# CELL BIOLOGY AND GENETICS

**Objective:** To introduce the concept of cells and their organelles.

## Unit I Cell Organization and Cell cycle


## Unit II Cell Membrane and Cell Wall

Cell Membrane - Structural models; Composition and dynamics; Transport of ions and macromolecules; Pumps, carriers and channels; Endo- and Exocytosis; Membrane carbohydrates and their significance in cellular recognition; Cellular junctions and adhesions; Structure and functional significance of plasmodesmata. Eukaryotic Cell wall – Composition and significance.

## Unit III Cell Signaling and Signal Transduction


## Unit IV Basic of Genetics


## Unit V Genes, Mutation and Mutagenesis

UV and chemical mutagens; Types of mutation; Ames test for mutagenesis; Methods of genetic analysis. Bacterial Genetic System Transformation, Conjugation, Transduction, Recombination, Plasmids and Transposons. Bacterial genetics map with reference to *E.Coli*. Virus and Their Genetic System Phage I and its life cycle; RNA phages; RNA Viruses; Retroviruses. Genetic Systems of Yeast and *Neurospora* - types.

**Recommended Texts:**

BIOMOLECULES AND METABOLISM

Objective: To discuss various biomolecules and their metabolism relevant to bioinformatics.

UNIT I: CARBOHYDRATES

Classification, Structure, Properties and Biological role of Carbohydrates. Carbohydrate Biosynthesis, Metabolism - Glycolysis, TCA cycle and ATP Bioenergetics. Glycogenesis, glycogenolysis, glyconeogenesis.

UNIT II: PROTEINS


UNIT III: NUCLEIC ACIDS

Structure of Nucleoside and nucleotides- Watson - Crick Model of DNA structure. A, B and Z-DNA Cruciform Structure in DNA, formation and stability of cruciforms, miscellaneous Alternative conformation of DNA, slipped mispaired DNA, parallel stranded, anisomorphic DNA, palindrome, secondary and tertiary structure of RNA, mRNA, methods for nucleic acid sequence determination, denaturation, strand separation, fractionation, isolation and purification of DNA mRNA, rRNA and tRNA, molecular hybridization, Cot value curve, hypochromic effect, DNA-protein interactions.

UNIT IV: LIPIDS


UNIT V: VITAMINS

Vitamins- Definition, classification - water soluble - thiamine, riboflavin, niacin, pyridoxine, folic acid, ascorbic acid- sources, structure, biochemical functions, deficiency diseases, daily requirements; fat soluble - vitamin A, vitamin D, vitamin E and vitamin K sources, structure, biochemical functions, deficiency diseases, daily requirements.

Recommended Texts

BIOPHYSICS & BIOINSTRUMENTATION

Semester : I
Category : 
Credits : 3
Hrs/Wk : 4

Objective: To enable students learn and appreciate various techniques to identify and elucidate biomolecular structures.

Unit I: Atomic & Molecular Structures.

Structure of Atom, Schrodinger’s theory, Quantum numbers, Pauli’s exclusion principle, Hund’s rule, Periodic table, Bonds between atom & molecules, Ionic, Covalent, Hydrogen, Electrostatic, Disulphide & Peptide bonds, Vander waals forces, Bond energies, Bond angles, Bayer’s strain, Weak interactions, Molecular orbital theories, Hybridization of orbitals, σ and π bonds.

Unit II: Thermodynamics.

Laws of Thermodynamics, Concept of free energy, Unavailable energy & Entropy, Negative entropy change in living system, Heat content of food, Bomb colorimetry, Energy generation & energy transfer processes in biochemical reactions, Metabolism of glucose & formation of ATP.

Unit III: Centrifugation and Chromatography

Centrifugation: Preparative and Analytical Centrifuges, Sedimentation analysis RCF, Density Gradient Centrifugation.

Chromatography Theory and Application of Paper Chromatography, TLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, GLC and HPLC.

