kinetics.   7+7+5 = 20

3. (a) Write the functions of steroids in pharmacy.

    (b) What are the raw materials for steroid production?

    © Briefly describe different bioconversion methods for steroid production. 6+5+9 = 20

4. (a) Describe the diffusional effects in enzymes immobilized in porous matrix.

    (b) Briefly describe the covalently bound enzyme immobilization process.

    © What is the selection criteria of matrix for enzyme immobilization?

                                                    8+6+6= 20