M.Sc. Semester – II

MB: 201 MICROBIAL PHYSIOLOGY

Objective: This paper deals with the understanding of the processes of life of microorganisms as mediated by its structures and chemical components operating together to accomplish the common tasks of life. The paper introduces inter-relatedness of microbiology, biochemistry and genetics in context of the functioning of bacterial cell

Unit-1	**MOLECULAR TOOLS FOR MICROBIAL PHSIOLOGY:**		
	Ref.: Moat	**Teaching Duration:**	**Lectures: 08**
1.1	Mutant Hunts		
1.2	Blotting procedures:		
1.3	3.1.1 Southern Blotting		[Primrose]
	3.1.2 Northern Blotting		[Primrose]
	3.1.3 Western Blotting		[Primrose]
	3.1.4 South western blots		(A.G.Moat)
1.4	Reporter genes		
1.5	DNA Mobility Shifts		
1.6	Primer Extension		
1.7	Two Hybrid Analysis		
1.8	FISH		

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Unit-2	**MOLECULAR ADAPTATION PHYSIOLOGY:**		
	Ref.: U. N. Streips, Moat, Desk Encyclopedia & David White	**Teaching Duration:**	**Lectures: 09**
2.1	Prototypical Two Component Signalling		
2.2	Regulation of Signal Transduction		
2.3	Spectrum of Functions		
	2.3.1 Osmolarity Changes and Porin Regulation		
	2.3.2 Quoram Sensing and Staphylococcal Virulence		
	2.3.3 Chemotaxis and Atypical Output Response		
	2.3.4 The Phosphorelay and Sporulation Initiation in Bacillus subtillis		
2.4	Physiology, Biochemistry & Genetic Aspects of:		
	2.4.1 Oxidative Stress Response and Regulation		
	2.4.2 Heat Shock Response		
	2.4.3 Nutritional Stress and Starvation Stress Response		
	2.4.4 pH Stress and Acid Tolerance		
2.5	Biochemistry and Physiology of Radiation Resistant Microorganisms		

Unit-3	INORGANIC METABOLISM & ENERGY PRODUCTION:		
	Ref.: David White:	**Teaching Duration:**	**Lectures: 08**
3.1	Assimilation of Nitrate and Sulphate		
3.2	Dissimilation of Nitrate and Sulphate		
3.3	Nitrogen Fixation		
3.4	Catabolism of Aliphatic Hydrocarbons		
	Growth on C_1 compounds other than CO_2 – The Methylotrophs		

Unit-4	PHOTOSYNTHESIS & BIOSYNTHESIS:		
	Ref.: David White & Moat	**Teaching Duration:**	**Lectures: 08**
4.1	Phototrophic Prokaryotes		
4.2	Purple Photosynthetic Bacteria		
4.3	Green Sulphur Bacteria		
4.4	Cyanobacteria and Chloroplast		
4.5	The Structure of Photosynthetic Membranes in Bacteria		
4.6	Cell wall and Capsule Biosynthesis		
	4.6.1 Peptidoglycan Structure and Synthesis		
	4.6.2 Lipopolysaccharide Structure and Synthesis		
	4.6.3 Extracellular Polysaccharide, Synthesis and Export in Gram negative Bacteria		

References:

1. The Physiology and Biochemistry of Prokaryotes, 2nd Edition, David White, Oxford University Press 2003, ISBN: 0-19-512579-7
2. Microbial Physiology, 4th Edition, 2009, Albert G. Moat, John W. Foster, Michael P. Spector, Wiley, ISBN: 978-81-265-2106-7.
3. Streips U.N. and Yasbin R.E. (2002). *Modern Microbial Genetics.*Scond edition. Wiley-Liss, A John wiely and sons Inc., publication, New York.
4. Schaechter M. (2004). *The Desk Encyclopedia of Microbiology*. Elsevier Academic Press, California USA.

MB 202: BIOINFORMATICS & OTHER "OMICS"

OBJECTIVES: The basic objective is to give students an introduction to the basic techniques of bioinformatics. Emphasis will be given to the application of bioinformatics and biological databases to problem solving in real research problems. The students will become familiar with the use of a wide variety of internet applications, biological database and will be able to apply these methods to research problems. This paper describe a rapidly growing branches of highthroughput, large scale biology & maturing scientific discipline like Genomics, Proteomics, Transcriptomics.

