

**SARDAR PATEL UNIVERSITY**  
**T.Y.B.Sc (BIONFORMATICS)**  
**BNF-301: Immunology**

**Effective from June- 2008**

**Three periods per week**

**External Marks: 80**

**Internal Marks: 40**

**Total Marks: 120**

**Unit –I :**

- Introduction to immunology, Types of immunity- Innate & Acquired. Humoral & Cell mediated, Active & Passive immunity, Antigens- Antigenic determinants, haptens components of Innate & Acquired immunity, Cells of the immune system, primary & secondary lymphoid organs (Bone marrow, Thymus, Lymph nodes, spleen. MALT & GALT)

**Unit – II :**

- Antibiotics – Structure, types & function. Monoclonal antibodies- Hybridoma technology (HAT selection) Application of monoclonal antibodies, B-Lymphocytes , BCR, B-cell development ( Maturation, activation & differentiation), T-lymphocytes , TCR, T-cell development (Maturation, activation & differentiation)

**Unit III :**

- Antigen processing & presentation- Endogenous and exogenous antigens. MHC- Structures, types & functions, Rearrangement & Expression of immunoglobulin genes, Generation of Antibody diversity.

**Unit IV :**

- Antigen- Antibody interactions- Agglutination. Precipitation, Immunodiffusion- single & double, Immuno- Electrophoresis, Complement Fixation Test, ELISA- principle, variants (indirect, sandwich & competitive) and applications, RIA.

**Unit V :**

- Complement system- Introductions & functions, Classical, Alternative & lectin pathway, Cytokines- introduction & types, Role of cytokines in immune response, Transplantation Localised & systemic. Proposed mechanism of generation of auto immunity.

**Unit VI :**

- Immunodeficiency- Primary & Secondary. (AIDS and SCID). Hypersensitivity- Introduction & Types. Apoptosis- Definition, mechanism & significance cell signaling- overview & significance. Role of Bioinformatics in immunology & vaccine development.

**Reference Books:**

1. Immunology by Janis Kubly
2. Immunology by Ivan Roitts.
3. Text Book of Immunology by C.V Rao

**SARDAR PATEL UNIVERSITY**  
**T.Y.B.Sc (BIONFORMATICS)**  
**BNF-302: Genetic Engineering**

**Effective from June- 2008**

**Three periods per week**

**External Marks : 80**

**Internal Marks : 40**

**Total Marks : 120**

**Unit – 1:-**

- R-DNA technology, Restriction enzymes, DNA-RNA modifying enzymes
- Cloning and expression vectors- plasmids (pBR322, pUC) , cosmids ,
- Phagemids(replacement and insertional vector) ,
- Eukaryotic expression vector(SV-40,retroviral vector)
- yeast plasmid based vectors ( YAC,YEP,YIP) shuttle vectors and Ti- plasmid based vector. (Co-integrate and Binary reactor)

**Unit –2**

- Transformation and Transfection various methods of - Recombinant selection & screening ,
- construction of C- DNA & genomic DNA Library.
- In situ hybridization, - methods and application
- Reporter genes-scorable reporter genes (LAC,LUX,GUS) Selectable reporter genes (CAT,NPT,Kan<sup>r</sup>).

**Unit – 3**

- Electrophoresis – Agarose and Polyacrylamide ,
- DNA foot printing, Gel filtration, assay
- HPLC , Ion exchange and affinity chromatography .
- PCR technology – Introduction and overview of classical and RT – PCR,
- Application of Sequencing technologies – Automated and chemical methods of DNA and Protein sequencing .

**Unit – 4**

- Hybridization technique -
- Southern, Northern & Western Blotting techniques,
- dot-Blot hybridization ,Nucleic acid probes and its applications, Radioactive and non radioactive probes and their application
- Autoradiography – principle and application

## **Unit – 5**

- Molecular Mapping – RFLP , RAPD , AFLP , STS , EST, repetitive DNA Micro and mini satellite ,
- SNPs and their application .
- Genomics – Organization of human genome ,
- DNA finger printing and its application

## **Unit – 6**

- Gene transfer to animals and plants, Electoporation , Micro injection, Particle bombardment , Ca<sup>++</sup> Phosphate Mediated, –Retroviral mediated and liposomes
- Application of transgenics, animals & plants
- Stem cell -Potential and applications.
- Gene Therapy-types, methods and application
- Site directed mutagenesis – methods and application

## **Reference Book**

1. Principle of Genetic Manipulation by Old and Primrose
2. Genomes by T. A. Brown
3. Gene Cloning T.A.Brown
4. An introduction to Genetic Analysis – Griffith Miller , Suzuki Levonting

**SARDAR PATEL UNIVERSITY**  
**T.Y.B.Sc (BIONFORMATICS)**  
**BNF – 303 : Bioinformatics Applications**  
**Effective from June- 2008**

**Unit 1:- Genomics:** Genome Anatomy- Prokaryotic genomes structures, Eukaryotic genomes structures , Human Genome Project - overview & applications, Genome sequencing, Comparative genomics.

