Course code	Course Name	L-T-P-Credits	Year of Introduction
CH463	ENZYME ENGINEERING	3-0-0-3	2016

Prerequisite: Nil

Course Objectives

- To impart the basic concepts of enzymes and the reactors involved in free and immobilized enzyme system
- To understand the kinetics and physicochemical characteristics of enzymes

Syllabus

Classification of enzymes, Commercial application of enzymes Production and purification of crude enzymes.. Mechanism of Enzyme action, Simple enzyme kinetics. Michaelis-Menten kinetics. Types of inhibition. Influences of pH, temperature, fluid forces, chemical agents and irradiation on enzyme activity. Enzyme immobilization. Advantages and disadvantages of different immobilization techniques. Application of immobilized enzyme systems. Mass transfer effects in immobilized enzyme systems. Batch and Continuous Operation of a stirred reactor. Immobilized enzyme reaction in a CSTR and plug flow reactor. Enzyme biosensors, design of enzyme electrodes and their application in industry.

Expected Outcome

Students will be able to:

i. Classify enzymes along with their applications in different fields
ii. Analyse the kinetics of enzymes and apply the same in the design of reactors
iii. Outline the types and methods of immobilization of enzymes
iv. Summarize the various types of enzyme reaction systems and reactors

References:

1. Gerharts, W, Enzymes in industry – Production and application.
2. James E Bailey & David F Ollis “Biochemical Engineering Fundamentals” McGraw Hill
3. Pauline M Doran “BiopriocessEngg. Principles” – Academic press
4. Taylor, R.F.(Ed.) “Protein Immobilization – Fundamentals and applications”. Wiley online Library.
5. Zubay G, Biochemistry, Maxwell Macmillan International Education

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Classification of enzymes, commercial application of enzymes in food, pharmaceutical and other industries. Enzymes for analytical and diagnostic applications. Production and purification of crude enzymes. Extracts from plant, animal and microbial sources	7	15%
II	Mechanism of Enzyme action, Concept of active site, enzyme-substrate complex and enzyme action, Simple enzyme kinetics with one substrate. Michaelis - Menten kinetics. Evaluation of parameters in the Michaelis - Menten kinetics Equation. Types of inhibition. Influences of pH, temperature, fluid forces, chemical agents and irradiation on enzyme activity	7	15%

FIRST INTERNAL EXAMINATION			
III	Enzyme immobilization. Physical and chemical techniques for enzyme immobilization adsorption, matrix entrapment, encapsulation, cross – linking, covalent binding. Advantages and disadvantages of different immobilization techniques. Application of immobilized enzyme systems	7	15%
IV	Mass transfer effects in immobilized enzyme systems. Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions.	7	15%
SECOND INTERNAL EXAMINATION			
V	Batch Operation of a stirred reactor Time course for batch enzyme reaction. Continuous operation in a stirred tank reactor. Immobilized enzyme reaction in a CSTR and plug flow reactor.	7	20%
VI	Enzyme biosensors, application of enzymes in analysis, design of enzyme electrodes and their application in industry, health care and environment	7	20%
END SEMESTEREXAMINATION			

Question Paper Pattern

Maximum Marks: 100 Exam Duration: 3 Hours

Part A: There shall be **Three questions** uniformly covering Modules 1 and 2, each carrying 15 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in one main question with a total of 15 marks for all the subdivisions put together.
(2 x15= 30 Marks)

Part B: There shall be **Three questions** uniformly covering Modules 3 and 4, each carrying 15 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in one main question with a total of 15 marks for all the subdivisions put together.
(2 x15= 30 Marks)

Part C: There shall be **Three questions** uniformly covering Modules 5 and 6, each carrying 20 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in one main question with a total of 20 marks for all the subdivisions put together.
(2 x20= 40 Marks)