Unit-1	**GENOME AND GENOMICS**		
	Ref: Primrose	**Teaching Duration:**	**Lectures: 07**
1.1	Introduction to Genomics: Structural, Functional and Comparative		
1.2	Comparative Genomics of Prokaryotes, Eukaryotes and Organelles		
1.3	Genome Mapping: RFLPs, SNPs, AFLPs		
1.4	Next generation sequencing method		
1.5	Genome assembling **Ref: Xiong**		
1.6	Genome Annotation **Ref:Xiong**		

Unit-2	**PROTEOMICS AND OTHER "OMICS"**		
	Ref:R.M.Twyman:	**Teaching Duration:**	**Lectures: 09**
2.1	Interaction Proteomics: Methods of Protein-Protein Interaction		
2.2	Expression proteomics		
	2.2.1 Basic techniques and approaches (2-D Differencial gel electrophoresis		
2.3	Functional Proteomics		
	2.3.1 Protein Microarray and its Application, 2.3.2 Types and Manufacture of protein chip		
2.4	Application of Proteomics: In the field of Medical, Pharmaceutical and Plant Biotechnology		
2.5	Transcriptomics: RNA level Gene Expression: DNA Micro array Technology and its Application, Printing Technologies **Ref: Primrose**		
2.6	Metagenomics: **Ref: The Science of Metagenomics**		
	2.6.1 Metagenomics offer a way forward and Contribution in various fields.		
	2.6.2 Designing a Metagenomics Project: Sequence based and Function based analysis.		

Unit-3	**DATABASES: IN SILICO RESOURCE FOR THE INFORMATION.**		
	Ref: Ghosh	**Teaching Duration:**	**Lectures: 09**
3.1	Biological Database and database design.		
3.2	Nucleotide sequence database: EMBL, gene bank, DDBJ		
3.3	Protein Database: 3.3.1 Protein sequence database:PIR, Swiss-Prot 3.3.2 Structure database: PDB, MMDB		

3.4	Classification database: CATH, SCOPE
3.5	Sequence-based Database Searches: BLAST, PSI-BLAST, RPS-BLAST
3.6	Metabolic pathway Database: KEGG

Unit-4	**APPLIED BIOINFORMATICS:**		
	Ref: Ghosh	**Teaching Duration:**	**Lectures: 09**
4.1	Pairwise Sequence Alignment **Ref: Xiong**		
	4.1.1 Sequence Homology versus Sequence Similarity		
	4.1.2 Sequence Similarity versus Sequence Identity		
	4.1.3 Methods: Global amd Local		
	4.1.4 ScoringMatrices: PAM and BLOSUM		
4.2	Multiple Sequence Alignment **Ref: Xiong**		
	4.2.1 Scoring Function		
	4.2.2 Exhaustive Algorithms		
	4.2.3 Heuristic Algorithms		
4.3	Markov Model And Hidden Markov Model **Ref: Xiong**		
4.4	Phylogeny: Statistical methods to obtained phylogenetic tree, Software for phylogenetic analysis		
4.5	Secondary structure prediction: Computation methods for secondary structure prediction: Chou Fasman, GOR and Softwares for Secondary structure prediction		
4.6	Protein Modeling: methods of Protein Modeling, Homology Modeling; fold recognition and threading approaches, and Ab-initio structure prediction methods.		

REFERANCES:

1. Twyman R. (2008). Principles of Proteomics. Taylor & Francis Publisher, Oxon.
2. Primrose S. and Twyman R. (2006). Principles of Gene Manipulation & Genomics, 7th edition. Black well Publishing, Malden.
3. Xiong, J., (2009).*Essential Bioinformatics*, Cambridge University press.
4. Board on Life Sciences. (2007). The Science of Metagenomics. Division of Earth and Life sciences, The Natonal Academies Press, washington DC.
5. ZhumarGhosh and BibekanandMallick(2008) Principles and ApplicationsOUP India

MB-203 Enzyme Kinetics & technology

Objective: This paper will give insight on kinetics of enzmes and enzyme inhibition. Students will learn about the general methodology of enzyme extraction & purification along with its applications. A recent trends in enzymology focus on modification of enzymes for its efficient applicability, an approach covered in enzyme engineering.