Unit IV: Spectroscopic Techniques

Theory and Application of UV and Visible Spectroscopy, Fluorescence Spectroscopy, MS, NMR, ESR, Atomic Absorption Spectroscopy, X-ray Spectroscopy, LASAR, Raman Spectroscopy. MALDI

Unit V: Tracer techniques


TOTAL 45

Recommended Text Books

# WEB TECHNOLOGY & DATABASE MANAGEMENT SYSTEM

**Objective:** To create awareness to students on database concepts and manage database effectively through SQL.

## Unit I Network Basics and Internet Technologies

<table>
<thead>
<tr>
<th>Component</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Networking - LAN, WAN &amp; MAN, Intranet Wireless communication Internet, Web Services WWW, URL, DNS - Servers-E-mail server, WEB servers, Browsers -IP Addressing - Structure of an IP address, Overview of TCP/IP and its services OSI reference model – Topologies - Networking gadgets - router, switch etc., - FTP and Telnet.</td>
<td>9</td>
</tr>
</tbody>
</table>

## Unit II Markup language

<table>
<thead>
<tr>
<th>Component</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>How a Web Browser communicates with a web server, what is HTML and various standard HTML tags, Introduction to CSS, Using external CSS files, Introduction to XML; Java Script, Basic Concepts, data types, control structures, operators, basic scripting.</td>
<td>9</td>
</tr>
</tbody>
</table>

## Unit III Database Concepts

<table>
<thead>
<tr>
<th>Component</th>
<th>Hours</th>
</tr>
</thead>
</table>

## Unit IV Introduction to Database Management System (DBMS)

<table>
<thead>
<tr>
<th>Component</th>
<th>Hours</th>
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</thead>
</table>

## Unit V Relational Database and Data Mining

<table>
<thead>
<tr>
<th>Component</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advantages and Disadvantages of RDBMS – Functional, Multivalued and Project Join Dependencies, Decomposition, Data Storage - Ordered indices, Static Hashing, Dynamic Hashing - Transaction Management Security and Authorization - Locking techniques, Granularity of Data Items - Introduction to Data mining: Classification, Clustering, Data Warehousing, Applications of Data Mining.</td>
<td>10</td>
</tr>
</tbody>
</table>

## Recommended Texts:

# FOUNDATION COURSE IN COMPUTERS AND PROGRAMMING

**Semester :** I  
**Credits :** 3  
**Hrs/Wk :** 4

**Objective:** To acquire basic computer skills for effective handling of bioinformatics tools.

## Unit I Computer Organization


## Unit II Devices

Storage Devices - hard disk, diskette, magnetic tape, RAID, ZIP devices, digital tape, CD-ROM, DVD (capacity and access time) Main circuit board of a Personal computer-micro processor, ports, expansion slots Memory-register, buffer, RAM, ROM, PROM, EPROM, EEPROM (comparison) - Types of processing - batch, real-time, online, offline - HPC, Cluster computing, Grid computing, Cloud Computing; Open Vs Proprietary Soft wares.

## Unit III Operating System

Representation of Information: Number Systems, Integer & Floating Point representation; Character codes (ASCII & EBCDIC); Basics of operating systems DOS, Windows, UNIX/LINUX. Basic commands to work in Unix/Linux platform. VI editor and other text editors. File Archiving – zip and unzipping files and folders; Shell Scripting, Utilities

## Unit IV Application Softwares and Packages

Introduction to Application Software’s / Packages – Introduction to MS-Office Suite - Word creating a new document templates and wizards scientific data representation and basic calculations with EXCEL - Creating Tables and databases using Access interactive presentations by using Power Point.

## Unit V Programming Basics

Introduction to Programming Languages and Paradigms, Syntactic Structure, Semantics, Data Representation, Data Abstraction, Procedure activation, Structured Programming, Block Structuring - Types of Programming Languages, High & Low level language; Compiler, Translator; Machine Language; SDLC and its stages - Algorithm design and analysis, flow charts.

