SEMESTER-I

Paper 1: Molecular Biology (GMMB-101)

Course Objective:

"1. This course is designed as such to target the knowledge and understanding of Nucleic acids and the experiments related to Genetics. 2. On completion of this course, the students will gain an understanding of the structure of DNA and RNA, their types and organization. 3. This course will gain an insight into the genomic structure, Nucleosome, Chromatin structure and organization of chromosomes."

Course Contents

Unit I

History of molecular biology; Nucleic acids as hereditary material; Structure of nucleicacid; Secondary and tertiary structure of nucleic acids; Types of RNA- rRNA, tRNA andmRNA; structure of ribosomes; Nucleases; Restriction and modification; Nucleic acid sequencing; DNA replication and DNA polymerases of E.coli.

Unit II

Transcription; RNA polymerases; Types of promoters; Reverse transcriptase and RNAreplicase; Genetic code; Translation; Gene regulation at transcriptional and translationallevel; Operon- positive and negative control; Attenuation; Molecular mechanism ofmutation; Mechanism of DNA repair.

Unit III

Molecular organization of eukaryotic genome- Structure of genomes, Chromatin; Typesof DNA polymerases, DNA replication; Types of RNA polymerases- Transcription,Structure of primary transcript; Ribozyme, RNA processing and alternate splicing;Structure of ribosomes and translation in eukaryotes; Development and differentiation;Molecular evolution.

Unit IV

Cell division cycle- Check points in cell cycle; apoptosis and its pathways; Oncogenes-Retroviruses, Tumor suppressor p53, Telomere shortening, Ras oncogenes; Oncoproteinsand gene expression; Genetic instability and cancer.

Suggested readings:

1. Lewin, B. Gene X, Oxford University Press.
2. Brown, T.A. Genomes, John Wiley and Sons Inc.
3. Brown. T.A. Molecular Biology LabFax, Bios Scientific Ltd.Oxford.
4. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. Molecular Biology of the Cell, Garland Publishing.
5. Watson, J.D, Weiner, A.M and. Hopkins, N.H Molecular Biology of the Gene Addison-Wesley Publishing.
6. Lodish, H., Berk, A., Zipursky, S., Matsudaira, P., Baltimore, D. and Darnell, J.E MolecularCell Biology, W.H. Freeman and Company.

Paper-2 Biochemistry (GMMB-102)

Course Objective

At the end of this course the students will be able to describe:

- Bioenergetics, pH, salts, acid and base, buffers.
- Carbohydrates and polymers
- Lipid classification and uses
- Enzyme classification and its activity

Course Contents

Unit-I

Unit I

Scope and importance of biochemistry; Fundamental principles governing life; Structure of water; Acid base concept and buffers; pH; Hydrogen bonding; Hydrophobic,Electrostatic and Vander Waal forces. General introduction to physical techniques for determination of structure of biopolymers.

Unit II

Classification, structure and function of carbohydrates; Biomembranes and lipids.Structure and function of amino acids and vitamins.Structure and function of proteins; Types of nucleic acid, their structure and functions.

Unit III

Enzymes: classification, mechanism of action; Factors affecting enzyme action; Immobilized enzymes; Hormones; Thermodynamic principles and biological processes, Bioenergetics.

Unit IV

Metabolism of carbohydrates, photosynthesis and respiration, oxidative phosphorylation, lipids, proteins and nucleic acids. DNA replication, transcription and translation in Prokaryotes and eukaryotes; recombinant DNA technology

Suggested readings:

1. Mathews C.K., VanHolde K.E. and Ahern K.G., Biochemistry, Benjamin /Cummings.
2. Stryer L., Biochemistry, W.H. Freeman and Company.
3. Devlin's Textbook of Biochemistry with Clinical correlations. John Wiley and Sons Inc.
4. Lehninger A.L., Nelson D.L., Principles of Biochemistry, M.M. Cox. Worth Publishing.
5. Robert K., Murray M.D., Granner D.K., Mayes P.A.andRodwell V.I. Harper's Biochemistry.McGraw-Hill/Appleton and Lange.

