

**Swami Ramanand Teerth Marathwada University, Nanded**  
**SYLLABUS B. SC. BIOINFORMATICS (SEMESTER PATTERN)**  
 (June-2014 Pattern)

**B. Sc. Bioinformatics Second Year (Third Semester)**

Code No.	Paper Title	Teaching Periods/ Week	Maximum Marks T/P (A)	Internal Test Marks (B)	Total Marks (A+B)	Duration of Exam (in Hrs)
BIT- 9	Molecular Biology	04	80	20	100	03
BIT-10	Biostatistics & Mathematics	04	80	20	100	03
BIT-11	Biodiversity and Phylogenetics	04	80	20	100	03
BIT-12	Programming in Perl	04	80	20	100	03
BIP- 5	Lab Course V Practical Based on (BIT-9 + BIT-10)	03+03	100	-	100	03
BIP-6	Lab Course VI Practical Based on (BIT-11 + BIT-12)	03+03	100	-	100	03
				Total	600	

**B. Sc. Bioinformatics Second Year (Fourth Semester)**

Code No.	Paper Title	Teaching Periods/ Week	Maximum Marks T/P (A)	Internal Test Marks (B)	Total Marks (A+B)	Duration of Exam (in Hrs)
BIT-13	Basics of Immunology	04	80	20	100	03
BIT-14	Biochemical Techniques	04	80	20	100	03
BIT-15	Biological Database management	04	80	20	100	03
BIT-16	Object oriented Programming	04	80	20	100	03
BIP-7	Lab Course VII Practical Based on (BIT-13 & BIT-14)	03+03	100	-	100	03
BIP-8	Lab Course VIII Practical Based on (BIT-15 & BIT-16)	03+03	100	-	100	03
				Total	600	

**B.Sc. Bioinformatics (Semester Pattern) III Semester****BIT- 9 Molecular Biology****Marks: 80 Hours: 50****Unit 1: DNA structure, replication & repair.**

DNA structure: Structure of DNA, Properties of DNA, Cot curve

DNA replication: Replication in prokaryotic and eukaryotic cells, models & mechanism of DNA replication, Enzymes involved in DNA replication – Primosome, Replisome, Topoisomerase, DNA polymerase, SSBP & Ligase.

DNA Repair- Direct repair – Photo Reactivation, Excision, mismatch, Recombination repair, SOS repair.

**Unit 2: Transcription and RNA processing**

Transcription in Prokaryotes: Initiation, Elongation & Termination.

Structure of RNA polymerase, Role of sigma factor, Promoter.

Transcription in Eukaryotes: Initiation, Elongation & Termination.

Upstream & downstream Promoters, Enhancer. RNA Polymerase I, II & III. Co & Post transcriptional modification in m-RNA- 5'capping, Intron Splicing, polyadnylation. RNA processing & Transport.

**Unit 3: Translation**

Prokaryotic and Eukaryotic- Mechanism, initiation, elongation, termination.

Co & post translational modifications in proteins, Heat shock proteins, Chaperons & Chaperonins. Properties of genetic code, Role of mRNA, tRNA, rRNA.

**Unit 4: Regulation of gene expression**

Regulation of transcription in prokaryotes, Operon concept, trp-operon, Lac-operon, Ara-operon.

**Reference Books:**

1. Upadhyya- Molecular Biology- Himalaya pub.
2. Watson – Molecular biology of gene- Pearson pub.
3. David Freifelder- Microbial Genetics – Narosa Pub.
4. David Freifelder– Molecular Biology – Narosa pub.
5. Gardner – Principals of Genetics – Wiley international pub.
6. Albert Bruce- Molecular biology of the cell- garland science.
7. Loddish - Molecular cell biology – W-H. freeman
8. Lewin – Genes X- Oxford
9. Fundamentals of Cell and Molecular biology-Baig, Telang and Ingle-Amruta
10. Genome- T.A. Brown- John Wiley

**Practicals :**

1. Study of Ames test
2. Study of fluctuation test
3. Isolation and quantitation of DNA from bacteria.
4. Isolation and quantitation of DNA from Yeast.
5. Effect of UV radiation on yeast / bacteria
6. Study of DNA repair mechanism by photo reactivation.
7. Agarose gel electrophoresis of genomic DNA & plasmid DNA
8. Isolation of Lac mutant by using Replica plate method.
9. Determination of T<sub>m</sub> value of DNA.

**B.Sc. Bioinformatics (Semester Pattern) III Semester****BIT- 10 Biostatistics and Mathematics****Marks: 80 Hours: 50****Unit 1: Introduction**

Definition; Concept of statistical population; Concept of statistical sample  
 Concept of Data – Discrete and continuous data; Representation of data  
 – Histogram, PolyGram, Frequency curve, Pie Diagram

**Unit 2: Measures of Central Tendency**

Concept of central tendency; Arithmetic Mean: Definition, Formulae and computation for ungrouped and grouped data; Weighted arithmetic mean; median: Definition, Formulae and Computation for ungrouped and grouped data; Quartiles: definition, formulae and computation for ungrouped and grouped data; Mode: definition, formulae and computation for ungrouped and grouped data.