**Recommended Texts**

TECHNIQUES IN MOLECULAR CELL BIOLOGY PRACTICALS

Semester : I
Category : Major Practicals

Credits : 3
Hrs/Wk : 5

1. Cellular Organelles isolation by differential centrifugation
2. Genomic DNA isolation and checking its purity
3. Plasmid DNA isolation
4. Isolation of Proteins
5. Purification of Proteins
6. TLC
7. Column chromatography
8. Agarose Gel Electrophoresis
9. SDS-PAGE
10. PCR
WEB TECHNOLOGY & DATABASE MANAGEMENT SYSTEM PRACTICALS

Semester : I  
Category : Allied Practicals  
Credits : 2  
Hrs/Wk : 5

Web Technology

1. Create a simple webpage.
2. Applying Formatting and Hyper links
3. Using Tables
4. Lists – Ordered, Unordered and Definition
5. Use frames to Include Images and Videos.
6. Add a Cascading Style sheet for designing the web page.
7. Design a dynamic web page with validation using JavaScript

DBMS

1. Simple Queries
2. Built-in-functions
3. Group Functions
4. Multiple sub-queries
5. SQL Views & Triggers
6. Simple PL/SQL Procedures
7. PL/SQL Procedures for accessing Databases
8. Payroll System
BASIC MICROBIOLOGY & IMMUNOLOGY

Semester : II  
Category : Core  
Credits : 4  
Hrs/Wk : 4

Objective: To develop skills in microbiology and immunology relevant to bioinformatics.

Unit I Introduction to Microbiology and Microscopy  
- History and Scope of Microbiology – Review of important milestones in Microbiology - Contributions of scientists during 1990 to update - Microbial Taxonomy – definition, classification - Whittaker Five Kingdom Concept and E. H. Haekel's Three kingdom concept – operative and taxonomic units - Phenotypic and taxonomic characters –Numerical Taxonomy, Molecular Taxonomy based on DNA, RNA and Proteins - Archaebacteria : taxonomic position (relatedness to eukaryotes and prokaryotes, unique molecular and biochemical features) - Nomenclature of Bacteria, Fungi and Virus. - Microscopy – Bright field, dark field, phase contrast, fluorescent, electron - Stains and their uses.

Unit II Morphology, Growth and Reproduction of microorganisms  
- Basic Morphology of Bacteria, Fungi and Virus - Microbial Growth - Definition, mathematical expression of growth, growth curve, measurement of growth and growth yields; Synchronous growth; Continuous culture; Growth as affected by environmental factors like temperature, acidity, alkalinity, water availability and oxygen; Culture collection and maintenance of cultures - Principles of microbial nutrition - Construction of culture media; Enrichment culture techniques for isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microorganisms -Methods in Microbiology Development of pure culture methods – Pure culture techniques; Theory and practice of sterilization

Unit III Applied Areas of Microbiology  
- Microbial Diseases – Bacterial – Gram Positive (Staphylococci, Streptococci, Mycobacterium) - Gram Negative (Gonococci, Enterobacteriaceae, Vibrio, Proteus, Pseudomonas), Viral (DNA virus – Flu, Adeno, Hepatitis, RNA virus – TMV, HIV) and Fungal (Candida and Aspergillus) - Role of Microbes in food production, spoilage and preservation – Industrial Production of alcohol and antibiotic – Bioremediation, Bioaccumulation and Bioaugmentation.

Unit IV Basic Immunology  
- Immunity – definition and types - Innate, Acquired – Arms of Immunity (Humoral and Cell mediated) - Components of immune system: organs, tissues and cells - Definition and Biology of antigens - haptns - antigenicity and immunogenicity – Immunoglobulin – Structure and functions; Ig classes - Antibody diversity and Ig genes – Monoclonal Antibodies and their production – Complement system and its pathways – Antigen Processing and Presentation.