**Unit 2 :- Gene Prediction :** Gene structure in Prokaryotes and Eukaryotes, Gene prediction methods: Neural Networks, Pattern Discrimination methods, Signal sites Predictions (Promoter, Splice, UTR, CpG-islands), Evaluation of Gene Prediction methods.

**Unit 3 :- Multiple Sequence Alignment :** Significance of MSA, Various approaches for MSA (Progressive & Iterative), Profile analysis, Block analysis, Pattern searching, Motif analysis. Sequence logo, Statistical methods for aiding alignment - Markov Models, PSI/PHI-BLAST

**Unit 4 :- Microarray Informatics:** Microarray - Introduction, Microarray Fabrication, Microarray hybridization and detection, Microarray Image Processing and analysis, Expression ratios, Transformations of the Expression ratio, Data Normalization, Distance Measures: Euclidean distance, Pearson Correlation Coefficient. Clustering Methods: Hierarchical (Single linkage, Complete linkage, Average linkage, Centroid Linkage), Non- Hierarchical (K-means, SOMs) Clustering, Applications of Microarray.

**Unit 5 :- Phylogenetic & molecular evolution :** molecular basis of evolution, Phylogenetic trees & different methods for phylogenetic inference, Construction- Maximum Parsimony Method, Maximum likelihood method and Distance Methods & significance of phylogenetic tree

**Unit 6 :- Drug design & discovery :** Contour of Drug, steps in development of new drugs, chemical & physiochemical parameters in drug-designing, drug metabolism, Interaction energy calculations, structure based drug designing, Combinatorial chemistry, virtual & high throughput screening, Docking.

Reference Books-

1. Genomes - T.A. Brown
2. Bioinformatics : Methods & Protocols – Misener & Krawetz
3. Genomics and its applications– David Mount
4. Setubal.J.,Meidanis J.-Introduction to computational molecular biology.
5. Essentials of Genomics and Bioinformatics - C. W. Sensen (Editor), 2002, John Wiley & Sons
6. Bioinformatics: From Genomes to Drugs, Thomas Lengauer (Editor), 2001, John Wiley & Sons

**SARDAR PATEL UNIVERSITY**  
**T.Y.B.Sc. (Bioinformatics)**  
**BNF-304 : WebDesigning and PERL**  
**Effective from June – 2008**

**Three periods per week**

**External Marks : 80**

**Internal Marks : 40**

**Total Marks : 120**

**Unit 1:- Introduction to HTML**

- Introduction to Markup Language
- Creating Simple Webpage
- Linking to other Web Page
- Text Allignment and Lists
- Text Formatting and Font Control
- Images
- Introduction to tables
- Introduction to Forms
- Introduction to Frames

**Unit 2:- Introduction to XML**

- XML : Difference between HTML & XML
- Creating your own XML Files
- XSL

**Unit 3:- Perl**

- Getting started with Scripting Language
- Sequences and String

**Unit 4 :-**

- Motifs and Loops
- Subroutine and bugs

**Unit 5 :-**

- Mutations and Randomization

**Unit 6 :-**

- The Genetic Code

**Reference Books**

1. Beginning Perl for Bioinformatics : James Tisdall (O' Reilly)
2. Teach Yourself XML: Sandra E. Eddy & John E. Schnyder
3. Sams Teach Yourself HTML in 24 hours : Dick Oliver (Techmedia)

**SARDAR PATEL UNIVERSITY**  
**T.Y.B.Sc. (Bioinformatics)**  
**BNF-305: Object Oriented Programming and Data Structure**  
**Effective from June – 2008**

**Three periods per week:**

**External Marks: 80**

**Internal Marks: 40**

**Total Marks: 120**

**Unit- 1 :-** Concept of Procedural, structured and object oriented programming

- Concept of Encapsulation, Data hiding, Inheritance and Polymorphism
- History of Object oriented Programming techniques
- Classes and Objects
- Advantages of object oriented programming over procedural languages

**Unit- 2 :-** Data types, Variables and Constants, Expression and statements, logical, relational, mathematical operators, ternary operator

- Simple I/O statements – reading and writing, Statements for formatted I/O usage of header files using INCLUDE statement
- Looping : while, Do...While, For loop, Continue and break statement, Switch statement, IF statement, IF..ELSE statement
- Array : Initializing one dimensional and two dimensional, Multi dimensional array, Passing arrays to functions.