**Unit 3: Measures of Dispersion:**

Concept of dispersion; Range: definition, formulae and Computation for ungrouped and grouped data; Standard Deviation: Definition, Formulae and Computation for ungrouped and grouped data. Variance: Definition, Formulae and Computation for ungrouped and grouped data; Coefficient of variance: Definition, Formulae and Computation for ungrouped and grouped data.

**Unit 4: Probability**

Permutation and combination; Sample space, Events and Types of events; Classical definition of probability and axioms of probability; Theorems on Probability: i)  $0 \leq P(A) \leq 1$  ii)  $P(A) + P(A') = 1$   
 iii)  $P(A \cup B) = P(A) + P(B)$  iv)  $P(A \cup B) = P(A) + P(B) - P(A \cap B)$   
 Conditional probability and Bayes' theorem; Problems on Probability

**Unit 5: Set Theory**

Introduction; Set Notation and Description; Subsets, Venn diagram, Set Operations

**Unit 6: Matrix Algebra**

Addition, subtraction and multiplication of matrix, transpose of matrix, inverse of matrix, conjugative matrix

**Unit 7: Limits and Complex Numbers**

Limits of sequences, series, limit of functions, the Fibonacci sequence, complex plane, algebraic operations, exponential function of complex variable, Oscillations

**Reference Books:**

1. Sheldon M. Ross: Introduction to probability models, 9th Edition, Academic Press, 2007.
2. Gilbert Strang: Linear Algebra and its application, 4th Edition, Cengage Learning, 2006.
3. NCERT class 12 mathematics books.

**Practicals:**

1. Problems based on above statistical methods
2. Problems based on above Mathematical methods

## **B.Sc. Bioinformatics (Semester Pattern) III Semester**

### **BIT- 11 Biodiversity and Phylogenetics**

**Marks: 80 Hours: 50**

#### **Unit 1: Biological Diversity**

Biological diversity of life; India as mega biodiversity nation; Hotspots of diversity; Genetic diversity; Species diversity; Ecological / ecosystem diversity. Two, Three, five kingdom classification system; Diversity informatics in India, challenge and potential.

#### **Unit 2: Biodiversity Databases**

Species 2000; Tree of life; National Biological Informatics Infrastructure; International Committee on taxonomy of viruses (ICIV) and ICTVDB. Animal Virus Information System (AVIS); Global biodiversity information facility (GBIF); Other biodiversity databases.

#### **Unit 3: Species Identification**

Barcode of life; Delta; ITIS; Databases and softwares for identification of species

#### **Unit 4: Metadata**

Definition; Metadata standards; Metadata & biodiversity; Need for metadata standards

#### **Unit 5: Phylogenetic Prediction**

Introduction; Relationship between phylogenetic analyses and multiple sequence alignment; Genome complexity; Evolutionary trees Rooted & Unrooted trees; Methods for phylogenetic prediction , Maximum parsimony method, Distance based alignment; Soft ware package for phylogeny prediction.

#### **Reference Book**

- 1) Bioinformatics sequence and genome analysis – by David W. Mount.
- 2) Practical taxonomic computing – by Pankhurst R.J

#### **Practicals:**

1. Study of different biodiversity databases and retrieval of biodiversity information from them
2. Study of database structures and designing biodiversity databases
3. Study of different species identification systems.
4. Study of different methods for sequence alignment.
5. Study of different methods for phylogenetic prediction

**B.Sc. Bioinformatics (Semester Pattern) III Semester****BIT- 12 Programming in Perl****Marks: 80 Hours: 50****Unit 1: Getting Start With Perl**

Introduction , computer program & programming language, Perl's benefits, portability, speed & program maintenance, Installing perl on your computer, how to run perl Program, text editor, finding help.

**Unit 2: The Art Of Programming**

Individual approaches to programming, bio programming strategies, the programming process.

**Unit 3: Sequence & Strings**

General introductions to DNA & protein sequence, Standard IUB/IUPAC nucleic acid codes, Standard IUB/IUPAC amino acid codes, A program to store a DNA sequence, Concatenating DNA fragments.

**Unit 4: Basic Operators**

Scalar variables, Arithmetic operators, comparison operators, logical operators, assignment operators, auto increment & auto decrement operators, Concatenating & repeating string operators.

**Unit 5: File Handling**

Opening a file, reading a file, writing a file, closing a file, determining a status of a file.

