M. Sc. Semester II
MB 2001: ENZYMOLOGY AND MICROBIAL PHYSIOLOGY

1. Course Code & Title

Course code: Core course 1
Course title: Enzymology and Microbial physiology
Course type: Core
Course credits: 04

2. Course overview and Course Objectives

The main aspect of this course is to study the kinetics of enzymes and enzyme inhibition. Students will learn about the general methodology of protein engineering applications of enzymes. Also, this paper will focus on the diverse metabolic processes of microorganisms along with concepts of physiological adaptations in microorganisms.

3. Course Objectives

- To study the structure of enzyme and the models of enzyme substrate reactions
- To learn the kinetics of enzymatic reactions, calculate Vmax and Km of enzyme catalyzed reactions and graphical representation of enzyme kinetics
- To gain an insight of protein engineering, enzyme engineered for new reactions and varied applications of microbial enzymes
- To understand the physiological adaptation of microorganisms in extreme conditions

3. Course Content

UNIT 1	ENZYME KINETICS Teaching Duration: Lectures 16
1.1	Enzyme 1.1.1The Structure of Enzymes 1.1.2 Models for Monosubstrate Reaction 1.1.3 Models for Bisubstrate Reaction 1.1.4 Monomeric and Oligomeric Enzyme 1.1.5 Multisubstrate Reaction
1.2	Kinetics of Enzyme catalyzed and uncatalyzed reactions
1.3	Kinetics of single substrate enzyme catalyzed reaction 1.3.1 Michaelis-Menten equation, its modification and its significance 1.3.2 Vmax and Km 1.3.2 Lineweaver-Burk plot, Eadie-Hofstee plot, Hanes plot.
1.4	Enzyme inhibition kinetics: 1.4.1 Reversible inhibition: 1.4.2 Competitive inhibition 1.4.3 Non-Competitive inhibition 1.4.4 Un Competitive inhibition 1.4.5 Allosteric inhibition 1.4.6 Substrate inhibition 1.4.7 Partial inhibition 1.4.8 Irreversible inhibition.

1.5	Kinetics of multi-substrate enzyme catalyzed reaction: 1.5.1 Ping-pong reaction 1.5.2 Random-order reactions 1.5.3 Compulsory order reactions

UNIT 2	PROTEIN ENGINEERING AND APPLICATIONS OF ENZYMES
	Teaching Duration: Lectures 16
2.1	Enzyme Engineering of industrial enzymes. 2.1.1 Rational design methods 2.1.2 Site directed mutagenesis
2.2	Chemical modifications and unnatural amino acids
2.3	Random methods
2.4	Application of enzymes in Industry. 2.4.1 Milling and Baking: Enzyme in Flour. 2.4.2 Enzymes in Starch production, Sweetener and syrup production, Starch liquefaction and dextrose. 2.4.3 Pectic enzymes in fruit and juice manufacture: Food processing related properties of pectic enzymes. 2.4.4 Textiles and laundry detergents: Enzymes in laundry detergents 2.4.5 Pulp and paper: Enzyme application in pulp and paper processes. 2.4.6 Enzymes and Bioremediation: Enzymology of n-alkane oxidation
2.5	Enzymes engineered for new Reactions-Novel catalysts for organic synthesis, Extremozymes, Synzymes, Artizymes

UNIT 3	PHYSIOLOGICAL ADAPTATION
	Teaching Duration: Lectures 16
3.1	Two component regulation 3.1.1 Prototypical Two Component regulatory system
3.2	Spectrum of Functions: 3.2.1 Osmolarity Changes and Porin Regulation 3.2.2 Quorum sensing and staphylococcal virulence 3.2.3 The Phosphorelay and Sporulation Initiation in *Bacillus subtilis* 3.2.4 Chemotaxis and Atypical Output Response
3.3	Physiology, Biochemistry & Genetic Aspects of: 3.3.1 Oxidative Stress Response and Regulation 3.3.2 Heat Shock Response 3.3.3 Nutritional Stress and Starvation Stress Response 3.3.4 pH Stress and Acid Tolerance
3.4	Biochemistry and Physiology of Radiation Resistant Microorganisms

UNIT 4	MICROBIAL METABOLISM
	Teaching Duration: Lectures 16
4.1	Assimilation and Dissimilation of Nitrate and Sulphate
4.2	Nitrogen Fixation
4.3	Phototrophic Prokaryotes.
4.4	Purple Photosynthetic Bacteria
4.5	Green Sulphur Bacteria.

4.6	The Structure of Photosynthetic Membranes in Bacteria.
4.7	Cell wall and Capsule Biosynthesis. 4.7.1 Peptidoglycan Structure and Synthesis. 4.7.2 Lipopolysaccharide Structure and Synthesis.

4. Course Learning Outcomes/Student's Learning Outcomes (SLO)

Unit 1: Students shall understand kinetics of enzyme catalyzed reactions, they shall be enabled to calculate the Vmax and Km of enzymatic reaction and represent graphically the mechanism of enzyme reactions

Unit 2: Students shall gain knowledge of protein engineering methods to modify enzymes and application of microbial enzymes in various fields

Unit 3: Students will gain an understanding of physiological adaptations of microorganisms' in extreme environment

Unit 4: Students shall develop an understanding of microbial metabolism

Recommended learning resources

- Byung Hong Kim (2008) *Bacterial Physiology and Metabolism*, Cambridge (ISBN-13 978-0-521-71230-9)
- Gray N., Calvin M., and Bhatia SC. (2012). Enzymes Biotechnology. 1st Edition. CBS Publishers, New Delhi. (ISBN; 9788123918297)
- Moat A., Foster J. and Spector M. (2009). Microbial Physiology, 4th Edition, Wiley. (ISBN; 978-81-265-2106-7)
- Palmer T (2004): Enzymology. East-West Press Pvt. Ltd., New Delhi.
- Pandey A., Webb, C., Fernandes, M. and Larroche, C. (2006). Enzyme Technology. SpringerVerlag., New York. (ISBN; 978-0-387-29294-6)
- Price N. and Stevens L. (1999). Fundamentals of Enzymology. 3rd Edition Oxford University Press., London. (ISBN; 9780198502296)
- Ramya.M and Ponmurugan.P (2015) Protein Engineering, Narosa Publishing House. ISBN 798-81-8487-424-2.
- Schaechter M. (2004). The Desk Encyclopedia of Microbiology. Elsevier Academic Press, California USA. (ISBN; 9780080961286)
- Streips U.N. and Yasbin R.E. (2002). Modern Microbial Genetics. 2nd Edition. Wiley-Liss, A John Wiely and sons Inc., publication, New York. (ISBN; 978-0-471-38665-0)
- White D. (2003). The Physiology and Biochemistry of Prokaryotes, 2nd Edition, Oxford University Press. (ISBN: 0-19-512579-7)

MB 2002: BIOINFORMATICS & BIO-NANOTECHNOLOGY

1. Course Code & Title

Course code: Core course II
Course title: Bioinformatics & Bio-nanotechnology
Course type: Core