Unit V Applied Immunology  
- Antigen-Antibody Reactions – affinity, avidity, specificity and cross reactivity – Important tests based on Ag-Ab reactions - Hypersensitivity Reactions – Immediate (type 1, type 2 and type 3) and Delayed (type 4) Immunotolerance – Central and Peripheral, Immunodeficiency, Transplantation immunology and Tumor immunology

Recommended Texts:
INTRODUCTION TO BIOINFORMATICS

 Semester : II
 Category : Core
 Credits : 4
 Hrs/Wk : 4

Objective: To impart knowledge basic bioinformatics skills for requirement.

Unit I Bioinformatics Basics

Basic concepts - Protein and amino acid, DNA & RNA, Sequence, structure and function - Forms of biological information, Types of Nucleotide Sequence: Genomic DNA, Complementary DNA (cDNA), Recombinant DNA (rDNA), Expressed sequence tags (ESTs), Genomic survey sequences (GSSs). DNA sequencing methods: Basic and Automated DNA sequencing, DNA sequencing by capillary array and electrophoresis, Gene expression data.

Unit II Bioinformatics databases

Introduction - Motivation- Type of databases - Nucleotide sequence databases: Primary nucleotide sequence databases : EMBL, GeneBank, DDBJ - Secondary nucleotide sequence databases: UniGene, SGD, EMI Genomes - Protein sequence databases – SwissProt/TrEMBL, PIR – Sequence motif Databases : Pfam, PROSITE – Protein structure and classification databases : PDB, SCOP, CATH SwissProt/TrEMBL – Pathway databases – KEGG etc.

Unit III Sequence alignment and database searching

Sequence alignments - Biological motivation - Pair wise alignments - Sequence alignment and applications: Uses: Choice to be made for alignment; Homology and related concepts; Dot Matrix methods; Dynamic programming methods for global and local alignments- Database Searching-FASTA, BLAST; statistical and Biological significance. Scoring matrices: PAM, BLOSUM etc.

Unit IV Multiple Sequence alignment

MSA Uses; Methods available- Iterative alignment, Progressive alignment – Profile Methods – , PSI-BLAST, HMM; Clustering and Phylogeny; Methods for Phylogeny analysis: Phenetic and Cladistic approaches; Motif detection; Protein family databases; Uses of Structure based sequence alignment.

Unit V Sequence Analysis

Nucleotide sequence - Reading frames; Codon Usage analysis; Translational and transcriptional signals; Splice site identification; Gene prediction methods; RNA fold analysis; Protein Sequence analysis - Compositional analysis ; Secondary structure prediction methods

Recommended Books

# PROGRAMMING IN C AND C++

<table>
<thead>
<tr>
<th>Semester : II</th>
<th>Credits : 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category : Core</td>
<td>Hrs/Wk : 4</td>
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</tbody>
</table>

**Objective:** To impart programming skills using C and C++.

## Unit I Introduction to C

Introduction and importance of programming with C - History of C language - The process of learning a language – Characteristic features of C language - Turbo C Editor - Saving, compiling and executing a C program. – Basic structure, data types, constants, variables, declaration and assigning variables – Control and Repetitive Statements: IF-THEN-ELSE, SWITCH, WHILE, FOR, DO; Break and Continue Statements, - operator types.

## Unit II File handling in C

C-Library - Input and Output functions, Function and its types - Introduction to arrays, pointers, structures - Simple programs in functions, pointers and arrays. – File handling: Opening, Updating and Closing a file, Command line arguments –Simple programs in files and command line arguments.

## Unit III Overview of C++ : Object oriented programming

Introducing C++ classes, Concepts of object oriented programming. Classes & Objects: Classes, Friend function, Friend classes, Inline function, Scope resolution operator, Static class members: Static data member, Static member function, Passing objects to function, Returning objects, Object assignment.