Paper 3: Microbial Genetics (GMMB-103)

Course Objective

On the completion of this course the students will be able to describe following subject matters: 1. Cycle: Mitosis and Meiosis: Control points in cell-cycle, Law of segregation & Principle of independent assortment. 2. This course is designed to understand the role and composition of various body fluids with reference to human body. 3. Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria. 4. Control of Microorganisms: By physical, chemical and chemotherapeutic Agents. 5. Preservation of various types of foods. Fermented Foods."

Course Contents

Unit I

Mendel's work on transmission of traits; Genetic Variation; Molecular basis of GeneticInformation; Mitosis and Meiosis; Linkage and crossing over; Cytological basis ofcrossing over; Molecular mechanism of crossing over; Recombination and recombinationfrequency

Unit II

Mutations- Induced versus Spontaneous mutations, Suppressor mutations, olecular basis of Mutations, mutant enrichment; Complementation tests; recombination tests andgene replacements; Cloning genes by complementation and marker rescue; DNA repairmechanisms

Unit III

Molecular mechanism of gene transfer by conjugation.Regulation of gene transfer byconjugation.Mapping bacterial genomes using Hfr strains. Transfer systems in grampositive bacteria. Ti plasmid and application; Transformation and transduction: Naturaltransformation and competence. Molecular basis of natural transformation; Regulation ofcompetence in B.subtilis.Artificially induced competence.Generalized versusspecialized transduction, T4 and lambda phage. Mapping bacterial genes by transduction;Positive and negative gene regulation and attenuation, using the lac, gal, trp, ara and tol operons, with emphasis on recent advances.

Unit IV

Lytic cycle of T4 and T7 bacteriphages, Regulation of expression of genes in phage T4and T7.Replication and packaging of filamentous phages M13 and f1.Benzer'sexperiments with the rII genes of phage T4 to construct phage genetic linkage maps.Lambda phage – Lytic and lysogenic cycles.Other lysogenic phages – P1 and □x174.Transposons and gene regulation. Yeast Ty-1 transposon. Phase variation system inSalmonella.

Suggested Readings

1. Snyder L. and Chapness W. Molecular Genetics of Bacteria 2007.
2. Birge EA. 1981. Bacterial and Bacteriophage Genetics. Springer Verlag.
3. Gardner JE, Simmons MJ &Snustad DP. 1991. Principles of Genetics. John Wiley& Sons.
4. Lewin B.1999. Gene. Vols. VI, IX. John Wiley & Sons.
5. Maloy A &Friedfelder D. 1994.Microbial Genetics.Narosa.
6. Scaife J, Leach D &Galizzi A 1985. Genetics of Bacteria.Academic Press.
7. William Hayes 1981. Genetics of Bacteria.Academic Press.
8. Microbial Genetics. Maloyet.al. 1994.Jones & Bartlett Publishers.

9. Dale J.W., Molecular genetics of bacteria. 1994. John Wiley &Sones.

Paper 4: Recombinant DNA Technology (GMMB-104)

Course Objectives

At the end of this course, genetic engineering the students will be able to describe: • Vectors and Enzymes, Plasmids, Cosmids, Phasemids, Transposons, Artificial Vectors • Sticky and Blunt Ended ligation methods, Homopolymer tailing method, Gene transfer in Prokaryotes and Eukaryotes, Strategies of gene transfer, blotting techniques, DNA sequencing methods • Applications of Molecular markers; RAPD and RFLP • Golden Rice, Bt Cotton, Antisense RNA technology, Production of transgenic mice • Gene therapy, Merits and demerits of GMOs

Course Contents

UNIT-I

Basics of DNA cloning: Simple cloning and cloning using linkers and adaptors. Cloning into various kinds of vectors – plasmids, phages lambda and M13, phagemids, cosmids, P1 phage, PACs, BACs and YACs.Selection and screening of clones**.**Methods of DNA and protein analysis: Agarose, polyacrylamide and pulsed field gel electrophoresis of DNA.

UNIT-II

Southern and Northern Blotting.Radiolabelling probes.Isolation and purification of DNA.RFLP analysis.DNA fingerprinting and its application in forensics, in disease diagnosis and in identification of strains.Native PAGE, SDS-PAGE and two-dimensional PAGE analysis of proteins.Western Blotting analysis. Polymerase Chain Reaction: Concept of PCR and various thermophilic enzymes used in PCR. Gradient PCRversus Touchdown PCR.

