SHIVAJI UNIVERSITY, KOLHAPUR
Syllabus – Introduced from June 2010
B.Sc. Part III
Bioinformatics

Course Code	Title of the Course	Theory/ Practical	Total Marks	Lecture/ Practical (hrs)
BIF 301	English	Theory	100	90L
BIF 302	Introduction to Structural Biology and Drug Designing	Theory	100	90L
BIF 303	Introduction to Genomics and Proteomics	Theory	100	90L
BIF 304	Web Designing	Theory	100	90L
BIF 305	Object Oriented Programming-II	Theory	100	90L
BIF 311	Practical on Structural Biology, Genomics and Proteomics	Practical	50	20P
BIF 312	Practical on Web Designing	Practical	50	20P
BIF 313	Practical on programming languages VB.net and Java	Practical	50	20P
BIF 314	Project work	Practical	50	-

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BIF 302: Introduction to Structural Biology and Drug Designing

SECTION-I: Structural Biology

UNIT I   **(09)**
Nucleic acid Structure:
1.1 Introduction, structures of nucleic acids, nucleosides and nucleotides, conformational possibilities of monomers and polymers, ribose ring puckering, conformational variants of DNA, Polymorphism of DNA, DNA supercoiling and unusual DNA structures, Structure of transfer RNA.
1.2 Introduction to Structural databases: Protein Data Bank (PDB), Nucleic Acid Data Bank (NDB), Molecular Modeling Data Bank (MMDB), PDB file formats of Biomolecules.

UNIT II   **(09)**
Protein Structure:
2.1 Protein structures, types of helices; globular proteins, simple proteins, conjugated proteins, glycoprotiens, lipoproteins, motifs, domains, membrane proteins; peripheral membrane proteins, integral membrane proteins. Electronic properties of proteins, protein-protien interactions, Ramachandran plot.
2.2 Conformational Analysis of phospholipids.

Unit III   **(09)**
Protein structure predication:
3.1 Introduction to Protein three dimensional structures to function and relation, protein structure prediction, prediction of protein structure from sequences by using homology modeling, protein folding. Expert Protein Analysis System (ExPASy), ExPASy tools; primary structure analysis and prediction using compute pI/MW, ProtParam, secondary structure analysis and prediction: using Chou-Fasman method, protein modeling using Swiss-pdb viewer and Modeller.
3.2 Structure visualization tools: Rasmol , KineMage, Cn3D.

UNIT IV   **(09)**
Basic concept of Molecular modeling:
4.1 Introduction, definition of molecular modeling, basic features of the molecular mechanics, principle, bonding interaction, non-bonding interaction, balls and springs, Force Fields, Hooks Law, coulomb interactions, Molecular modeling packages, application of the molecular modeling; energy minimization by Steepest Descent method.

UNIT V (09)
Experimental Techniques:
5.2 **X–Ray spectroscopy:** Introduction, crystals and symmetries, crystal systems, growth of crystals of biological molecules, hanging drop technique; X-ray Diffraction, X-ray Data Collection, application of X-ray in biology and medicine.
5.3 **NMR spectroscopy**: Introduction, basic principles of NMR, NMR theory and experiment, NMR applications in biochemistry and biophysics: conformation of biomolecules, NMR in Medicine.

SECTION II: – Drug Designing

UNIT I: (09)
Pharmaceutical Biotechnology
1.1 Introduction; Antibacterial antibiotics; narrow spectrum and broad spectrum antibiotics, mechanism of action of antibiotic, antifungal antibiotics, antiviral agents, antitumor agents, chemical disinfectants, antiseptics, preservatives. Sulfa drugs,
1.2 Recent advances in pharmaceutical Biotechnology: synthetic vaccines, DNA vaccines, edible vaccines.