## Unit IV Array, Pointers, Constructors, Destructors and File handling

Array of objects, Pointers to object, Type checking C++ pointers, The This pointer, Pointer to derived types, Pointer to class members, Constructor & Destructor : Introduction, Constructor, Parameterized constructor, Multiple constructor in a class, Constructor with default argument, Copy constructor, Default Argument, Destructor.

## Unit v Inheritance, Polymorphism and Operator overloading

Inheritance : Base class, Access control, Inheritance & protected members, Protected base class inheritance, Inheriting multiple base classes, Constructors, destructors & Inheritance, When constructor & destructor function are executed, Passing parameters to base class constructors, Granting access, Virtual base classes.

Function & operator overloading: Function overloading, Overloading constructor function, Operator Overloading: Creating a member operator function, Operator overloading restrictions, Operator overloading using friend function.

## Recommended Books

### GENOMICS AND PROTEOMICS

**Objective:** To introduce the students to the concept of *in silico* and *in vitro* analysis of Genome and Proteome.

<table>
<thead>
<tr>
<th>Unit I Genomics and Metagenomics</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization of the prokaryotic and eukaryotic genomes; Genome databases; Annotation of genome. Genome diversity: taxonomy and significance of genomes bacteria, yeast, <em>Caenorhabditis, Homo sapiens, Arabidopsis</em>, etc. Metagenomics: Gene networks: basic concepts, computational model such as Lambda receptor and lac operon. Basic concepts on identification of disease genes, role of bioinformatics-OMIM database, reference genome sequence, integrated genomic maps, gene expression profiling; identification of SNPs, SNP database (DbSNP).</td>
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<table>
<thead>
<tr>
<th>Unit II Comparative genomics</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic concepts and applications, whole genome alignments: understanding the significance: Artemis, BLAST2, MegaBlast algorithms, PipMaker, Vista, MUMmer, applications of suffix tree in comparative genomics, synteny and gene order comparisons. Comparative genomics databases: COG, VOG - Application of sequence based and structure-based approaches to assignment of gene functions – e.g. sequence comparison, structure analysis (especially active sites, binding sites) and comparison, pattern identification, etc. Use of various derived databases in function assignment,</td>
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</table>

<table>
<thead>
<tr>
<th>Unit III Genome mapping</th>
<th>10</th>
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</table>

<table>
<thead>
<tr>
<th>Unit IV Proteomics</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein arrays: basic principles. Computational methods for identification of polypeptides from mass spectrometry. Protein arrays: bioinformatics-based tools for analysis of proteomics data (Tools available at ExPASy Proteomics server); databases (such as InterPro) and analysis tools. Protein-protein interactions: databases such as DIP, PPI server and tools for analysis of protein-protein interactions</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit V Microarray and clustering</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNA microarray: database and basic tools, Gene Expression Omnibus (GEO), Array Express, SAGE databases DNA microarray: understanding of microarray data, normalizing microarray data, detecting differential gene expression, correlation of gene expression data to biological process and computational analysis tools</td>
<td></td>
</tr>
</tbody>
</table>

**Recommended Texts:**

BASIC MATHEMATICS AND BIOSTATISTICS

Semester: II  Credits: 3
Category: Core  Hrs/Wk: 4

Objective: To enable students to understand the concept of mathematics and statistics and apply them effectively for biological problem solving.

Unit: I Matrices and vectors


Unit-II Differentiation and Integration

Concept of limit, continuity, Differentiation. (derivations of standard functions), Maxima and Minima – Introduction to partial differentiation. Integral calculus – definite integrals only.