Unit-1	**ENZYME KINETICS:**		
	Ref: T. Palmer	**Teaching Duration:**	**Lectures:09**
1.1	Kinetics of uncatalyzed chemical reaction		
1.2	Kinetics of Enzyme catalyzed reactions		
1.3	Methods use for investigating kinetics of enzyme catalyzed reaction:		
	1.3.1 Initial velocity studies		
	1.3.2 Rapid enzyme catalysis		
1.4	Kinetics of single substrate enzyme catalyzed reaction:		
	1.4.1 Michaelis-Menten equation, its modification and its importance		
	1.4.2 *Vmax*and *Km*		
	1.4.3 Lineweaver-Burk plot, Eadie-Hofstee plot, Hans plot, Dixan plots		
1.5	Enzyme inhibition kinetics:		
	1.5.1 Reversible inhibition:		
	1.5.2 Competitive inhibition		
	1.5.3 Non Competitive inhibition		
	1.5.4 Un Competitive inhibition		
	1.5.5 Allosteric inhibition		
	1.5.6 Substrate inhibition		
	1.5.7 Partial inhibition		
	1.5.8 Irreversible inhibition		
1.6	Kinetics of multi-substrate enzyme catalyzed reaction:		
	4.6.1 Ping-pong reaction		
	4.6.2 Random-order reactions		
	4.6.3 Compulsory order reactions		

Unit-2	**Enzyme Extraction, Isolation and Purification**		
	[Ref. Shanmugam]	**Teaching Duration:**	**Lectures: 08**
2.1	Enzyme extraction and isolation		
2.2	Purification of enzymes		

Unit-3	**Enzyme Engineering of industrial enzymes**

	Ref: Ashok Pandey	Teaching Duration:	Lectures: 07
3.1	Introduction		
3.2	Targets and results for industrial enzymes		
	3.2.1Detergent enzymes		
	3.2.2 Starch hydrolysis and fructose manufacturing		
	3.2.3 Animal feed enzymes		
	3.2.4 Xylanase in pulp bleaching		
	3.2.5 Chemoenzymatic synthesis		
3.4	Rational Design methods		
	3.4.1 Site directed mutagenesis		
	3.4.2Chemical modifications and unnatural amino acids		
3.5	Random methods		
	3.5.1 Sequence space		
	3.5.2 Methods for mutagenesis		
	3.5.3 Methods for recombination		
	3.5.4 Sequence homology independent recombination		
	3.5.5 Screening and selection		

Unit-4	Applications of enzyme		
	Ref. Shanmugam	Teaching Duration:	Lectures: 07
4.1	Large scale applications of enzymes		
4.2	Role of enzymes in detergent industries		
4.3	Enzymes in starch industries		
4.4	Applications of enzymes in baking industries		
4.5	Applications of enzymes in dairy industries		
4.6	Applications of enzymes in animal feed biotechnology		
4.7	Applications of enzymes in textile, paper and pulp industries		
4.8	Diagnostic and therapeutic enzymes		

REFERENCES:

1. Palmer T (2004): *Enzymology.* East-West Press Pvt. Ltd., New Delhi.
2. Price N C and Stevens L (1999) *Fundamental of Enzymology* , 3rd Ed. Oxford
3. Shanmugam S and Sathishkumar T, (2009), Enzyme technology, 1st ed., I. K. Int. pub. House

MB-204 RESEARCH METHODOLOGY, BIOSTATISTICS AND IPR

Objectives: The learning objective of the paper will enrich the students with basic principle of research methodology which help the students to learn essential steps involved in research. It also increase the understanding in use of biostatistics in analysis and interpretation of data. This paper also provide opportunity to learn importance of IPR in the todays knoeledge based industry and role of international organization in protection of IPR.