UNIT II: (09)
Policies in Drug Designing
2.1 Quality assurance: ISO, WHO, certification
2.2 Good manufacturing practices, GMP, GLP, Government regulations, policies,
2.3 Food and drug administration.
2.4 IPR

UNIT III (09)
Introduction Drug Design and Discovery
3.1 Introduction; Natural product; Drugs; principles of drug Development.
3.2 Bioinformatics in drug development; Chemoinformatics and Pharmacoinformatics.
3.3 Applications of Drug Discovery and In-Silico Drug Designing
3.4 Area influencing drug discovery; Molecular Biology, pharmacogenomics and pharmacoproteomics.

UNIT IV (09)
Structure-based drug designing
4.1 Introduction; Structure-based drug designing approaches: Target Identification and Validation, homology modeling and protein folding, receptor mapping, active site analysis and pharmacophore mapping, Grid maps.

UNIT V: (09)
Ligand-based drug designing and Docking
5.1 Introduction; Ligand-based drug designing approaches: Lead Designing, combinatorial chemistry, High Throughput Screening (HTS), QSAR, Database generation and Chemical libraries, ADME property.
5.2 Introduction to docking methods to generate new structure; Tools and Molecular docking programs: AutoDock, Dock, HEX.

Reference Books:
1) Bioinformatics methods and applications by S. C. Rastogi, N. Mendiratta, P. Rastogi.
2) Biophysics by Vasantha Pattabhi and N. Gautham.
3) Principle of bioinformatics by p. shanmughavel.
4) Instant notes Bioinformatics by D.R. Westhead, J.H. Parish and R.M. Twyman
5) Computational Biochemistry by C. Stain Tsai.
6) Basic Bioinformatics by S. Ignacimuthu, S.J.
7) Computarional Drug Designing , David C. Young
8) Computational Drug Design: A Guide for Computational and Medicinal Chemists, David C. Young
9) Textbook of drug design and discovery, Povl Krogsgaard-Larsen, Tommy Liljefors, Ulf Madsen
10) Computer-aided drug design: methods and applications, Thomas J. Perun, Catherine Lamb Propst

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BIF 303: Introduction to Genomics and Proteomics

SECTION-I: Genomics

UNIT-I (09)
Organization of Genome:
1.1 Prokaryotic Genome: - Structure and organization of prokaryotic genome, Prokaryotic gene structure, extra chromosomal DNA.
1.2 Eukaryotic Genome :- Structure and organization of Eukaryotic genome, Eukaryotic gene structure, Exon, Intron, Repetative DNA, centromere, telomers, Overlapping & alternative genes , Structural genes, Gene family, Alu family, Transposable elements.

UNIT-II (09)
Nucleotide sequence Database:-
2.1 Introduction, Importance of database, Types of databases,
2.2 NCBI- primary sequence submission, , subset of NCBI, Database entries,
Locus, Accession number, Source, feature of sequence, FASTA format, BLASTn.
2.3 European Molecular Biology Laboratory (EMBL)-
 Sequence Retrieval System(SRS), Database entries,
2.4 DNA Databank of Japan(DDBJ)

UNIT III (09)
3.1 Gene Prediction Approaches
Gene prediction methods, Laboratory Based approach, Feature based approach,
 Homology Based approach, Statistical and HMM approaches, Gene prediction tools,
Genescan, Glimmer.
3.2 Functional site prediction:-
Finding functional sites with internet tool (Web gene Server), Genelang, BCM finder,
ORF finder, splice site prediction, PolyA site, CpG island, Exon , tRNA gene prediction.

UNIT-IV (09)
4.1 Genome Mapping:-
Introduction to genome map; Genetic maps: - Restriction Fragment Length
Polymorphism (RFLP), Variable Number Tandem Repeats (VNTR), Sequence Tagged
Sites (STS), Expressed Sequence Tags (EST). Physical maps: - Chromosomal or
cytogenetic maps, Expression maps, Radiation hybrid maps, chromosome jumping,
chromosome walking.
4.2 Genome Sequencing:- Clone based sequencing, Shotgun sequencing method,
pyrosequencing , Sequence assembly program, Assembler, Gelmerge.