Unit-III Data and its collection

Sampling methods: Simple random sampling, Stratified and systematic sampling (concepts only). Graphic and diagrammatic representation of Data. Averages: Mean, Median and Mode- Dispersion: Range, Quartile Deviation, Mean deviation, Standard deviation and co-efficient of variation, skewness and kurtosis (simple problems)

Unit-IV Probability


Unit V Hypothesis Testing and ANOVA

Testing of Hypothesis: Null and alternative hypothesis, Two types of errors, one tail, two tailed test- Standard error –Sampling distribution- Large and small sample test related sample mean and difference between the means - Analysis of variance - meaning- assumptions, one and two way analysis. Statistical Packages – An introduction to SPSS/SAS.

Recommended Texts:

MICROBIOLOGY & IMMUNOLOGY PRACTICALS

Semester : II  
Category : Major Practicals  
Credits : 3  
Hrs/Wk : 5

1. Sterilization techniques – Dry heat, moist heat, chemical agents
2. Media Preparation – Broth and agar media
3. Isolation and enumeration of microbes from soil sample
4. Pure culture techniques – Pour plate, Streak Plate
5. Staining techniques – Simple and Differential (Gram, Acid Fast)
7. Bacterial Growth curve
8. Kirby-Bauer Antibiotic Disk diffusion test
9. Collection of Blood (capillary and vein puncture) and Isolation of serum/plasma
10. Agglutination Test – Blood Grouping (slide and tube test)
11. Immunodiffusion technique
12. Serum electrophoresis
13. Immunoelectrophoresis
14. ELISA
15. Western Blotting
PROGRAMMING IN C AND C++ PRACTICALS

Semester : II
Category : Allied Practicals

C Programming

1. Expressions
2. Control Statements
3. Arrays
4. Stack
5. Queue
6. Pointers
7. Linked Lists
8. File Management in C for Biologists.

C++

1. Functions
2. Classes and Objects
3. Constructors and Destructors
4. Polymorphism
5. Inheritance
6. Introducing Pointers to Objects
ALGORITHMS IN COMPUTATIONAL BIOLOGY

Semester : III  
Category : Core  
Credits : 4  
Hrs/Wk : 4

Objective: Concepts and applications of problem solving ability relevant to bioinformatics and computational biology.

Unit 1 Strings and trees:  

Unit 2 Sequence alignment:  

Unit 3 Alignment strategies:  

Unit 4 Pattern matching:  

Unit 5 Methods of analyses of Biomolecular structures:  
Visualization and representation of molecular structure - computer graphics – methods of representing a three-dimensional object on a two-dimensional surface – methods of representing biological molecules – geometrical analyses – bond lengths, angles, hydrogen bonds, torsion angles, calculations of planes, the Ramachandran map.

Recommended Texts:

STRUCTURAL BIOINFORMATICS AND DRUG DESIGN

Semester : III
Category : Core

Objective: To develop students managing biomolecular structures and designing of effective drugs using in silico methods.

UNIT I  Structure Prediction

Prediction of secondary structure - membrane predict - Comparative modeling - Sequence Alignment Homologs - analogs - Homology modeling - steps in homology modeling - side chain modeling – loop modeling - fold recognition – ab initio prediction – Predicting protein structures by threading protein folding – active site/binding site prediction – tools – databases - CASP.

UNIT II Quantum Chemistry


UNIT III Molecular Mechanics & Visualization


UNIT IV Molecular Dynamics

Molecular Dynamics (MD) simulation of biopolymers - time steps - Setting up MD - energy conservation in MD Simulation -continuous potentials and constraint dynamics - MD at constant temperature and pressure - incorporating solvent effects - examples-random number generator - Monte Carlo simulation of biological macromolecules - MD softwares.

UNIT V Drug Design


Total 45 hrs.

Recommended Texts:

2. Willi Bannwarth, Berthold Hinzen, “Combinatorial Chemistry A practical approach”; 2000, Wiley
APPLICATIONS OF BIOINFORMATICS

Semester: III  Credits: 4
Category: Core  Hrs/Wk: 4

Objective: To expose different areas benefited by employing the bioinformatics concepts.

