

**Paper Details**

S. No.	Paper Type Core/CBCE/ SEC/AECC	Paper Code	Title of Paper	Credit	M. Marks (Internal Assessment)	M. Marks (University Exam)
1.	Core	PBT 101	Research Methodology & Biotechniques	4	25	75
2.	Core	PBT 102	Research Project, Review & Annotated Bibliography	4		100
3.	Core	PBT 103	Genomics	4	25	75
4.	CBCE	PBT 104	Molecular Medicine & Industrial Biotechnology	4	25	75

## Syllabus for Paper: Research Methodology & Biotechniques

### **UNIT-I: Biophysical and Biochemical Techniques**

Chromatography: Principle, normal and reverse phase liquid chromatography, ion exchange, molecular exclusion, affinity chromatography, HPLC, GC, ICP-MS ; Electrophoresis Techniques: principle, Support media (agarose and polyacrylamide gels), agarose gel electrophoresis of DNA and RNA, southern and northern transfer, PFGE, Native PAGE, SDS-PAGE ; Centrifugation Techniques: Principle of sedimentation, centrifugation, ultracentrifugation, analytical centrifugation, preparative centrifugation, general applications of centrifugation; Spectrophotometry Techniques: theory and applications of CD, UV-VIS, IR, Fluorescence, Atomic absorption spectroscopy, FRET and its application.

### **UNIT-III: Genetic engineering, Immunology and Molecular Biology Techniques**

Extraction of DNA, cellular screening, Polymerase Chain Reaction, DNA sequencing, DNA synthesis, bacterial transformation, molecular hybridization, FISH, Chromosomal banding and painting, Karyotyping, cloning techniques, r DNA Expression techniques; Preparation of culture media, types of culture media, Culture of micro-organisms, Culture in liquid medium, Culture in solid medium, Sterilization, Dilution technique for plate count, Enumeration techniques. Immunohistochemistry, Monoclonal antibody production.

### **UNIT-II: Histology and Microscopic Techniques and Radio-isotopes Techniques**

Fixation of tissue, cell culture, Magnification and resolution of microscopes, components of light microscope, Theory and principles of microscopy, light, dark field, fluorescence microscopy, TEM, SEM, confocal microscopy, microtomy, ultramicrotomy, freeze fracturing, flow cytometry; Radioactivity and radioisotopes, rate of decay, units of radioactivity, specific activity, Detection and measurement of radioactivity Cerenkov counting and autoradiography, Applications in biological sciences - Analytical, diagnostics and metabolic studies, Safety aspects of radioactive handling, alternatives to radio-labeling.

### **UNIT-IV: Research Methods, Biostatistics and Bioinformatics**

Introduction to applications of statistics in biology, Introduction to applications of Collection of data, Measures of dispersion, Simple correlation, Regression analysis, Tests of significance-F-test, paired and unpaired t-test, Chi-square test and its applications, Analysis of variance (ANOVA), Types of biological data, Biological Databases: Nucleic acid and protein sequence and protein structure databases, Bioinfo tools DNA sequence analysis (DSA), Sequence annotations and sequence analysis - Phylogeny of gene (blast, fasta, HMMer) and residue conservation. Primer design and T<sub>m</sub> Calculation, DNA Restriction pattern analysis.



## Paper – **II** Genomics

### Unit I.

#### Organization of genomes:

Introduction: genome, genomics, omics and importance, general features, C-value paradox, gene identification, gene prediction rules and softwares: genome databases; annotation of genome. Genome diversity: taxonomy and significance of genomes-bacteria, yeast, *Caenorhabditis*, *Homo sapiens*, *Arabidopsis*, etc. synthetic genomes and their applications.

### Unit II.

#### Mapping genomes:

Genetic mapping- i) Cross breeding and pedigree analysis, ii) DNA markers- RFLPs, SSLPs, SNPs. Physical mapping- restriction mapping, RAPD, Fluorescent in situ hybridization, Radiation hybrid mapping and sequence tagged site mapping.

### Unit III.

#### Genome projects:

The Human genome projects, HapMap Project, the 1000 genome project, the ENCODE project. Structural genomics: assembly of a contiguous DNA sequence- shotgun method, clone contig method, and whole- genome shotgun sequencing. Understanding a genome sequence: locating the genes in a genome sequence, determining the functions of individual genes and by studying the activity of a protein coded of an unknown gene

### Unit VI.

#### Functional genomics:

Determining functions of individual genes: computer analysis experimental approaches; case study- annotation of the *Saccharomyces*. RNAi, gene targeting, knock out mice; functional annotation by sequence comparison. DNA microarrays. Structural genomics, pharmacogenomics, drug detoxification genes, evolution of chromosomes and genomes. Comparative genomics, molecular phylogenetics, mitochondrial DNA analysis.

## Pre-Ph.D Syllabus Paper III

### Medical and Industrial Biotechnology

#### Unit-I

**Gene Therapy Strategies:** History and scope of gene therapy, Types of gene therapies; Somatic and germ lines, Gene replacement and gene addition, In vivo, ex vivo and in vitro gene therapies. Gene therapy vectors: Viral vectors: Retrovirus, Adenovirus, Adeno-associated virus, Lentivirus, Herpes virus, Nonviral vectors; Naked DNA, Liposomes and lipoplexes, Transposon. Gene editing methods: Cre-Lox system, Zn-finger nuclease, TALEN, CRISPR-Cas9.

#### Unit-II

**Gene Therapy for Human Diseases:** Gene therapies for Hemophilia B,  $\beta$ -Thalassemis and Sickle cell disease, Cystic fibrosis, Duchenne muscular dystrophy, Inherited neurological disorders, Inherited retinal disorders, Cancer Immunotherapy, Tyrosinemia, Severe combined immunodeficiency syndrome (SCID), Gene therapy of nonheritable disorders, recent advancement in gene therapy.

#### Unit-III

**Industrial Biotechnology Systems:** Selection of microorganisms: Genetic manipulation and potential problems of genetic engineering, preservation of microorganisms. Rationale for the design of vectors for the over expression of recombinant proteins in microorganisms: selection of suitable promoter sequences, ribosome binding sites, transcription terminator, fusion protein tags, Purification tags, protease cleavage sites and enzymes, inducible expression systems. Over expression model systems: *E. coli*, Yeast, Baculovirus, *Agrobacterium tumefaciens*, oral vaccines

#### Unit-IV

**Product and Processes in Industrial Biotechnology:** Industrial production of lactic acid, vinegar, insulin, alcohol, baker's yeast, antibiotics, enzymes. Fermented foods: Milk, cheese, meat, alcoholic beverages, breads and Single Cell Proteins (SCP). Controlling food spoilage: aseptic handling, low-temperature, high-temperature, dehydration, chemical-based preservation, radiation, osmotic pressure. Food-borne diseases: Food borne infections, intoxications. Biosensors, biopesticides, Petroleum microbiology.

#### Recommended Books:

1. Microbiology by Prescott, Harley, Klein (Mc.Graw Hill).
2. Microbiology by Michael J. Pelczar, JR., E.C.S. Chan, Noel R. Krieg (Tata Mc.-Graw Hill).
3. Genome by TA Brown