UNIT-V (09)
5.1 DNA microarray:-
Introduction, Basic steps for gene expression, concept of microarray, types of microarray,
Spotted array, Oligonucleotide array, Designing the experiment, Two color microarray
experiment, clustering gene expression profile, self organizing maps.
5.2 Tool for microarray analysis :- softfinder, Xcluster, Microarray Data Manager
(MADAM), Serial Analysis of Gene Expression (SAGE), Microarray experimentation ,
fabrication, Application of microarray**,** Medical application.

SECTION-II: Proteomics

UNIT-I (09)
Method of Protein Microcharactrization:-
1.1 Introduction, proteomics an analytical challenge, The life and death of protein,
    functional protein family, gene expression, codon bias, and protein level overview of
    protein and peptide separation.

1.2 Methods in protein separation :- One dimensional SDS-PAGE,2D-SDS-PAGE, problem with 2D-SDS-PAGE, High performance liquid chromatography (HPLC), Capillary electrophoresis, protein digestion technique,

1.3 Protein analysis technique Mass spectroscopy for protein analysis, protein identification by peptide mass fingerprinting.

UNIT –II   (09)
Protein sequencing:-

2.1 Introduction,

2.2 Cleavage of disulphide bond and separation of polypeptide chain, Chemical hydrolysis of polypeptide chain and determination of amino acid composition,

2.3 Steps in the determination of amino acid sequences, enzymatic method for protein sequencing Identification of C-terminal residues of peptide.

2.4 Partial hydrolysis of polypeptide chain, separation and analysis of peptide, ordering the peptide fragment, assignment of position of disulphide linkage.

2.5 Amino acid sequence of some peptides and protein (Ribonuclease, Insulin).

UNIT-III   (09)
Protein sequence Databases :-

3.1 Introduction :- Database definition, data, Biological databases, Protein sequence database.

3.2 Primary sequence Database:- Introduction to Protein Information Resource (PIR), Martinsried institute of protein sequence (MIPS), Swiss-PROT, Structure of Swiss-PROT Entries, Translated EMBL (TrEMBL).

3.3 Secondary sequence Database: - Introduction to PROSITE, PROFILE, PRINTS, BLOCK, pfam and IDENTITY databases.

UNIT-IV   (09)
Sequence Alignment:-

4.1 Introduction :- Definition of sequence alignment , definition of Local and global sequence alignment, differences between local and global sequence alignments with examples, pairwise sequence alignment and multiple sequence alignment, dot matrix method.

4.2 Scoring matrices:- Percent Accepted Mutation matrices (PAM), gap, gap opening penalties, gap extension penalties, useful program for alignment ClustalW, BLASTp, application of BioEdit, Application of pairwise and multiple alignment.

UNIT V   (09)
Phylogenetic analysis:-

5.1 Introduction: Evolution, definition of phylogenetic tree, nodes, internodes, root, tree, styles; cladogram, phenogram, curvogram,

5.2 Steps involved in construction of phylogenetic tree

5.3 Methods of phylogenetic analysis:- Distance method, Character based Method

5.4 Tree Evaluation :- Jumbling sequence addition order, Bootstrap and Jacknife Replicate, Problems in phylogenetic analysis,

5.5 Phylogenetic analysis tool (Phylip, ClustalW).

References:-
1) An introduction to Bioinformatics by T. K. Attwood,Parry-Smith D. J.
2) Principle of bioinformatics by p. shanmughavel.
3) Computational biochemistry by C. Stain Tsai.
4) Bioinformatics methods and applications by S.C. Rastogi, N. mendiratta, P. Rastogi.
5) Cell and Molecular biology by Gerald Karp
6) Genome by T. A. Brown.
7) Principle of gene manipulation by primrose and old
8) Biochemistry by Lubert stryer
9) Lehninger's principle of Biochemistry by Nelson D. L.and Cox M. M.

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BIF 304: Web Designing

SECTION – I: HTML

UNIT-I   (09)
World Wide Web (WWW) -
1.1 History, Working, Web Browsers and their versions, its functions.
1.2 URLs, websites, Domain names, Portals.
1.3 Concept of Search Engines.
1.4 Search engines types, searching the Web and Web Servers.