Unit I Data Mining
7


Unit II Data Preprocessing and Clustering
12

Descriptive Data Summarization, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation, Data Warehouse and OLAP technology – A Multidimensional Data Model – From Data Warehousing to Data Mining, Types of Data in Cluster Analysis – Partitioning Methods-Hierarchical Methods – Density Based Methods- Grid-Based Methods- Model Based Clustering Methods- Clustering High Dimensional Data - constraint-Based Cluster Analysis - Clustering paradigms - K-medoid algorithm - Heirarchical Clustering – Additive Properties of Cluster features – Categorical clustering algorithms.

Unit III Cheminformatics and Databases
9

Introduction to Cheminformatics - History and evolution of Cheminformatics - Chemical representation - Sequence, 2D, 3D structure, Types of chemical representation - linear notation, tabular storage, graphical representation – Chemical data management - Chemical mark up languages. Chemical Databases - CHEMDB, KEGG LIGAND, CSD, CAS REGISTRY, BIOMETA DB, National Cancer Institute Database(NCI) - Chemical searching methods - exact searching, sub structure searching, similarity searching, reaction searching.

Unit IV Pharmacogenomics in personalized medicine
8

Pharmacogenomics of Cardiovascular Diseases, of Cancer treatment, of Neurodegenerative Diseases, in Depression, Respiratory diseases, in AIDS, in Antibiotics. Management Of Pharmacogenomic Information - The Pharmacokinetins and Pharmacogenomics knowledge Base, Systems for the Management of Pharmacogenomic Information

Unit V Introduction to Immunoinformatics
9


Recommended Texts:

# PERL PROGRAMMING IN BIOINFORMATICS

**Semester : III**  
**Category : Core**  
**Credits : 4**  
**Hrs/Wk : 4**  

**Objective:** To enable students acquire perl programming skills handle biological data.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topic</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td><strong>Unit I</strong></td>
<td>Introduction to Perl</td>
<td>8</td>
</tr>
<tr>
<td><strong>Unit II</strong></td>
<td>Regular Expression in Perl</td>
<td>8</td>
</tr>
<tr>
<td><strong>Unit III</strong></td>
<td>Subroutines &amp; Modules</td>
<td>9</td>
</tr>
<tr>
<td><strong>Unit IV</strong></td>
<td>CGI-programming</td>
<td>10</td>
</tr>
<tr>
<td><strong>Unit V</strong></td>
<td>Bio-Perl modules</td>
<td>10</td>
</tr>
</tbody>
</table>

- **Unit I Introduction to Perl**  
  Data types: Scalar, Arrays (including array Functions and Operators) and Hashes, References, Operators, scope of variables: my, local, our, Control statements, File input/output operations.

- **Unit II Regular Expression in Perl**  
  Regular Expressions: Special Characters: +, *, [ ], Pattern modifiers, Meta Symbols Conditional Match Operators, Pattern Anchors, Escape Sequences

- **Unit III Subroutines & Modules**  
  Subroutines prototypes, Subroutine parameters, Passing References, Functions: index, rindex and substring, Packages, package auto loading, Modules: using modules, creating modules.

- **Unit IV CGI-programming**  
  The concept of CGI, Why CGI is used, How CGI works. The two methods of Data submissions, the differences in the two methods of submissions, the importance of Environment variables in a CGI program, the basic steps required to process from information in a CGI program, Why Perl is the language of choice for programming in CGI.

- **Unit V Bio-Perl modules**  
  Installation and usage of Bio-Perl modules, execution of customized blast search using Bioperl modules.

**Recommended books:**

Elective – I

SYSTEMS BIOLOGY AND METABOLIC PATHWAYS

Semester : III  Category : Elective
Credits : 4  Hrs/Wk : 4

Objective: To develop in silico methods in managing metabolic pathways.