UNIT III

Designing primers. Cloning PCR products. Long PCR, Inverse PRC, Vectorette PCR,RT-PCR, 5' and 3' RACE, qPCR, Real Time PCR using SYBR Green, Scorpion primers and TaqMan probes,MOPAC, Multiplex PCR, Differential Display PCR, RAPD fingerprinting of micro-organisms, Ligation ChainReaction, Overlap PCR, Rolling Circle Amplification Technology.Construction of cDNA and genomic DNA libraries: Vectors used in the construction of cDNA versus genomicDNA libraries. Steps and enzymes involved in the construction of cDNA versus genomic DNA libraries. Screeninglibraries by colony hybridization and colony PCR.Screening expression libraries.Enriching for clones in cDNAlibraries by positive selection and subtractive hybridization.Identifying genes in complex genomes by directselection of cDNA and exon trapping.

UNIT IV: Genome sequencing: DNA sequencing by Sanger's method – traditional and cycle sequencing. Physical mappingby restriction fragment fingerprinting of BAC clones and STS mapping..Genome annotation at the nucleotide level, protein level and process level.Comparative genome sequencing ofmicro-organisms to identify and categorize SNPs. Array CGH.Transcriptional analysis of gene expression and transcriptomics: Gene expression analysis by NorthernBlotting, RT-PCR, EST analysis and the use of reporter genes. Transcriptome analysis by DD-PCR and EST analysis, DNA microarrays (cDNA arrays and oligo arrays).Byconventional and PCR-based methods.Human therapies – TPA, interferon, antisense molecules. Vaccines – Hepatitis B, AIDS, and DNA vaccines.Transgenics and animal cloning: Creating transgenic animals and plants. Animal cloning.

Suggested Readings:

1. Molecular Biology by David P. Clarke, 1st edition; Elsevier Academic Press; 2005.
2. Molecular Cloning: A laboratory manual by Joseph Sambrook& David Russell, 3rd edition; CSHLpress; 2001.
3. DNA Technology : The Awesome Skill by I. Edward Alcamo, 2nd edition; Hardcourt Academic Press;2001.
4. Molecular Biology of the Gene by James Watson, Tania Baker, Stephen Bell, Alexander Gann, MichaelLevine & Richard Losick , 6th Edition; CSHL Press; 2007

List of practical based on theory papers (Semester-I)

GMMB LAB-101

1. Microscopic examination of bacteria, actinomycetes, algae, fungi and protozoa.
2. Differential staining methods; Study of shape and arrangement of bacterial cells.
3. Preparation of microbiological media; Sterilization: principles & operations.
4. Preparation of specific media for isolation of bacteria, actinomycetes and fungi from natural sources; Sampling and quantification of microorganisms in air, soil and water.
5. Isolation of thermophiles from compost.

6. Preparation of standard and buffer solutions.
7. Use of simple techniques in laboratory (spectrophotometery-verification of Beer's law, relation between O.D. and percentage transmission; Centrifugation) Estimation of sugars, Estimation of Proteins by Lowry‘s method.

List of practical based on theory papers (Semester-I)
GMMB LAB-102

1. Estimation of DNA and RNA by diphenylamine and orcinol methods.
2. Determination of enzyme activity and study of enzyme kinetics.
3. Separation of biomolecules by electrophoresis.
4. Production of amylases and proteases by fungi.
5. Plant tissue culture media preparation.
6. Cell and explant culture, regeneration and transformation.
7. Isolation of genomic and plasmid DNA.
8. Gel electrophoresis techniques; Restriction enzyme digestion, ligation, transformation and screening of transformants; PCR.
9. Isolation and identification of fungi from different environmental samples.
10. Study the nutritional requirement of fungi, Cultivation of fungi in submerged and solid state fermentation,
11. Isolation and identification of algae from different habitats.
12. Culturing of algae under lab conditions, Study hydrogen and bioethanol production by algae, Algae as a source of SCP,