UNIT 1	**RESEARCH METHODOLOGY**		
	Reference: Gurumani, Ranjit Kumar	**Teaching Duration**	**Lectures: 08**
1.1	Research: What does it means? **(Ranjit Kumar)**		
1.2	Types of research. **(Ranjit Kumar)**		
1.3	The research process: A quick glance**(Ranjit Kumar)**		
1.4	Formulating a research problem **(Ranjit Kumar)**		
1.5	Constructing hypothesis **(Ranjit Kumar)**		
1.6	Selecting a study design**(Ranjit Kumar)**		
1.7	Contents of research proposal - outline**(Ranjit Kumar)**		
1.8	Literature citation **(Gurumani)**		
1.9	Research report **(Gurumani)**		
1.10	Research report- Tables **(Gurumani)**		
1.11	Research report- Figures **(Gurumani)**		
1.12	Research report- Formatting & Typing. **(Gurumani)**		

UNIT 2	**FUNDAMENTALS OF BIOSTATISTICS**		
	Reference: Arora	**Teaching Duration**	**Lectures: 09**
2.1	Introduction to Biostatistics 2.1.1 Defination, Development & Application of Biostatistics 2.1.2 Role of Biostatistics 2.1.3Data and its collection 2.1.4Classification of Data		
2.2	2.1.3 Importance and usefulness of Statistics Preliminary Concepts 2.2.1 Variables and constants 2.2.2 Populations and Samples 2.2.3 Random Samples 2.2.4 Discrete and Continuous Variables 2.2.5 Relationship and Prediction		
2.3	2.2.6 Variables in biology		
2.4	Sampling Techniques **(Khan)**		
2.5	Diagramatic and Graphical Representation of Data **(Khan)** Frequency Distribution **(Gurumani)**		

UNIT 3	METHODS OF DATA ANALYSIS		
	Reference: Khan	**Teaching Duration**	**Lectures: 10**
3.1	Measures of Central Tendancy 3.1.1 Arithmetic Mean 3.1.2 Median 3.1.3 Mode 3.1.4 Geometric Mean 3.1.5 Harmonic Mean 3.1.6 IllustrativeProblems		
3.2	Student t-test **Ref: Gurumani** **3.**2.1 Introduction 3.2.2 Student's t-Distribution 3.2.3 Application of t-Distribution		
3.3	Analysis of Variance (ANOVA) **Ref: Gurumani** **3.**3.1 Principle of Anova 3.3.2 Partitioning of Anova 3.3.3 Comparison of pairs of Means 3.3.4 Assumption Underlying Anova 3.3.5 Application of Anova		

UNIT 4	Intellectual Property Right (IPR)		
	Reference: Sateesh M.K.	**Teaching Duration**	**Lectures:06**
4.1	Introduction		
4.2	Forms of intellectual property		
4.3	International and regional agreement/treaties in IPR		
4.4	IPR related legislation in india		
4.5	International organization and IPR		
4.5.1	World Trade Organization (WTO)		
4.5.2	WTO treaties		
4.5.3	Genenral Agreement on tariffs and trade (GATT)		
4.5.4	Trade – Related Aspects Of IPR (TRIPS)		
4.5.5	World Intellectual Property Organization (WIPO)		

REFERENCES:

1. Sateesh M.K. (2008) Bioethics and Biosafety, I.K.International Publishing House Pvt. Ltd.
2. Gurumani N. (2011) Research Methodology For Biological Sciences, MJP Publishers, Chennai (ISBN: 978-81-8094-016-0)
3. Arora, P. N. (2007). *Biostatistics*. Himalaya Publishing House.
4. Kumar, R. (2005). *A Step-by-step Guide for Beginners*. Sage Publications.
5. Khan I. A. & Khanum A Fundametals of Biostatistics, Ukaaz Publications, Hyderabad. (ISBN: 9788190044103)

LIST OF PRACTICALS
SEMESTER 2

1. Find out the cellulase activity by using CMC as substrate.
2. To determine Km &Vmaxof alpha amylase.
3. To study the effect of pH, temperature on alpha amylase activity.
4. To study the effect of activators and inhibitors on alpha amylase activity.
5. Immobilization studies:Preparation of urease/Amylase entrapped in alginate beads and determination of percent entrapment
6. Ultraviolet irradiation survival curve.
7. Perform chemical mutagenesis.
8. Isolation of mutants: Respiratory deficient.
9. Sequence retrival systems for Nucleic acid and Proteins
10. To Study the protein Structure database (PDB)
11. Sequenc based search analysis by BLAST
12. Any two EMBOSS applications for nucleiotide and protein sequence analysis.
13. Sequence analysis by Multiple sequences alignment.
14. Computer assisted oligonucleotide primer designing.
15. Rasmol application for protein structure visualization. (Demonstration)
16. Protein Secondary structure prediction
17. Homology modeling: SwissModel

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