Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH (HONS.) DEGREE EXAMINATION, DECEMBER 2019

Course Code: CH463

Course Name: ENZYME ENGINEERING

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) What are Oxidoreductases? Give two examples. (4)

b) Discuss the applications of enzymes in medical field with suitable examples. (5)

c) Describe Ion exchange chromatography technique for enzyme purification. (6)

2 a) Explain the significance of "active sites" in the context of enzyme action. (5)

b) An experiment measuring velocity versus substrate concentration was run, first in the absence of substance A and then in the presence of substance A. The following data were obtained. (10)

[S] µM	**Velocity in the absence of A** (µmol min^{-1})	**Velocity in the presence of A** (µmol min^{-1})
2.5	0.32	0.20
3.3	0.40	0.26
5.0	0.52	0.36
10.0	0.69	0.56

Determine whether the substance A is an inhibitor. If yes, what kind of inhibition is it? What are the values for K_m and V_{max} in the absence and presence of substance A?

3 a) State the applications of enzymes in food and beverage industries. (3)

b) Explain the Fischer lock-and-key hypothesis for enzyme specificity. (4)

c) Develop an expression for rate of enzymatic conversion during non-competitive inhibition. Specify all applicable assumptions and provide appropriate graphical illustrations. (8)

PART B

Answer any two full questions, each carries 15 marks.

4 a) Mention *any two* limitations of enzyme immobilization. (2)

b) Describe the process of enzyme immobilization by entrapment method. (8)

c) Explain "pore diffusion" in the context of immobilized enzyme systems. (5)

5 a) Outline the key advantages of immobilized enzymes in comparison with free-enzymes. (5)

b) With the help of a neat sketch, outline the steps involved in the transport of substrate and product molecules between a well-mixed liquid phase and the interior of a heterogeneous solid enzyme pellet. Also identify the major mass transfer resistances associated with this process. (10)

6 a) Explain the chemical techniques used for immobilization of enzymes. (5)

b) Explain the surface renewal theory of mass transfer. (4)

c) Describe *any three* applications of immobilized enzyme systems. (6)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Discuss the benefits of "recycling" in a continuous enzyme reactor. (4)

b) Consider a series of equivolume continuous stirred tank bioreactors, **n** in number. The rate of medium flow through the series of vessels is **F** litres/h and the volume of each vessel is **V** litres. Using steady state and unsteady state mass balances, develop a general model for the limiting substrate concentration in the n^{th} vessel. Assume that the medium flowing from the **$(n-1)^{th}$** vessel into the **n^{th}** vessel is mixed instantaneously and completely with the contents of the **n^{th}** vessel. The yields based on the cell mass may be assumed as constant regardless of the number of vessels under consideration. Define all notations used and show clearly all the steps involved in the model development. (16)

8 a) With the aid of a neat sketch, describe the main components of a biosensor with their functions. (10)

b) Outline the applications of biosensors in the food industry. (5)

c) Explain the principle and working of potentiometric biosensors. Append a neat sketch. (5)

9 a) With a neat sketch, explain the operation of a fluidized bed reactor for immobilized enzymes. (5)

b) Outline *any five* applications of biosensors in medical diagnostics. (5)

c) Compare the operation of a stirred tank enzyme reactor in batch, continuous and recycle modes. Write the relevant rate equations in each case, assuming the applicability of Michaelis-Menten kinetics for enzyme catalysis. (10)

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