UNIT I Terminology & Principles


UNIT II Standard Models and Approaches


UNIT III Modeling of Gene Expression


UNIT IV Evolution and Self - Organization

Evolution and Self-organization - Quasispecies and Hyper cycles - Other Mathematical Models of Evolution - Prediction of Biological Systems from Optimality Principles - Data Integration - Database Networks – Information Measurement in Heterogeneous Data - The Human interactome - Protein-DNA and Protein-Protein Interactions – Scale free networks in Cell Biology.

UNIT V Information Retrieval and Examination


Recommended Texts

Elective - II  

**RECENT TRENDS IN BIOINFORMATICS**

<table>
<thead>
<tr>
<th>Semester: III</th>
<th>Credits: 4</th>
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</thead>
<tbody>
<tr>
<td>Category: Elective</td>
<td>Hrs/Wk: 4</td>
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</tbody>
</table>

**Objective:** To provide knowledge to students on latest trends in bioinformatics.

**Unit I Basics of Cloud Computing**


**Unit II Advanced Algorithms in Computing**

Introduction to Artificial Neural Networks, Genetic Algorithms and their applications in the field of Bioinformatics; Pattern Discovery, Association and Classification. Statistical mechanics Machine Learning Algorithms.

**Unit III Basics of Systems Biology and Microarrays**


**Unit IV Metagenomics**


**Unit V Healthcare informatics:**

Sampling, appropriate use of controls, data collection including human-testing of statistical significance, sensitivity and specificity.ROC plots. Methods and issues specific to healthcare. Understanding and interaction Health organization especially academic health centers, understanding the health care environment, understanding the organization informatics- Interaction between these three units-machine learning approaches to make decision making and discovery. Human factors in clinical systems – use of machine learning to make modeling, data mining, policy design and law.

**Recommended Texts**

Practicals

TOOLS IN BIOINFORMATICS

Semester : III  
Category : MAJOR PRACTICALS

Credits : 3  
Hrs/Wk : 5

Objective: To develop basic computer skill for bioinformatics applications.

- **Sequence Alignment and their analysis**
  1. Pair wise Sequence alignment
  2. Multiple Sequence Alignment
  3. Sequence Analysis
  4. Protein Families
  5. Structural Classification
  6. Phylogenetic Analysis

- **Structure Prediction**
  1. Gene Structure Prediction – GENMARK, GLIMMER
  2. Comparative Genomics – VISTA SERVER

- **Structure Analysis**
  1. Primary Structure Analysis
  2. Secondary structure prediction
  3. Homology Modeling SPDBV, MODELLER
  4. Threading
  5. Validation of the Models
  6. Energy minimizations and optimization
  7. Protein Structure alignment

- **Molecular Docking**
  1. Binding Site Identification
  2. Molecular Docking using Argus lab and Autodock
  3. Molecular Dynamics
Practicals

PERL PROGRAMMING PRACTICALS

Semester : III
Category : MAJOR PRACTICALS

Credits : 3
Hrs/Wk : 5

Objective: To develop basic computer skill for bioinformatics applications.

1. Scalar variables and Array variable
2. Array functions
3. Hashes variable
4. Control structures
5. File input and output
6. Pattern matching
7. Subroutines
8. Bioperl module installation
9. Sequence retrieval using bioperl module
10. Convert one format sequence to another using bioperl module
11. Web page creation using HTML forms and attributes
12. Accessing details using the CGI.pm module.
Objective: To expose students to international project practices, through a real-life project work under time and deliverable constraints, applying the knowledge acquired through various courses, aiming at some original work.

Students are required to carry out a 5 months individual project and submit a dissertation embodying the findings of the same. Being a Postgraduate level dissertation, original work is expected. The project work is to be done preferably in an internal/external organizations viz., national, state, R&D laboratories. Students should maintain Lab notebooks; with one page brief report for each day. Lab notebooks shall form a component for evaluation and shall be presented to the external examiner, if demanded. Internal evaluation shall be based on project progress reports submitted on a monthly basis.