UNIT-II   (09)
Internet Basic
2.1 Elements of The web, Viewing Web Pages with a browser.
2.2 Using a browser for Mail, News and Chat,
2.3 Security and privacy issues (Cookies and firewalls), Plug-In and active
     Controls etc. Internet advantage and disadvantage
2.4 Internet Services –USENET, LIST-SERVE,

UNIT-III   (09)
HTML Basics and Introduction to HTML elements
3.1 Basic tags, Attributes, Creating HTML Page,
3.2 Formatting, HTML Links, List Types and its Tags.
3.3 Creating HTML Tables, Adding Pictures.
3.4 HTML and Page Accessibility, Colors and Background.

UNIT-IV (09)
Advanced HTML
4.1 Use of frames and forms in web pages.
4.2 Formatting web pages by using GIF.
4.3 Getting JPEG files on web and clip arts.
4.4 Use of interlinks

UNITV (09)
Design Basics
5.1 What Is Design?
5.2 Design and Perception.
5.3 Brief History of Design on the Web
5.4 Elements of Design, Unity and Variety.
5.5 Emphasis, Focal Point, and Hierarchy
5.6 Contrast, Visual Balance.

SECTION II : Microsoft Front Page

UNIT I
Introduction to MS-Front page (09)
1.1 Front page Packages
1.2 Features of FrontPage
1.3 Installing and Activating FrontPage
1.4 The FrontPage main window
1.5 Starting and Quieting front page
1.6 Switching views
1.7 Use of Task pan, Tool bar,
1.8 Opening, closing, saving Web page.

UNIT II
Creating a Web Site (09)
2.1 The example of Web site
2.2 Web site structure
2.3 Rearrange the structure
2.4 Building the Home page (Add Links, Bars, Shared borders)
2.6 Add Template and themes

UNIT III
Improving Your Site's Appeal (09)
3.1 Entering and editing text.
3.2 Formatting text (Paragraphs, lists and Heading)
3.3 Links Page
3.4 Setting links color.

3.5 Creating text Hyperlink
3.6 Automatic and verified hyperlinks.
3.7 A page of Photograph and photo Gallery.
3.6 Offer Animation, Video, and Games
3.6 Use Web Components to Jazz Up a Site

UNIT IV
Making Your New Site a Success (09)
4.1 Publish Your Site
4.2 Use Extra Browser
4.3 Review the web site
4.4 Modify text and check spelling
4.5 Web report
4.6 Backup the web site.
4.8 Way to publish (Domain name, publish with FTP)

UNIT V
Enhancing Your Site (09)
5.1 Register your URL
5.2 Add a Search Engine to Your Site
5.3 Adding database connection
5.4 Turn Your Site into a Community
5.5 Connect a Database to Your Site
5.6 Use Your Site to Gather Information
5.7Attract the Widest Possible Audience
5.8 Learn More about Your Web's Audience

Reference Books:
1. HTML, DHTML, Java Script - Ivan Bayross
2. Teach Yourself in 24 Hours - SAMS Book
3. Sams Teach Yourself Microsoft FrontPage 2003 in 24 hour book
4. HTML Examples - http://www.w3schools.com/html/html_examples.asp
5. HTML Complete - Sybex
6. Web Publishing - Monica and J. D'Souza
7. An Introduction To Web Design and Programming – Paul S. Wang, Sanda S.

   Katila

8. FrontPage-2003 in easy steps – Michel Price.
9. Microsoft office FrontPage 2003 – Nelson Hester.

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BIF 305: Object oriented programming –II

SECTION I: Visual Basic .NET Programming

UNIT I (09)
Introduction to Visual Programming
1.1 Event driven programming
1.2 History of VB.Net, Features of VB.Net
1.3 Architecture of VB.Net [.Net server, framework, services etc.]
1.4 Net Framework: framework components, classes, CLR, VB.Net IDE
1.5 VB.Net: Variables
1.6 Keywords, constants
1.7 Data types
1.8 Conditional statements, looping statements, case control statements.