**Unit 7: Lists & Arrays**

Introduction to lists, storing lists in array variables, more about lists & arrays, Array library function.

**Unit 8: Pattern Matching**

How pattern matching works, pattern matching operators, anchoring the patterns, patterns matching function, program to calculate the reverse complement.

**Unit 9: Control Flow & Looping Statements**

If statements, If – else, while, until, single line conditional statement, the 'For' statement the 'for each' statement, the 'do' statement, the last, next, redo, continue statements.

**Unit 10: Subroutines & Hashes**

Introduction & advantage of subroutines, writing subroutines, use of local variable & passing parameter to subroutines, returning a value from subroutines, passing data to subroutines, hashes & its creations from an array variables.

**Unit 11: The Genetic Code**

Introduction to genetics code & codon table, translating codons to amino acids (using hashes), translating DNA into proteins, sequence file formats, FASTA format, Transcription:- DNA & RNA. Introduction to BioPerl.

**Unit 12: Introduction to Python**

Brief introduction of Python; comparison with Perl

**Reference Books:-**

- 1.) James Tisdall 2001 "Beginning Perl For Bioinformatics" O'reily & Associates.
- 2.) Schwartz , Foy and Phoenix, "Learning Perl" sixth Edition

**Practicals:**

1. write a simple program like program for storing DNA sequence in a variable
2. write programs by using different perl operators.
3. Write programs for file handling.
4. write programs by using lists and arrays.
5. write programs for pattern matching, conditional and looping statements.
6. write programs by using subroutines and hashes.

**B.Sc. Bioinformatics (Semester Pattern) IV Semester**

**BIT- 13 Basics of Immunology**

**Marks: 80 Hours: 50**

**Unit 1: Overview of immune system**

History, innate and acquired immunity, passive immunity, infection.

**Unit 2: Immunoglobulin**

Antibodies: Antibody – structure and function, antigen, antigen-antibody reaction.

**Unit 3: Cells of immune system**

Differentiation of stem cell, structure of B-cell, T-cell, Microphage, nature killer cell, Organs of immune system.

**Unit 4: Immune response**

Humoral immune response, Cellular immune Response, MHC I&II complex.

**Unit 5: Immunodeficiency Diseases**

Primary immunodeficiency, secondary immunodeficiency, Autoimmunity.

**Reference Books:-**

- 1.) Eli Benjamini, coico, sunshine, immunology (fourth edition)
- 2.) N.V. shastri, Principles of immunology (himalaya publication house)
- 3.) Immunology – Kuby- W.H. Freeman
- 4.) Essentials of Immunology- Roitt I. M.- Blackwell
- 5.) Immunology- Nandini Shetty- New Age International
- 6.) Textbook of Microbiology – Anantnarayan and Panikar-Orient Longman
- 7.) Immunology- A.K. Abbas- Elsevier

**Practicals:**

1. Immunodiagnostics (demonstration using Kits- Widal, VDRL)
2. Determination of Blood Group
3. Immunodiffusion, Immuno Electrophoresis, Western Blotting,
4. Differential Leukocyte Count
5. Lymphoid organ, Cell and their microscopic observation
6. Immunization, collection of Serum
7. Purification of antibody from Serum

**B.Sc. Bioinformatics (Semester Pattern) IV Semester****BIT- 14 Biochemical Techniques****Marks: 80 Hours: 50****Unit 1: Microscopy & Spectroscopy:**

Light Microscopy: Simple & Compound Microscope, Phase contrast Microscope, Electron Microscope (TEM/SEM) (Principle, Theory, ray diagram, Image formation and applications). Spectroscopy: General principle, Electromagnetic Spectrum, Basic law of absorption, Visible & Ultraviolet Spectroscopy, application in biology.

**Unit 2: Chromatography**

Adsorption chromatography, Partition chromatography: Paper Chromatography, TLC, Column Chromatography, Ion exchange chromatography, GC.

**Unit 3: Centrifugation**

Centripetal Force, Centrifugal force, basic principle of centrifugation, centrifuge type, types of rotor density gradient centrifugation, Nature of density gradient, preparative centrifugation, Differential centrifugation & applications.

**Unit 4: Electrophoresis Techniques**

General Principles, Factors affecting on Electrophoretic Mobility, Agarose PAGE & SDS PAGE. Isoelectric focusing (IEF), Pulse field gel electrophoresis

**Reference Books:**

1. Biophysical Chemistry- Upadhyay, Upadhyay and Nath-Himalaya
2. Practical Biochemistry- Wilson & Walker -Cambridge
3. Practical Biochemistry- David Plummer- Tata McGraw Hill
4. Principles of Biochemistry- Lehninger –Kalyani Publications
5. Light Microscopy in Biology-A.J. Laccy.
6. Instrumental Methods of Chemical Analysis- Chatwal Anand- Himalaya
7. Instrumental Methods of Chemical Analysis –B.K. Sharma-Goel
8. Physical Biochemistry- David Freifelder

**Practicals:**

1. Study and Care of Microscope, Observation of Microscopic samples
2. Study of Colorimeter and determination of Lambda Max.
3. Study of UV-Visible Spectrophotometer
4. Study of Paper Chromatography/ TLC.
5. Separation of Pigments/ Biomolecules by Chromatography.
6. Separation of pigments by column chromatography
7. Demonstration of GC/ HPLC/ HPTLC
8. Principles and working of different centrifuges.
9. UV Spectroscopic Analysis of DNA, RNA & Proteins
10. Study of Paper/PAGE/ SDS-PAGE/ Agarose Gel Electrophoresis

**B.Sc. Bioinformatics (Semester Pattern) IV Semester****BIT- 15 Biological Database Management****Marks: 80 Hours: 50****Unit 1: Relational Database**

Introduction; Codd's 12 rules; Principles of RDBMS; Comparison between HDB-NDB-RDB; Concept of domain; Tuple; Cardinality; Oracle data type; Interactive SQL; Oracle & client server technology; Data manipulation in Database Management system (DML commands); DDL commands; Creating Tables; Insertion of Data in to table; Viewing data in Table; Renaming table , Destroying tables; Examining the objects created by Users; Working with ASCII file from the SQL prompt.

**Unit 2: Manipulation On Oracle Tables**

Competition on table data; Oracle table; Dual, Sys- date; Oracle functions; Data Constraint; Data constraints; Defining different constraints on table; User constraints table; defining dropping integrating constraints in the Alter table command; default value concept.

**Unit 3: More On SQL**

Grouping data from table in SQL; Sub queries, joins, using the Union.

**Unit 4: Introduction To PL / SQL**

Introduction; Generic PL/SQL; PL.SQL execution environment.

**Unit 5: More On PL/SQL**

Oracle transaction; Processing PL/SQL for block; What is cursor?; cursor for loops.

**Unit 6: Database Objects**

Store procedure and functions; Where do stores procedure and function resides; How oracle engine execute procedure and function; Advantage using procedure and function; procedure V/S function; Syntax of creating procedure and function.

**Reference Books:-**

- 1) Database System Concept –By Koarth
- 2) Modern Database Management –Iv-Edition By Fred R.Meffadden, Jeffrey, A. Hoffer(Aw)
- 3) Principle Of Database Management – By James Martin.
- 4) Database Management System – By Bipin Desai
- 5) Plsql – The Programing Language Of Oracles By Ivan Bay Rows – li Edition Bpb Publication

**Practicals:**

1. Creating and manipulating tables by using DDL and DML commands
2. Study of different oracle functions.
3. Study of different oracle constraints.
4. Study of grouping data from tables with SQL.
5. Study of sub queries and joins with SQL.
6. Study of PL/SQL



**B.Sc. Bioinformatics (Semester Pattern) IV Semester****BIT- 16 Object Oriented Programming****Marks: 80 Hours: 50****Unit 1: Introduction OOps**

Object oriented programming, basic concept of oops , benefits of oops

**Unit 2: Introduction To C++**

Tokens, keywords, identifier data types, constants, operation precedence and associating, I/O – statements, structure of c++ program, Control statements, looping statements, Type casting, array, pointer, structure & unions.

**Unit 3: Functions In C++**

Function, function prototype, Call by value, call by reference, Return by reference, Inline function, friend function, Default argument, function overloading.

**Unit 4: Class & Objects**

Defining class, members, objects, visibility mode, static data members, static member function, pointer to members, array of objects.

**Unit 5: Constructors And Destructors**

Introduction to constructors, Parameterized constructors, Multiple constructors in a class, copy Constructors, Destructors.

**Unit 6: Operators Overloading**

Defining operator overloading, overloading unary operators, overloading binary operators, rules of overloading operators.

**Unit 7: Inheritance & Polymorphism**

Concept of inheritance, type of inheritance, polymorphism, virtual class, virtual functions, rules for virtual function, pure virtual function.

**Unit 8: Console I/O Operations**

C++ streams, C++ streams classes, unformatted I/O operations, formatted I/O operations.

**Reference Books**

1. Object oriented programming with c++ By :- E. Balaguruswami.
2. Object oriented programming with c++ by :- Richard Johnsonburg & Martin Kalin.
3. C++ Complete Reference By: - H. Dieldt

**Practicals:**

1. Study of structure of C++ program.
2. Write C++ programs using control and looping statements.
3. Write C++ programs using arrays, pointers, structures and unions.
4. Write C++ programs using class and objects.
5. Write C++ programs for operator overloading.
6. Write C++ programs for inheritance and polymorphism
7. Write C++ programs using consol I/O functions