Course code	Course Name	L-T-P - Credits	Year of Introduction
CH407	BIOCHEMICAL ENGINEERING	3-0-0-3	2016

Prerequisite : Nil

Course Objectives

1. To understand different types of cells and classification of kingdom protistae.
2. To interpret kinetics of enzyme catalyzed reactions
3. To compare different types of fermentation cycles and growth phases.
4. To know different metabolic pathways and transport across cell membrane
5. To analyze Heat and mass transfer effects in bioprocess and bioreactors.

Syllabus

Cell theory , structure of cells-protist kingdom- Kinetics of Enzyme catalyzed reactions- Michaelis – Menten equation, Substrate concentration dependence of enzyme catalysed reactions- substrate activation and inhibition- competitive and uncompetitive inhibition- Enzyme specificity- Immobilized enzyme technology- Applications of enzymes - Metabolic pathways and energetics of the cell- Transport across cell membranes- Measuring and monitoring of growth process- Fermentation schemes- Transport phenomena in Bio process system- bio-chemical reactors

Expected Outcome

The students will be able to

i. Understand the fundamental aspects of Biochemical Engineering
ii. Develop the kinetics of enzyme catalyzed reactions and transport processes
iii. Explain the metabolic pathways and energetic of the cell.

Reference Books

1. James E. Baileay and David F. Ollis., “Bio-chemical Engineering Fundamentals”. Mc Graw Hill International Editions.
2. D G Rao., “Introduction to Biochemical Engineering”, Tata Mc Graw Hill.
3. Michael L Shuler and Frikret Khargi., “Bioprocess Engineering Basic Concepts” PHI Publications.

Course Plan

Module	Contents	Hours	Sem. Exam marks
I	Micro Biology, Cell theory, Structure of cells, cell fractionation, protist kingdom and their distinguishing characteristics.	2	15%
	Chemicals of life*:* repetitive and non repetitive bio polymers - lipids, sugars and polysaccharides, nucleotides RNA and DNA, amino acids and proteins. Protein structure,	4	15%
II	Kinetics of Enzyme catalyzed reactions: simple enzyme kinetics with oneor two substrates, Michaelis - Menten Kinetics, Evaluation of parameters in Michaelis – Menten equation, Substrate concentration dependence of enzyme catalysed reactions: substrate activation and inhibition, Modulation and regulation of enzyme activity - competitive and uncompetitive inhibition, other influences on enzyme activity	7	15%

FIRST INTERNAL EXAMINATION			
III	Enzyme specificity and enzyme specificity hypotheses, Enzymes of industrial importance. Isolation of crude enzyme - Koji technique - Enzyme purification. Immobilized enzyme technology: enzyme immobilization,medical and analytical applications of immobilized enzymes. Applications of hydrolytic enzymes: esterases, carbohydrases, proteolytic enzymes, pectic enzymes and additional applications. Medical application of enzymes.	6	20%
IV	Metabolic pathways and energetics of the cell: Metabolic reaction coupling : ATP, ADP and NAD. Oxidation and reduction- Coupling via NAD. Embden-Meyerhof pathway (EMP), Pentose phosphate cycle - Entner Doudorff (ED) pathway, Respiration - TCA cycle. Transport across cell membranes - passive transport, active transport and facilitated diffusion.	7	20%
SECOND INTERNAL EXAMINATION			
V	Measuring and monitoring of growth process (Hemacytometer, colony count and turbidity methods). Batch cultivation - growth cycle (lag, exponential, stationary and death phase). Fermentation schemes - Gaden's classifiation (type I, II and type III) and Deindoerfer classification	8	15%
VI	Transport phenomena in Bio process system-Gas-liquid mass transfer in cellular system - basic mass transfer and concepts - rates of metabolic oxygen utilization – determination of oxygen transfer rates-mass transfer across free falling or raising bubble and free surface with or without agitation in heat transfer. Microbial heat generation and correlation, bio-chemical reactors, types of reactors for sterilization.	8	15%
END SEMESTER EXAMINATION			

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 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)

Part C: There shall be **Three questions** uniformly covering Modules 5 and 6, 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)