UNIT II (09)
.NET Controls
2.1 Activex controls
2.2 Forms, Controls & properties
2.3 Text Boxes, Labels, Command Button, Radio Button, Option Buttons, Check Boxes, List Box ,ComboBox,Scoroll Bar, Progress Bar, Group Box, Calender, Date Time Picker, Picture Box, Image List,Rich Text Box, Popup/Content Menus, List View Control , Tree View Box.

UNIT III (09)
Arrays and string class
3.1 The array class
3.2 collections, lists, string class, jagged array, array list
3.3 String class and function.
3.4 OOP using .net
3.5 Classes
3.6 Objects,constructor,destructor
3.7 Methods, properties, delegates, assemblies, namespaces.

UNIT IV (09)
Inheritance, Polymorphism
4.1 Inheritance
4.2 Single, multiple, multilevel inheritance
4.3 Polymorphism-constructor overloading, method overloading, overriding
4.4 File operation-read, write, delete
4.5 Exception - type of errors, structured and unstructured exception.

4.6 Tracing errors: breakpoint, watch, quick watch, locals and autos.

UNIT V (09)
ADO.Net
5.1 Components of ADO.Net
5.2 Features of ADO.Net
5.3 Datasets, Data table, Datarow, datacolumn, Datareader
5.4 ADO.Net programming

SECTION – II: Java Programming

UNIT I : (09)
An Overview of Java
1.1 Features of Java
1.2 Difference between C++ and JAVA
1.3 JVM (The Java Virtual Machine),Java byte code
1.4 Java program: source code, compile andexecute, keywords, identifiers, variables,
      data types, operators, Selection and iteration constructs in Java
1.5 Overview of classes and objects
1.6 Writing a Java class, adding fields and methods,
1.7 Instantiating of an object
1.8 Methods: definition, invoke, parameter passing and overloading
      Methods
1.9 Constructors: default constructors, parameterized constructor, overloading
      constructors
1.10 This keyword, garbage collection, finalize () method

UNIT II (09)
 Inheritance
 2.1 An overview of inheritance and implementation, instantiating child objects
 2.2 Single versus multiple inheritance, method overriding
 2.3 keywords: super and final, object class and its methods
 2.4 Interfaces: definition, user defined interfaces and their applications,
 2.5 Implementing an interface, extending interfaces
 2.6 Packages: definition, CLASSPATH,import statement, access control and packages,
      an overview of java.io package: input and output streams, writer and reader classes

UNIT III (09)
Polymorphism and Abstraction
3.1 An overview of polymorphism,
3.2 Virtual methods
3.3 Abstraction, abstract classes, abstract methods
3.4Overview of exception handling, flow of control

3.5 Throwable classes, catching exceptions, multiple catch blocks, throws   keyword, throwing exception.
3.6 Finally keyword

UNIT IV   **(09)**
Multithreaded programming
 4.1 Main thread
 4.2 Creating a thread: implementing runnable, extending thread
 4.3 Creating multiple threads: using isAlive() and join(), thread priorities,
 4.4 Synchronization, deadlock issues, suspending, resuming and stopping threads

UNIT V   **(09)**
 Introduction to AWT
 5.1 AWT classes
 5.2 Windows fundamentals: component, container, panel, window, frame, canvas
 5.3 Working with frame windows: setting the windows dimensions, hiding and showing
      window, setting a window title, closing a frame window, creating a frame window in
      an applet
  Working with graphics: drawing lines, rectangles and circles

Reference Books:
1) Visual Basic.NET Black Book – Steve Holzner
2) Visual Basic.NET Programming Bible – Bill Evjen
3) Pro ADO.NET with VB.NET – Sahil Mailk and Paul Dickinson
4) Beginning VB.NET- Wrox Publication
5) The Complete Reference Java2 Tata McGraw-Hall
6) Learning Java, Rich Raposa, WILEY- dreamtech India Pvt. Ltd.
7) Programming with JAVA - E Balagurusamy

