

B.Sc. Part III

There will be three written papers and one practical examination. The following courses are prescribed.

PAPER I Biostatistics, Bioinformatics and Bioinstrumentation

Unit-I

Basics of Biostatistics

Calculations of mean, median, mode, variance, standard deviation

Concepts of coefficient of variation, Skewness, Kurtosis

Elementary idea of probability and application

Data summarizing: frequency distribution, graphical presentation—bar, pie diagram, histogram

Tests of significance: one and two sample tests, Z-test, t-test, F-test and Chi-square test

Unit-II

Basics of Computers

Basics (CPU, I/O units) and operating systems

Computer networking, internet and e-mail

Concept of homepages and websites, World Wide Web, URLs, using search engines

Databases: nucleic acids, genomes, protein sequences and structures, SNP db

Bibliography

Unit-III

Basics of Bioinformatics

Information retrieval from biological databases, Entrez system, SRS

Sequence analysis (homology): pairwise and multiple sequence alignments-BLAST, CLUSTALW

Protein structure prediction---visualizing 3D-structures of proteins

Phylogenetic analysis

Unit-IV

Bioinstrumentation

Microscopy: principles and application--light microscopy, dark field microscopy, phase-contrast microscopy, fluorescence microscopy, confocal microscopy, electron microscopy, Photography-- digital imaging and image processing

Centrifugation: principle, types of rotors, high speed and ultracentrifuge

Colorimetry and spectrophotometry: Beer-Lambert law, absorption spectrum

Chromatography: paper, thin layer, column---ion-exchange, gel filtration, HPLC, affinity

Measurement, applications and safety measures of radio-tracer techniques

PAPER II Population Genetics, Behavioural Genetics and Applied Molecular Genetics

Unit-I

Population and Evolutionary Genetics

Microevolution in Mendelian population: allele frequencies, genotype frequencies, Hardy-Weinberg equilibrium and conditions for its maintenance

Forces of evolution: mutation, selection, genetic drift

DNA polymorphism in natural population

Unit-II

Genes and Environment

Genotype to phenotype: effect of environment, penetrance, expressivity, phenocopy, gene interactions and modifying genes

Inheritance of quantitative traits—continuous and discontinuous variation

Polygenic inheritance, genetic variance, heritability

Unit-III

Behavioural Genetics

Genetics of animal and human behaviour—selection studies, inbred strain studies, twin and adoption studies, linkage and association studies

Learning and memory

Psychological disorders---mental retardation, learning disorders, mood disorders, anxiety disorders, personality disorders

Unit-IV

Applied Molecular Genetics

Nucleic acid fractionation, detection by electrophoresis, DNA sequencing, polymerase Chain Reaction (PCR), primer designing, DNA fingerprinting, site directed mutagenesis, RFLP

Molecular cloning, genomic libraries, Gene transfer techniques: electroporation, microinjection

Oligonucleotide synthesis, preparation of probes, hybridization, Southern, Northern and south-western blotting

Detection of proteins, PAGE, ELISA, western blotting, hybridoma technology

Applications of recombinant DNA technology: crop and live stock improvement, development of transgenics, Gene therapy, Development of DNA drugs and vaccines

DNA diagnostics--genetic analysis of human diseases, detection of known and unknown mutations

PAPER III Genomics

Unit-I

Organization of genomes

Overview of prokaryotic and eukaryotic genomes

Human genome project: mapping strategies

Mitochondrial genome, nuclear genome, gene density, CpG islands, Gene families and superfamilies: gene duplication, pseudogenes, repetitive DNA and transposable elements

Unit-II

Comparative Genomics

Conservation and diversity of genomes

Genome size and organizations of genes

C-value, number of genes and complexity of genomes

Comparative genomics as an aid to gene mapping and study of human disease genes

Unit-III

Functional Genomics

Concepts of transcriptome and proteome

Microarray technology, and Proteomics

Prediction, diversity and multiplicity of protein functions

Sequence homology and prediction of gene functions

Unit-IV

Pharmacogenomics and Human Health

Concept of pharmacogenomics and pharmacogenetics

Genetic polymorphisms in drug metabolizing enzymes, drug targets, effects on drug response

Personalized medicine—optimizing drug therapy

Gene chips: applications in disease profiles, drug target discovery, drug action and toxicity

B.Sc. Part III
Genetics and Genomics Practical Syllabus

1. Application of different statistical tools to genetic studies.

2. Use of different computer programmes- MS Word, MS Powerpoint, MS Excel, Adobe Photoshop, INTERNET, Search engines, Homepages etc.

3. Genomics through Bioinformatics tools

- NCBI, Entrez, PubMed, Gene, Genomes
- BLAST, PSI-BLAST, homology searching
- Multiple alignment, CLUSTAL W
- Gene families
- Protein structure prediction (ExPasy, PROSITE).
- Phylogenetic analysis (PHYLIP).
- Primer designing

4. Molecular Genetics Techniques

- **Protein Chemistry:** Fractionation by differential centrifugation, Spectrophotometric estimation, Detection of proteins by Polyacrylamide Gel Electrophoresis (PAGE), Purification of proteins by paper and Gel filtration chromatography.
- **Nucleic Acid Chemistry:** DNA extraction from blood and flies, Quantitation by spectrophotometry, Detection of DNA on gel by Agarose gel electrophoresis, Southern hybridization and Comet Assay.
- **DNA Fingerprinting and Diagnostics:** Manual DNA sequencing (Demonstration), Polymerase Chain Reaction (PCR).
- **Molecular cloning:** Preparation of competent bacterial cells, Inserting a fragment of DNA in a suitable vector, Transformation using the recombinant plasmid.

5. Seminar

6. Class Record and *Viva-voce*