

## Course Structure: B. Tech (Bioinformatics)

Department of Bioinformatics, Singhania University, Rajasthan

Course Code	Course Title	T1+T2 / Inter.	A1+A2	Per. Assis.	Exam. / Eval.	Total
<b>Semester - I</b>						
BTBI-111	Introduction of Bioinformatics	40	15	5	40	100
BTBI-121	Basics of Biology	40	15	5	40	100
BTBI-131	Basics of Mathematics	40	15	5	40	100
BTBI-141	Fundamental of Computer	40	15	5	40	100
BTBI-151	General English	40	15	5	40	100
<b>Semester - II</b>						
BTBI-112	Molecular Biology	40	15	5	40	100
BTBI-122	Operating System (Windows, Linux)	40	15	5	40	100
BTBI-132	Statistics and Probability	40	15	5	40	100
BTBI-142	C – Language	40	15	5	40	100
BTBI-152	Computer Lab – II	40	15	5	40	100
<b>Semester - III</b>						
BTBI-211	Biological Databank	40	15	5	40	100
BTBI-221	Database Management System	40	15	5	40	100
BTBI-231	Computer Networking & HTML	40	15	5	40	100
BTBI-241	Computer Lab - III	40	15	5	40	100
BTBI-251	Minor Project - I	40			60	100
<b>Semester - IV</b>						
BTBI-212	Computational Method for Sequence Analysis	40	15	5	40	100
BTBI-222	Molecular Imaging & Drug Designing	40	15	5	40	100
BTBI-232	Oracle	40	15	5	40	100
BTBI-242	C++ - Language	40	15	5	40	100
BTBI-252	Computer Lab - IV	40	15	5	40	100

<b>Semester - V</b>						
BTBI-311	Genomics, Proteomics and HGP	40	15	5	40	100
BTBI-321	Animal & Plant Biotechnology	40	15	5	40	100
BTBI-331	Perl Programming for Bioinformatics	40	15	5	40	100
BTBI-341	Advanced Multimedia	40	15	5	40	100
BTBI-351	Computer Lab – V	40	15	5	40	100
<b>Semester - VI</b>						
BTBI-312	Gene Expression & MicroArray Analysis	40	15	5	40	100
BTBI-322	Pharmacogenomics & Pharmacogenetics	40	15	5	40	100
BTBI-332	Microsoft Visual Basic (VB)	40	15	5	40	100
BTBI-342	Computer Lab – VI	40	15	5	40	100
BTBI-352	Minor Project - II	40			60	100
<b>Semester - VII</b>						
BTBI-411	Information Theory & Stochastic Process	40	15	5	40	100
BTBI-421	Advanced Algorithm for Computational Biology	40	15	5	40	100
BTBI-431	ASP	40	15	5	40	100
BTBI-441	Core Java	40	15	5	40	100
BTBI-451	Computer Lab – VII	40	15	5	40	100
<b>Semester - VIII</b>						
BTBI-412	Major Project	100			300 *	400
	* (Project Report Evaluation: 150 & Comprehensive Viva-voce: 150)					
<b>Grand Total:</b>						<b>3900</b>

**Abbreviation:**

T1 Terminal Test 1  
T2 Terminal Test 2  
A1 Assignment 1  
A2 Assignment 2

Inter Internal  
Per Assis Personal Assessment  
Exam Final Semester Exam  
Eval Evaluation

### **BTBI – 111: Introduction of Bioinformatics**

The nature of chemical bonds, Introduction to Genes and Proteins, Nucleotides, Orientation, Base pairing, The central dogma, Promoter sequences, Genetic Code, ORFs, Introns and Exons, Slice variants, Protein structure, Primary, Secondary, Tertiary and Quaternary, The notation of homology. Introduction to Data Generating Techniques: Restriction Enzymes, Gel Electrophoresis, Blotting and Hybridization, Cloning, PCR. Biological databases, Search engines, Public databases: PubMed, EMBL, GenBank, PDB, Swiss-Port. Genomics and Proteomics: Prokaryotic genomes, Eukaryotic Genomes, Gene Structure, GC Content in Eukaryotic genomes, Gene Expression, Protein Classification, 2D-Electrophoresis, Mass spectrometry, Microarray technology, X-ray crystallography, NMR, Sequence and Phylogeny Analysis, Detecting ORFs, Outline of sequence alignment, Introduction to BLAST, Multiple sequence alignment, Phylogenetic analysis.

#### Text / Reference Books:

1. Fundamental Concepts of Bioinformatics, D.E. Krane and M.L. Raymer, Person Education, 2003.
2. Bioinformatics Computing by B. Bergeron, Prentice –Hall, 2003.
3. Bioinformatics: A practical guide to the analysis of genes and proteins, D. Baxivani and F. Oulette, Wiley Indian Edition, 2001
4. Bioinformatics: Sequence and Genome analysis, D.W. Mount, Cold Spring Harbour Laboratory Press, 2001

### **BTBI – 121: Basics of Biology**

Origin of life, Classification and Evolution of Organisms, Prokaryotic and Eukaryotic Cells, Cell Theory. Plant and Animal Cell, Cell wall, Cell Membrane, Cell Organelles (Structure and Functions), Transport system in cell. Cell division: Mitosis and Meiosis, Twins. Introduction of Mendelian Genetics, Monohybrid and Dihybrid cross, Double Helical Structure of DNA. Environment and Evolution, Green House Effect

### **BTBI – 131: Basics of Mathematics**

Linear equations (one and two variables), Polynomials, Quadratic equation, Sequence and Series (AP, GP, HP), Binomial theorem. Trigonometric functions (Circular function, Sum and Difference, Multiples, Submultiples), Trigonometric equations. Introduction, Laws of logarithms, Anti-logarithms, Applications of logarithm. Differentiation: Function, Limit, Continuity, Differentiation, Differential equation, Maxima, Minima, Application of derivatives. Algebra of matrix, Determinants, Adjoint and Inverse of a matrix, Systems of simultaneous linear equation

#### Text / Reference Books:

1. Mathematics of Class XI & XII by Dr. R. A. Sharma

### **BTBI – 141: Fundamental of Computer**

Digital Circuits and Computer Architecture: Transistors – and Integrated Circuits (LSI, VLSI); Operation of processor; Number Systems and Digital Circuits; ALU; Memory Chips, Storage Devices,

Memory Hierarchy; I/O Devices; Bus Systems; Computer Organization and Architecture; Microprocessor; Moore's Law, Operating Systems and DBMS: Windows and Linux; Basics of relational Databases; SQL. Programming Languages: Algorithms; Problem Solving Classification; Basics of C Language, Concepts of objects and classes, Introduction to object-oriented Programming. Computers Networks: Protocols; Wireless LAN and Mobile Computing. Introduction to Web Technology: HTML and Web pages; The Internet and Intranet; WWW; Java Script and Dynamic Web Pages; Multimedia Application; Computer Network Security, e-Commerce.

Text/Reference Books:

1. The Essential Guide to Computing: The story of Information Technology, E. Garrison Walters, PHI, 2001.
2. A Balanced Introduction to Computer science by David Reed, PE, 2000.
3. Introduction to Computing Systems: From Bits to Gates to C and Beyond. Yale N. Patt and Sanjay J. Patel. Prentice Hall India, 1999

**BTBI – 151: General English**

Transformation of sentences, Determiners, Parts of Speech. Times and Tense, Common errors (Noun, Pronoun, Articles, Adverb, Punctuation, Preposition, etc). Models in conversational usage, prefix suffix idioms and phrasal verbs. Composition – I, Unseen Passage, Precise Writing. Letter writing, Paragraph Writing, Report Writing, Essay Writing

**BTBI – 112: Molecular Biology**

Concepts in Biology: Characteristics of living organisms, Structure of cells, Energy flow; Nutrition and Metabolism; Information storage and expression, Reproduction and Inheritance. Biomolecules: Carbohydrates, Amino Acids, Proteins, Lipids, Nucleic acids. Enzymes; Properties, Activation energy, Reaction kinetics, Intercellular Communication, Flow of genetic information, DNA expression and replication. Genes; Changing size of Genes, Gene synthesis, Cloning (Plant and Animal), Mutation, Gene Targeting, Gene Therapy. Level of secondary structure, Basic concepts of molecular dynamics, Molecular simulation studies. Protein structure determination by X-ray Diffraction, NMR, Introduction to nucleic acid structure, Genome organization, HGP.

Text / Reference Books:

1. Molecular Biology by David Friefelder, Jones & Burtlett Publishers inc, 2000
2. Molecular Cell Biology by Alberts, Bruce Bray, Watson & James, Garland Publishing, 1999.

**BTBI – 122: Operating System -Windows, Linux**

Introductory concepts, Operating systems, Mainframe systems, Multiprocessors, Distributed systems, Real – Time systems, Computing environments. Computer system structure, Computer system organization, I/O structure, Storage structure, Storage hierarchy, Hardware protection, Network structure. Operating system structures, System components, OS Services, System calls, System programs, System structure, Virtual machines Processes, Process concepts, Process scheduling, Operations on processes, Process states, Cooperating processes, Inter-process communication, Common OS problems. DOS and Windows, Introductory concepts, Architecture and special features,

Useful DOS commands, DOS – Editor, EDIT & writing Batch Files, Different Versions and their Distinguishing features, Managing Operations with Windows. Linux: Introductory concepts, Architecture and special features, Useful Linux commands, Related operating system and their Introduction.

Text / Reference Books:

1. Operating Systems by Glavin, Addison Wessely, 2000
2. Modern Operating Systems by S. Tanenbaum, Prentice Hall (India), 1999
3. Operating Systems Concept and Design by Milan Milenkovic, Tata McGraw Hill, 2000

**BTBI – 132: Statistics and Probability**

Probability, Conditional Probability, Random Variables, Expected Value. Continuous and Discrete distributions: Binomial, Geometric, Poisson, Pascal, Uniform Exponential and Normal, Poison Process. Multidimensional random variables, Multidimensional and bivariate normal distribution, Moment generating functions. Law of large numbers, Central limit theorem, Sampling distribution, Point and Interval Estimation Testing of hypothesis, Goodness of fit, Linear regression. Principal component analysis, Discriminant analysis, Cluster analysis, Multivariate analysis of variance.

Text / Reference Books:

1. Statistical Methods in Bioinformatics: An Introduction by W. Evans & G. Grant, Springer, 2001
2. First course in Probability by Sheldon Ross, Prentice-Hall (India), 2001

**BTBI – 142: C - Language**

Introduction to programming: The basic model of computing, Algorithm and Flow-charts, Programming Languages, Compilation, Linking, Testing, Debugging and Documentation. Introduction to C language: Character set, variables and Identifiers, Built in data types, Arithmetic operators and expression, constant and literals, Relational operator and logical connectivity, Sample assignment statement, Basic input/output statement, Sample C program. Conditional statement and Loops: Decision making within a program, different conditional statements in C, Looping statement in C, Structured programming, Nested loop, Infinite loop. Arrays and Pointers: Definition and purpose, Difference between arrays and pointers, Static and dynamic memory allocation. Functions: Modular programming and Functions, Standard library of C function, Function prototype and function definition, Calling a function, Recursive function. Structure, Union, and File: Definition of structure, Union and File, difference between structure and union.

Text / Reference Books:

1. Programming with C, K.R.Venugopal & Sudeep R. Prasad, Tata McGraw Hill
2. Programming in C, Herbert Schildt, THM, Fifth Edition, 2002
3. C How to program, Deitel & Deitel, Pearson Edition, Third Edition, 2001
4. Programming in C, Denis Ritchie, THM, Fourth Edition, 2000

## **BTBI – 152: Computer Lab - II**

Windows and Linux installation, user interface, File management, Data Security, Users management. Using Linux and Windows commands. Problem Solving using C language. Protein structure determination by X-ray Diffraction and NMR, Gel electrophoresis.

## **BTBI – 211: Biological Databank**

Overview of Database, Need of database, Application in Biological field. Introduction, Documentation and Application of listed Database

Primary Sequence Database (DDBJ, EMBL Nucleotide DB, GenBank), Meta-databases (Entrez, euGenes, GeneCards, SOURCE, mGen, GenSolution), Genome Databases (Ensembl, JGI Genomes of the DOE-Joint Genome Institute, CAMERA Resource for microbial genomics and metagenomics, MGI Mouse Genome, Corn), Protein Sequence Databases (UniProt, PIR, Swiss-Prot, DIP Database of Interacting Proteins, Pfam Protein families database of alignments and HMMs , ProDom Comprehensive set of Protein Domain Families, SignalP Server for signal peptide prediction), Protein Structure Databases (PDB, CATH Protein Structure Classification, SCOP, SWISS-MODEL), Metabolic pathway Databases (BioCyc, KEGG, BioCarta), Microarray Databases (ArrayExpress, Gene Expression Omnibus, SMD, GPX), Specialized Databases (CGAP Cancer Genes, GDB Hum. Genome Db, NCBI-UniGene, OMIM Inherited Diseases, p53)

### Text / Reference Books:

1. Bioinformatics: A practical guide to the analysis of genes and proteins, D. Baxivanis and F. Oulette, Wiley Indian Edition, 2001

## **BTBI – 221: DataBase Management System**

Introduction, Characteristics of Data base approach, Database users, Intended uses of databases, Implication of database approach. Database System Concepts and Architecture, Data Models, Schemas and Instances, DBMS Architecture and data independence, database languages, Classification of DBMS. Database Design: Informal Design guidelines for relation Schemas, functional Dependencies, Normal forms based on primary keys, general Definition of 2<sup>nd</sup> and 3<sup>rd</sup> Normal forms, BCNF, Need of further Normalization. Data Modeling using ER diagram, ER Model Concepts, Notation for ER Diagrams. The Relational Model, Relational Model Concepts, Relational Model Constraints, Introduction to Relational Algebra.

### Text/Reference Books:

1. Fundamentals of Database System by Elmasari and Navathe, Prentice Hall (India), 2001
2. Data Mining Concepts and techniques- Jiawei Han, Micheline Kamber, Morgan Kaufmann publisher, 2001

### **BTBI – 231: Computer Networking and HTML**

Basic concepts of Computer Networking and Internet: Introduction to Internet; Understanding the Internet, Intranet, Extranet; Hardware requirement to connect to Internet; S/W requirement and Internet service products; Internet addressing scheme. Introduction to WWW and its resources; URL; Web surfing (Sites related to Bioinformatics, education, research and commerce); Web search engines; Electronic mailing – SMTP. Internet Software: Introduction to TCP/IP and other network protocols; DNS – IP Address to name conversion and vice-versa; Basic Functionalities of TCP/IP – Client / Server model. Internet Programming Tools- HTML, DHTML, JavaScript: Designing and developing web pages using HTML/DHTML; Introduction to JavaScript and its components; Event Model. Web security: Web security issue; User – Interface; Security

#### Text / Reference Books:

1. The INTERNET Book- By Douglas E. Comer (PHI Pub.) 2<sup>nd</sup> Edition 2001
2. Internet and World Wide Web- How to Program- By Deitel & Deitel (Pearson Education) 4<sup>th</sup> Edition 2003.
3. HTML, DHTML, JavaScript- By Ivan Bayross (BPB Pub.) 4<sup>th</sup> Edition 2003

### **BTBI- 241: Computer Lab – III**

Signing and Creating Web pages using: HTML, Java Script. Accessing and annotation of report generated in Biological Databank listed in papers: BTBI-211. Creating database for Biological projects including Schema, E-R Diagram, and Normalization.

### **BTBI – 212: Computational Methods for Sequence Analysis**

Introduction to sequence databases: DDBJ / EMBL / GenBank; Information retrieval from databases; Analysis of DNA and Protein sequences: distribution, pattern and motif searches, Segmentation. Sequence alignment: Scoring matrices, PAM, BLOSUM, Local and global alignment concepts; Dynamic programming; Needleman - Wunch algorithm, Smith - Waterman algorithm; Statistics of alignment score; Multiple sequence alignment. Database searches for homologous sequences: FASTA, BLAST and CLUSTALW, Comparison, Artificial Neural Network concepts, Preceptron, Multilayer preceptron, Secondary Structure Prediction using ANN. Evolutionary analysis: Distances, Clustering methods, Tree representation, Genome sequence assembly; Gene finding methods; Analysis and prediction of regulatory regions. Profiles and Hidden Markov Model, Gene identification and prediction, DNA Microarrays, Gene Expression, Clustering gene expression profiles.

#### Text / Reference Book:

1. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, A. D. Baxevanis and B. F. F. Ouellette John Wiley and Sons (ASIA) Pvt. Ltd. 2002
2. Bioinformatics methods and applications - Genomes, Proteomics and Drug Discovery, S. C. Rastogi, N. Mendiratla and P. Rastogi, Prentice Hall (India), 2004
3. BLAST by I. Korf, M. Yandell & Joseph Bedell, O'Reilly, 2003
4. Biological Sequence Analysis – Probabilistic Models of Proteins and Nucleic acids, R. Durbin, S. Eddy, A. Krogh, G. Mitchison, Cambridge University Press, 1988

### **BTBI – 222: Molecular Imaging and Drug Design**

Overview of Drug design, Simulation Methods, Molecular Mechanics, Monte Carlo, Semi-Impirical Method, Ab-initio Method. Analog based drug design: QSAR, Molecular Structure determination, Advance crystallographic techniques, Simulation Annealing (Autodock /Quantum), Peptide Sequencing, EST Clustering. Comparative Protein Modelling: Homology Modeling, Structural Alignment, Ramachandran plot (Side Chain Placement Refinement & Validation of Model), 3D- Pharmacophore modeling. Computer-aided drug designing: Drug design, Lead discovery, ADMET in drug design, Lipinski "rule of 5", Principle and Methods of Docking, Ligand based drug designing, Target identification, Drug Metabolism, Denovo design of drug. Structure based drug design. Introduction of Drug discovery, Pharmacogenomics, Analysis of SNP's, Drug discovery technologies and strategies.

#### **Text / Reference Book:**

1. Molecular Modelling: Principle and Applications, Andrew R. Leach, Longman Singapore Publisher, 1999
2. Bioinformatics: From Genome to Drugs (Vol. I and II), Thomas Lengauer, Wiley- VCH, 2000
3. Structural Bioinformatics, P. E. Bourne and B.H. weissing, Wiley VCH, 1999
4. Bioinformatics Method and Applications-Genomics, Proteomics and Drug Discovery, S.C. Rastogi, N. Mendiratla and P. Rastogi, Prentice Hall (India), 2004

### **BTBI – 232: Oracle**

Introduction to SQL \*Plus, SQL \*Plus Commands, SQL Buffer Commands; Creating Tables, Inserting rows to the table, View the rows in the table, Delete rows from a table, Update rows in the table; ROLLBACK, COMMIT and SAVEPOINT; Lock Table; SQL select, Sorting Columns, Additional Operators; Data types in Oracle; Referential Integrity; Join Operator, Table aliases; Column format. Functions and Operators: Number function, Character Function, Conversion function, aggregate function, Data functions, Some other functions. Alter Table; Constraints; Group By clause; Create Sequence Command; Sub query; SET Operators; SQL \*PLUS Report; Views, SQL \*Plus Input Variables. Introduction to PL/SQL, PL/SQL construct, Iteration – Looping commands, Variable Attributes; Cursors, Triggers, Procedures and Functions. Objects; Abstract Data type, Object Views; Methods; Collectors; Table Space; Basic Database Administration; Data Dictionary; Remote Data Access.

#### **Text / Reference Book:**

- 1.

### **BTBI – 242: C++ - Language**

Methodologies: Concepts of structured and Object-Oriented programming, Advantages of OOPs methodologies. Introduction to Object-Oriented programming: Characteristics of OOPs Languages, C++ programming Basics operators, Loops, Arrays, Pointers. Principle of Object-Oriented programming, Introduction to Abstraction, Encapsulation, Inline function, Reference variable, Access specifier, Information Hiding, Friend Functions, Friend Class. Operator overloading, Function overloading. Inheritance: Extending classes, Types of inheritance, Virtual base class, Problems with multiple inheritance, Containership. Advanced pointers, Virtual functions, Polymorphism, Pointers to

Class, Array pointers to Class, Virtual Function-Abstract Class, Pure Virtual Function, Files and Streams, Building class Libraries in C++. File Handling in C++, Template class, Exception Handling.

Text / Reference Book:

1. Object Oriented Programming with C++, E. Balagurusamy, Tata McGraw Hill
2. Object Oriented Programming in C++, Robert Lafore, Techmedia 2002
3. C++, How to program by Deitel & Deitel, Person Edition, 2002
4. The C++ Programming Languages by Stroustrup, Addison, Wesley., 2001
5. Problem Solving the object of Programming, Walter Savitch, Pearson Edition, 2003

**BTBI- 252: Computer Lab - IV**

Sequence Alignment Software: Searching for sequence databases; Protein databases, PDB, BLAST, FASTA, CLUSTW, Comparing and aligning sequences; Phylogenetic trees for sequences. Developing database applications: SQL queries using Oracle, Interface databases with VB. Problem solving using C++ programming language.

**BTBI – 311: Genomics, Proteomics and HGP**

Primer Selection Phylogeny, Protein Sequence Analysis, SAGE, Primer Chain Reaction (PCR). Genomics, Fragmenting the genomes, Need of markers, Marker Sequencing (RFLP, AFLP & SNP, etc); Genome sequencing: Basic Sanger sequencing, Automated sequence, Gene Identification, MUMmer , Blast2. Proteomics, Microarray: The technique of microarray design, 2-D gel electrophoresis, Peptide sequencing, Mass spectroscopy. Metabolomics, Metabolic pathway databases: KEGG, COG, WIT; Drug target identification. Functional genomics: Application of sequence based and structure based approach of gene function eg: Sequence comparison, Structure analysis (active site, binding site) and comparison; Approaches for determining gene expression patterns and functions. What is HGP: Goals, Progress & History of HGP.

Text / Reference Book:

1. Handbook of Comparative Genomics: Principles and Methodology by T.B. Kitano, Graziano Pesole, 2003.
2. Computational Molecular Biology by P. Clate & R. Backofen, Willy Publication, 1998 Proteomics,
3. Timothy Palkill, kluwer Academic Publisher, 2002
4. Introduction to Proteomics: Tools for the new Biology, Daniel C. Liebler, Humana Press, 2001
5. Foundation to systems Biology (Ed) by Hiroaki Kitano, MIT Press, 2001

**BTBI- 321: Animal & Plant Biotechnology**

**Animal Biotechnology**

General metabolism, Special secondary metabolites / products, Insulin growth hormone interferon, t-plasminogen activator, factor VIII etc. Growth factors promoting proliferation of animal cells (EGF, FGF, PDGF, IL-1, NGF erythropoietin etc). Expressing cloned proteins in animal cells, Over production and processing of chosen protein. The need to express in animal cells, Production of

vaccines in animal cells, Production of monoclonal antibodies, Bioreactors for large scale culture of cells, Transplanting cultured cells.

### **Plant Biotechnology**

Introduction to *in vitro* methods, Terms and definitions, Use of growth regulators; *in vitro* pollination and fertilization; Introduction to the processes of embryogenesis and organogenesis and their practical applications; Clonal multiplication of elite species (Micropropagation), axillary bud, shoot-tip and meristem culture. Haploids and their applications. Somaclonal variations and application; Endosperm culture and production of triploids; Practical applications of tissue and organ culture; Single-cell suspension cultures and their applications in selection of variants / mutants with or without mutagen treatment (of haploid cultures preferably). Somatic hybridization - an introduction; Various methods for fusing protoplasts: chemical, electrical, Use of markers of r selection of hybrid cells; Practical applications of somatic hybridization (hybrids vs cybrids), Protoplasts and tissue culture for genetic manipulation of plants, Introduction to *A. tumefaciens*, Tumor formation on plants using *A. tumefaciens* (Monocots vs Dicots), Root-formation using *A. rhizogenes*, Practical application of genetic transformation.

Text / Reference Book:

### **BTBI – 331: Perl Programming for Bioinformatics**

Getting started with PERL, Perl's Benefits, Versions of Perl, Downloading and installing Perl in Linux/Windows environment, How to run perl programs in Linux/Windows environment, Error Message, Debugging, Perl interpreters, Perl scripts. Scalar values and scalar variables, Strings and numbers, Assignment statements, Blocks, Arrays, Hashes, Operators, Binding operators, Loops, IO, Input from file, Input from STDIN, Input from file named in command line, Regular expression, Pattern matching, Meta symbols, Pattern modifiers, Subroutines and modules, Built-in functions. Application of Perl in Bioinformatics: Representing strings and sequenced data in Perl, Program to store a DNA sequence, Concatenating DNA fragments, DNA to RNA transcription, