

Swami Ramanand Teerth Marathwada University, Nanded
Syllabus B. Sc. Bioinformatics (Semester Pattern June 2013)
(w. e. f. 2015-16)

B. Sc. Bioinformatics Third Year (Fifth 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-17	Genetic Engineering	04	80	20	100	03
BIT-18	Metabolomics	04	80	20	100	03
BIT-19	Chemo Informatics	04	80	20	100	03
BIT-20	Programming in JAVA	04	80	20	100	03
BIP-9	Lab Course IX Practical Based on (BIT-17 + BIT-18)	03+03	100	-	100	03
BIP-10	Lab Course X Practical Based on (BIT-19 + BIT-20)	03+03	100	-	100	03
				Total	600	

B. Sc. Bioinformatics Third Year (Sixth 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-21	Concept of Genomics	04	80	20	100	03
BIT-22	Concept of Proteomics	04	80	20	100	03
BIT-23	Advanced Techniques in Bioinformatics	04	80	20	100	03
BIT-24	Visual Basic and PHP	04	80	20	100	03
BIP-11	Lab Course XI (Practical based on BIT-21+22+23+24)	03+03	100	-	100	03
BIP-12	Lab Course XII (Project Work)	03+03	100	-	100	03
				Total	600	

B.Sc. Bioinformatics (Semester Pattern) V Semester**BIT-17 Genetic Engineering****Marks-80****Hours-50****Unit 1:- Principles of Gene Cloning**

Endonuclease – an essential tool for Gene cloning, Types & Properties, DNA Ligases, Plasmids. Antibiotic resistance markers, Vectors: Plasmids (pBR322, pUC18/19), Bacteriophages (λ Phage, M 13 Phage), Cosmids, Artificial Chromosomes, Ti plasmid. Methods of Gene Transfer- vector based and direct transfer of DNA: Gene Cloning Strategies. Markers and reporter genes in gene cloning

Unit 2:- Techniques in Molecular Biology

Denaturation & Renaturation of DNA, T_m , GC content from T_m . Renaturation Kinetics of DNA & Complexity of DNA.

Electrophoresis: Agarose Gel Electrophoresis, Blotting techniques: Southern, Northern, Western Blotting and applications.

PCR: Mechanism, Types and Application. DNA Micro array principle & applications

DNA Sequencing: Sanger's and Maxam Gilbert's Method, Automated DNA sequencing.

Unit 3:- Library construction

Library construction, screening and applications: Genomic library, cDNA library.

Nucleic Acid Probe, Chemical Synthesis of DNA, Autoradiography of DNA

Screening of library-Probe based direct and indirect methods.

Unit 4:- Applications of r-DNA technology

Agricultural applications i) BT-Cotton, ii) Transgenic maize, iii) Golden rice etc.

Protein engineering: to improve properties of proteins and enzymes.

Pharmaceutical Applications: i) Recombinant hormones ii) Vaccines iii) Blood Clotting factors v) Tissue Plasminogen Activator vi) Erythropoietin v) Human growth hormone.

Concept of Gene Therapy

Reference book:-

1. Principles of Genome analysis and Genomics - Old & Primrose-Black well
2. Molecular biology of Gene – J.D Watson
3. From Genes to Clones- Winnacker- Panima
4. Molecular Biotechnology –Glick-ASM
5. ABC of Gene cloning- Wong-Springer
6. Genomes 3 - T.A.Brown-Garland Science
7. Gene cloning and DNA Analysis- T.A. Brown- Wiley- Blackwell
8. Text book of Biotechnology – U Satyanarayan –Book & Allied

Practical

1. Based on Syllabus

B.Sc. Bioinformatics (Semester Pattern) V Semester

BIT-18 Metabolomics

Marks: 80 Hours: 50

Unit 1: Introduction to Metabolomics

Definition, origin, Terms- metabolom, metabolites, catabolism, anabolism, metabolism metabolomics. Applications- medical diagnosis, biomarker discovery, agriculture, Toxicity assessment/toxicology, Functional genomics. Nutrigenomics, etc

Unit 2: Metabolic Pathways

Major Metabolic Pathways: Gluconeogenesis, Pentose phosphate pathway, Glycogen synthesis and degradation, Fatty acid oxidation and synthesis, Amino acid catabolism, Purine and pyrimidine nucleotide synthesis,

Unit 3: Metabolite separation and Detection Methods

Separation -Gas chromatography, HPLC, CE. Detection- Mass spectrometry (MS), MALDI, Nuclear magnetic resonance (NMR) spectroscopy. Statistical methods- XCMS, MZmine, MetAlign, etc.

Unit 4: Computational metabolomics

Full Genome Annotation through knowledge of Metabolic Pathways
Organism Specific Metabolic Pathways, Comparison of Metabolic Pathways

Reference Books:

1. Fundamentals of Biochemistry (2nd edition) by D., Voet, Voet, J.G. & Pratt, C. W. John Wiley & Sons, 2006.
2. Lehninger Principles of Biochemistry (4th edition) by D. L. Nelson & M. M. Cox, W. H. Freeman & Co, 2005.
3. Gene regulation and metabolism: postgenomic computational approaches. By Collado-Vides, J. & Hofestadt, R. Cambridge, The MIT Press, 2002.

Practical:

1. Study of Metabolic Pathways databases -KEGG, PathDB, EcoCyc and MetaCyc , EMP
2. Study of Parasite Metabolic Pathways
3. Tools for analysis of metabolites.
4. Databases and software for Comparison of Metabolic Pathways

B.Sc. Bioinformatics (Semester Pattern) V Semester

BIT-19 Chemo Informatics

Marks: 80 Hours: 50

Unit 1: Introduction

Cheminformatics definition, scope of cheminformatics, history of cheminformatics, why to use informatics methods in chemistry?

Unit 2: Representations of chemical compounds

Introduction, Computer Representations of Chemical Structures: Graph Theoretic Representations, Linear Notations, Connection Tables, Canonical Representations of Molecular Structures. 2D structure databases, Reaction Databases, The Representation of Patents and Patent Databases.

Representations of 3D molecular structures: Experimental 3D Databases, 3D Database Searching. Theoretical 3D Databases: Structure-Generation Programs,

Unit 3: Molecular Descriptors

Introduction, Descriptors Calculated from the 2D Structure: Simple Counts, Physicochemical Properties, Molar Refractivity.

Structure Searching: Substructure Searching, Screening Methods, Similarity searching, Conformational Search and Analysis: Systematic and Random Conformational Search.

Unit 4: Drug and Drug-Targets

Drug: definition, "Drug-Likeness" and Compound Filters, rule of five. Lead Compound: definition, natural and synthetic resources of lead compounds. Drug targets: Enzymes, receptors, carrier proteins, structural proteins, nucleic acids, etc.

Unit 5: Cheminformatics tools for drug discovery

Combinatorial Synthesis and Combinatorial Library, QSAR, 3D Pharmacophores. Screening Methods: High-throughput screening, Virtual Screening. Protein-Ligand Docking. The Prediction of ADMET Properties, Toxicity Prediction.

Reference Books:

1. Handbook of Cheminformatics, volume 1, by John Gastiger, Thomas Engel, WILEY-VCH pub 2003.
2. An Introduction to Cheminformatics, by Andrew R. Leach & Valerie j. Gillet, Springer
3. Instant Notes in Medicinal Chemistry, by G. Patrick, BIOS Scientific pub. 2001

Practicals :

1. Chemical structure drawing and manipulation using software like ACD ChemSketch, chemDraw, etc.
1. Practical Aspects of Structure Searching from chemical compound databases.
3. 3D Database Searching.
4. Searching from Drug databases.
5. Comparison and Evaluation of Conformational Search Methods.
6. Practical Aspects of Protein-Ligand Docking.

B.Sc. Bioinformatics (Semester Pattern) V Semester**BIT- 20 Programming in JAVA****Marks: 80 Hours: 50****Unit 1: An Introduction and overview of Java**

A Short History of Java, Features of Java, Comparison of Java and C++, Java Tools And Editors(Appletviewer, Jar, Jdb). Java Environment. Types of Comments, Built In Data Types, Variables and Constants(Final Keyword Related to variables), Operators, Memory Allocation Using new Operator., Output using println() method, Control Statements, Arrays, Simple Java Program.

Unit 2: Objects and Classes

Defining Your Own Classes, methods and objects, using this keyword, constructors, types of constructors, constructor overloading, static variables and methods, access specifiers (private, protected and public), packages-creating, accessing and using packages, Garbage collection, finalize() method.

Unit 3: Inheritance and Interfaces

Inheritance Basics and Types of Inheritance, use extends keyword, Super class, Subclass and use of Super Keyword, Method Overriding, Use of final keyword related to method and class, Use of Abstract class, Defining and Implementing Interfaces, interface variables and interface methods.

Unit 4: Exception Handling

Dealing Errors, types of exception, exceptions handling using try and catch, using throws keyword, uses finally block.

Unit 5: Strings, Streams and Files

String class and String Buffer Class, Stream classes, Byte Stream classes, Character Stream Classes, Using the File class, Creation of files, Reading/Writing characters and bytes, Handling primitive data types.

Unit 6: Applet Programming with Graphical User Interface

Applet Life Cycle, Applet HTML Tags, Passing parameters to Applet, Repaint() method, User Interface Components with AWT in applet, Buttons and Labels, Checkboxes and Radio Buttons, Lists and Combo Boxes, Dialogs (Message, confirmation, input (like file selection)).

Reference Books:

1. Complete reference Java by Herbert Schildt(5th edition)
2. Java 2 programming black books, Steven Horlzner
3. Programming with Java , A primer ,Forth edition , By E. Balagurusamy
4. Java servlet Programming by Jason Hunter, O'Reilly
5. Core Java Volume-I-Fundamentals, Eighth Edition, Cay S. Horstmann, Gary Cornell,
6. Prentice Hall, Sun Microsystems Press.
7. Core Java Volume-II-Advanced Features, Eighth Edition, Cay S. Horstmann, Gary Cornell, Prentice Hall, Sun Microsystems Press.

Practicals : Based on Syllabus

B.Sc. Bioinformatics (Semester Pattern) VI Semester

BIT-21 Concept of Genomics

Marks: 80 Hours: 50

Unit 1: Introduction.

Genomics definition, History- Early sequencing efforts DNA sequencing technology developed, Complete genomes, The "omics" revolution, C-Value paradox, Human Genome Project.

Unit 2: Genome Analysis

Sequencing- Shotgun sequencing, High-throughput sequencing, Illumina (Solexa) sequencing, Ion Torrent
Assembly- Assembly approaches, Finishing.
Annotation. Genome databases

Unit 3: Introduction to Research Areas of Genomics

Functional genomics, Structural genomics, comparative genomics Epigenomics, Metagenomics, Pharmacogenomics.
Study systems - Viruses and bacteriophages genomics, Cyanobacteria genomics, Human genomics.

Unit 4: Applications of genomics

Biomarker discovery, gene expression, transfection, epigenetics, agriculture, pharmaceuticals, genomic medicine, Synthetic biology and bioengineering, etc.

Reference Books:

1. Principles of Genome analysis and Genomics-Primrose and Twyman-Blackwell Publishing
2. Principles of Proteomics-R.M Twyman-BIOS advanced text
3. Functional Genomics-Stephen Hunt, Livesey- Oxford
4. Genetic Programming-W. Banzhaf, Nordin, Keller, Francone- Elsevier Bioinformatics: sequence and genome analysis by David Mount, cold springer harbour press, 2004.
5. Comparative genomics: empirical and analytical approaches to gene order dynamics, map alignment and the evolution of gene families by Sankoff, D. & Nadeau, J.H., Netherlands, Kluwer Academic Publishers, 2000.

Practical :

1. Study of genome databases
2. Study of some genome visualization tools
3. Demonstration of sanger sequencing method
4. Study of genome assembly methods

B.Sc. Bioinformatics (Semester Pattern) VI Semester

BIT-22 Concept of Proteomics

Marks: 80 Hours: 50

Unit 1: Introduction.

Definition, Proteome, Different protein functions, What Is Proteomics?; Why Proteomics?; Applications of proteomics, Protein Structure Basics- Amino Acids, Peptide bond, Hierarchy, Determination of Protein Three-Dimensional Structure, Protein Structure Database.

Unit 2: Protein synthesis and Modifications

Translation, Post translational modifications- Protein processing in Endoplasmic Reticulum and Golgi apparatus, role of chaperons, The modifications such as proteolytic cleavage; formation of disulfide bonds; addition of phosphoryl, methyl, acetyl, or other groups onto certain amino acid residues; attachment of oligosaccharides or prosthetic groups to create mature proteins.

Unit 3: Protein separation and Identification

Extracting Proteins from Biological Samples, Protein Separations- 1D- and 2D- SDS-PAGE, Isoelectric Focusing (IEF), HPLC (reverse phase (RP), size exclusion, ion exchange, or affinity chromatography), identification using MS, MALDI-TOF etc.

Unit 4: Protein Analysis

Protein-protein interactions, Protein array, protein structure prediction Tools and servers.

Reference Books:

1. Principles of Genome analysis and Genomics-Primrose and Twyman-Blackwell Publishing
2. Introduction to proteomics: tools for the new biology by Liebler, D.C. & Yates, J.R.III, Humana Press
3. Protein Science-Arthur M. Lesk- Oxford
4. Proteomics: from protein sequence to function by Pennington, S. R. & Dunn, M. J.: Viva Books Introduction to proteomics: tools for the new biology by Liebler, D.C. & Yates, J.R.III, New York. Humana Press, 2002.
5. Proteomics: from protein sequence to function by Pennington, S. R. & Dunn, M. J.: New Delhi, Viva Books Private Ltd, 2002.

Practical :

1. Study of protein databases
2. Study of protein-protein interactions databases
3. protein structure prediction Tools and servers.

B.Sc. Bioinformatics (Semester Pattern) VI Semester

BIT-23 Advanced Techniques in Bioinformatics

Marks: 80 Hours: 50

Unit 1: Introduction

Biological data representation in digital form, Microarray, Next Generation Sequencing,
Introduction to Artificial Intelligent, Introduction to search, Search algorithms, Heuristic search methods, optimal search methods,

Unit 2: Machine learning approaches

Principles Methods and Applications of: - Dynamic programming, Hidden Markov Model, Neural networks, Genetic algorithms.

Unit 3: Molecular Modeling

An overview. Introduction and challenges
Molecular modeling methods – Conformational searching, Ramachandran maps, Ab-initio methods, Homology Modeling.

Unit 4: Data Mining

Introduction to Data Mining in Bioinformatics, data mining process- Data collection, Data preprocessing, data mining, information interpretation, visualization.
Data mining tasks, classification, clustering, association, summarization, text mining etc.
Data mining techniques- Databases and data ware housing, statistics, machine learning

Reference Book's:-

- 1) Handbook of Hidden Markov models in Bioinformatics-Martin Gollery- CRC Press
- 2) Algorithms in Bioinformatics-Ed. Gary Benson, Roderic Page- Springer
- 3) Bioinformatics-The machine learning Approach- Pierre Baldi and Soren Brunek
- 4) Advance data mining techniques in Bioinformatics- Hui- Huan G Hsu- IGP
- 5) Building Bioinformatics Solutions –Cornod Bessant, I Shadforth, Oakley-oxford
- 6) Bioinformatics - machine learning Data mining in Bioinformatics - Bedi & Brunak
- 7) Protein Bioinformatics-Eidhammer, Jonassen, Taylor-Wiley
- 8) Bioinformatics: sequence and genome analysis by David Mount, cold spring harbor

Practical

Based on syllabus

B.Sc. Bioinformatics (Semester Pattern) VI Semester

BIT- 24 Visual Basic and PHP

Marks: 80 Hours: 50

Unit 1: VB Fundamentals

Introduction to visual basic, menu bar, tool bar, project explorer, tool bar property window, form layout window, project types . Anatomy of forms – properties, methods & forms working with MDI form.

Unit 2 : Study of Various Controls

Command button, text button, Label box, Option button, check bar, frame controls, combo box, image controls, picture box, scroll bar, list bar, designing menu structure, Visual basic programming

Unit 3: Introduction to PHP

Evaluation of PHP, Basic Syntax, Defining variable and constant Php Data type, Operator and Expression Handling, Html Form With Php, Capturing Form Data, Dealing with Multi-value filed, Generating File uploaded form, Redirecting a form after submission.

Unit 4 : Decisions and loop and Function

Making Decisions, Doing Repetitive task with looping, Mixing Decisions and looping with Html
What is a function, Define a function, Call by value and Call by reference, Recursive function

Unit 5: String and Array

Creating and accessing String, Searching & Replacing String, Formatting String, String Related Library function
Definition, creation of array in PHP, Accessing array, Performing different operation in array

Reference Books:

1. Mastering Visual Basic by BPB publication
2. Peter Norton Guide to visual Basic
3. visual Basic 6 by Gary Cornell
4. Beginning with SQL server (TMH publication)
5. VB. Black book
6. PHP, My SQL, Apache –J C Meloni

Practical :

Based on Syllabus

B.Sc. Bioinformatics (Semester Pattern) VI Semester

BIP 12 : Lab Course XII (Project Work)

Marks-100

Guidelines for project work

1. The projects will be allotted during V semester
2. Students will design experiment of project under guidance of supervisor
3. Selection of topic relevant to priority to areas of biotechnology
4. Collection of literature from various sources
5. Planning of research experiments
6. Performing the experiments with scientific and statistical analysis
7. Project writing and compilation of report
8. Presentation of experimental data in schedule of practical examination
9. Project to be carried out individually or in group of three students maximum