Practical Courses
B.Sc.-III Bioinformatics

BIF -311 Practical on Structural Biology, Genomics and proteomics

1. Model building of nucleic acid, protein and organic molecules using the ISIS draw.
2. Model building of nucleic acid, protein and organic molecules using the chem-sketch.
3. Introduction to PDB.
4. Downloading and analysis of the pdb file of the biomolecules.
5. Analysis of Secondary and tertiary structure of protein using visualizing software like Rasmol.
6. Analysis of quarternary structure of protein using visualizing software like Rasmol.
7. Analysis of the secondary structure of protein using web tool.
8. Three dimensional structure prediction by using the homology modeling technique using SPDBV.
9. Energy calculation of the biomolecules using molecular mechanics and quantum mechanics. (Argus lab).
10. Calculate PI/MW of protein.
11. Molecular Docking of protein and ligand by HEX.

Genomics and Proteomics:
1. Understanding ENTREZ search engine.
2. Introduction to PUBMED Central database using the ENTREZ search engine.
3. Getting the amino acid sequences by exploring and querying the protein Sequence database.
4. Getting the gene sequences by exploring and querying the nucleic acid Databases.
5. Functional site prediction using Web-Gene Server
6. Construction of Phylogenetic Tree using ClustalW.
7. Construction of Phylogenetic Tree using Phylip.
8. Similarity search for nucleotide using the BLASTn and   interpretation of the results.
9. Smilarity search for protein using the BLASTp and interpretation of the results.
10. Protein and nucleic acid pair-wise sequence alignment by using ClustalW.
11. Introduction to PROSITE and PROSITE Data entries.

BIF -312 Practical on Web Designing

Practical for HTML

1. Introduction to various search engines.
2. Setting an IP address and TCP/IP.
3. Internet surfing and Internet Services.
4. Creating web page using HTML.
5. Viewing created web page with different; Font size, line Height settings, different browsers and different users.
6. Making web page attractive by using different color schemes, background color and dynamic properties.
7. Designing various forms to use as many input controls.
8. Creating interactive forms on the Web.
9. Adding a New Web Page to a Web Site.
10. Using Interactive Forms on the Web
11. Using Frames to Display Database Results in Web Pages.

Frontpage:
1. Installation of FrontPage
2. Demonstration of example website.
3. Create the first webpage using FrontPage with and experimenting with font family.
4. Developing Web Page with Front Page using built in facilities for document creation, navigation and links.
5. The FrontPage tutorial.
6. Publish your website using FTP.
7. To embed another webpage and its content in existing page using inline frames.
8. Add Meta variable Tags to your Web Page.
9. Insert image map and hotspot.
10. Rectify error on your website using FrontPage.

BIF -313 Practical on programming languages VB.net and Java

VB.net:
1. Accept three numbers & find out the largest & lowest among these.
2. Calculate compound interest of given principal amount for given time period with given rate of interest. Use appropriate controls.
3. Implement a standard calculator.
4. Accept 10 elements in array & perform binary search.
5. Demonstrate string class method & properties.
6. List box & combo box demonstration with differences in properties.
7. Simple class & object based programs.
8. Calculate difference between two dates use proper User Defined data type.
9. Demonstrate simple polymorphism.
10. Connect your application to Ms-Access/SQL server database using ADO.Net classes.
11. Implement read and write operation of file
12. Design different application using SQL/MS-Access and ADO.Net

JAVA:

1. Find prime number between 1 to 50.
2. Write a program which uses switch & break case statements.
3. Find out length of given string.
4. Find area of rectangle using constructor.
5. Write a program of insertion sort.
6. Write a program which implements stack operation.
7. Multithreading using get property.
8. Multithreading using sleep property.
9. Write a program which implements mouse listener and mouse motion listener.
10. Creating a frame window in an applet.
11. Draw line , rectangle, oval in an applet
12. AWT – Controls and Event Handling

BIF -314 Project work