**Unit- 3:-** Structures and Enumerated Data types: Declaration of structure, initialization of structure, Array of structure and pointers to structure, structure within structures, Enumerated Data types

- Classes : Creating new type of class, Classes and members, Accessing class members, Implementing class methods, Constructors and Destructors, Private and public class.

**Unit- 4 :-** Function Definition

- Declaring and defining function, passing of parameters, passing structure variables as argument, passing address (passing by reference), Function with arguments, Overloading function, Inline Function, Storage classes and Static Storage Classes
- Pointer
- Concept of a pointer variable and its declaration, Pointer arithmetic, Pointers in string handling, Pointer to pointer, Arrays of pointers, Pointers to array, Dynamic memory allocations, Pointers to objects

**Unit- 5 :-** Array & Stack

- Storage structure for arrays
- Definition of stacks, operations on stacks (PUSH, POP, PEEK, CHANGE)
- Application of Stack
- Recursion(Factorial)
- Polish Notation

- Conversion of infix expression to polish notation
- Conversion of polish notation to code

**Unit-6 :- Queues**

- Operation on queue (insert, delete)
- Circular queue (insert, delete)
- Linked List
  - Linked list (insert, delete & storage representation)
  - Single Linked List
  - Circular Linked List
- Trees : Introduction to Trees

**Text Books:**

1. Balaguruswamy: Programming in Ansi C, Tata McGraw Hill Publication
2. Trembley & Sorenson : An Introduction to Data Structure with Application, Tata McGraw Hill Publication

**Reference Books:**

1. Henry Mullish & Herbert L. Cooper : The Spirit of C, Jaico Publication
2. Bhagat Singh & Thomas L. Naps: Introduction to Data Structure, Tata McGraw Hill Publication

**Main Reference Books:**

1. Rajaraman : Object Oriented Programming & C++, New age international publishers.

**SARDAR PATEL UNIVERSITY**  
**T.Y.B.Sc (BIONFORMATICS)**

**BNF – 306: Structural Bioinformatics & Bio-database and RDBMS**

**Effective from June- 2008**

**Three periods per week**

**External Marks : 80**

**Internal Marks : 40**

**Total Marks : 120**

**Unit 1:- Macromolecular Structures :** DNA: Types of Double helices (A,B,Z). Structural and Geometrical parameters of each and their comparison, RNA: Secondary structures, Tertiary structures, t-RNA tertiary structure. RNA secondary structure prediction methods and its limitations ( mfold method of Zuker), Applications of RNA structure modeling

**Unit 2 :- Anatomy of proteins :** Primary Structure, Secondary Structure, Super Secondary Structures, Tertiary & Quarternary structure of proteins. Protein – protein interaction. Principle of Protein folding & Unfolding: Levinthal Paradox, Protein folding models, Protein Unfolding, Disorders/Diseases of Protein Misfolding (Alzheimer's disease, Cystic fibrosis, Mad Cow disease, Prions)

**Unit 3 :- Protein Structure Prediction & Comparison : Methods for protein secondary and tertiary structure prediction-**Algorithms of Chou Fasman, GOR, PHD, PSI-PRED and Neural network method; Steps involved in Homology Modeling, Ramachandran Plot, Transmembrane prediction methods. Concepts in 3D structure comparison, Algorithms for structure comparison ( VAST & DALI).

**Unit 4 :- SQL and Constraints :** Fundamentals of RDBMS Fundamentals of RDBMS :

- Normalization, CODD's Principles
- Introduction to SQL syntax
- Components of SQL
- Oracle Data Types : Char, Varchar2, Varchar, number, date, raw, long raw,
- Command: Create, insert, update, delete, select, alter, drop
- Use of Distinct and Order By clause
- Select \*from Tab, Use of Desc keyword
- Create the table from another table
- Inserting data into table from another table
- Data constraints : column level, table level, Null value, primary key, unique key, foreign key, Default
- Check Integrity Constraints
- Drop constraints
- Logical Operators : AND, OR, NOT
- Range Searching: Between , Not Between
- Pattern Matching : Like, In



## **Unit 5 :- Oracle Functions, Joins and Sub queries :**

- Group / Aggregate functions : AVG, MIN, MAX, COUNT, SUM
- Numeric functions : ABS, POWER, ROUND, TRUNC, SQRT,GREATEST, LEAST, MOD, FLOOR,CEIL,EXP
- Character Functions : UPPER, LOWER, INITCAP, LENGTH, SUBSTR, LPAD, RPAD, LTRIM, RTRIM,TRIM,INSTR
- Date functions : ADD\_MONTHS, LAST\_DAY, MONTHS\_BETWEEN , NEXT\_DAY
- Special Date Formats using To\_Char
- Conversion Functions : TO\_NUMBER, TO\_CHAR, TO\_DATE,
- GROUP BY , HAVING clauses
- Sub-Queries, nested sub-queries
- Joins of two or more tables, self join, outer join, inner join
- Subqueries: Union, Intersect, Minus Clause
- Oracle transactions : Commit, Rollback, SavePoint

## **Unit 6 :-\_Oracle Transaction and PL/SQL**

- Indexes – creating , dropping, uses
- Sequences – creating, dropping, altering, using (CURRVAL, NEXTVAL)
- Views – creating, dropping, using updateable and non-updateable views
- Granting and Revoking Permissions
- Introduction to PLSQL
- Control Structures: If, Loop, While, For
- Stored procedure and Stored Functions
- Data warehousing, Data Mining, DDBMS ( Only Definitions)

### **Reference Books:**

1. AN INTRODUCTION TO COMPUTATIONAL BIOCHEMISTRY by C. Stan Tsai, A JOHN WILEY & SONS, INC., PUBLICATION
2. Introduction to Bioinformatics by Arthur M. Lesk
3. SQL, PL/SQL The Programming Language of ORACLE, By Ivan Bayross, BPB Publications, 3<sup>rd</sup> Revised Edition

**Sardar Patel University**  
**T.Y.B.Sc. (Bioinformatics)**  
**BNF-307 : Practicals based on BNF – 301 and BNF-302**  
**Effective from June – 2008**

**Three periods per week :**

**External Marks : 80**

**Internal Marks : 40**

**Total Marks : 120**

1. Isolation of genomic DNA from plant cells.
2. Isolation of RNA from mammalian cell.
3. Isolation of Plasmid DNA.
4. Preparation of competent cell. Restriction digestion, ligation and Transformation
5. Gel electrophoresis- Agarose (for separation of DNA & RNA)
6. SDS PAGE. (Demo)
7. Radial Immunodiffusion,
8. ELISA.
9. PCR amplification of target DNA.(Demo)
10. Study of chromosomal Abberations using colchicine.
11. Study and identification of amino acid by paper chromatography.
12. Estimation of DNA by DPA method.
13. Estimation of protein by Folin Lowry method.
14. Bacterial cell culture , media preparations and inoculation(spread plate ,streak plate and pore plate).
15. Estimation of antibiotic activity by Disc method.
16. Replica plating.
17. Enzyme assay of pH, temperature and incubation time.

**SARDAR PATEL UNIVERSITY**  
**T.Y.B.Sc. (Bioinformatics)**  
**BNF-308 : Practicals based on BNF – 303 and BNF-304**  
**and 306 (structural bioinformatics part)**

**Effective from June – 2008**

**External Marks : 80**  
**Internal Marks : 40**  
**Total Marks : 120**

**Part 1: Practical based on 303 & 306 (50%)**

1. Retrieve DNA and Protein sequence , do MSA, using clustal W (from EBI), draw Dendogram and Jalview.
2. Advance Querying of databases- use of PSI BLAST (NCBI)
3. Identification of gene using Genscan.
4. Proteomics analysis (physiochemical property of protein ) using Protparam.
5. 3D structure visualization and analysis using Rasmol,
6. Structure alignment visualization using Cn3D and structure comparison.
7. ORF finder (NCBI)
8. Motif and domain search (ExPasy server) , Prosite database
9. Sequence logo.
10. Phylogenetic analysis : phylodraw, treecon
11. RNA structure prediction using Mfold
12. Add more tool based on paper Bioinformatics applications and structural bioinformatics.
13. A MINI PROJECT.

**Part 2: Practical based on 304 (50%)**

1. Programs based on scripting languages (PERL)
2. Programs based on HTML
3. Creating Forms, tables, frames, images etc
4. Program based on XML

**SARDAR PATEL UNIVERSITY**  
**T.Y.B.Sc. (Bioinformatics)**  
**BNF-309: Practical based on BNF – 305 and BNF-306**  
**Effective from June – 2008**

**External Marks : 80**  
**Internal Marks : 40**  
**Total Marks : 120**

**Part 1: Develop & process the programs for data structures using C++ language (50%)**

- Simple program using object oriented programming language
- Programs based on arrays
- Programs based on Structures
- Programs based on Classes
- Programs based on Data Structures

**Part 2 : Using SQL and PL/SQL (50%)**

- Creation and manipulation of a database table
- Simple database queries
- Database Queries based on joins
- Database Queries based on Group by and Having
- Simple PL/SQL blocks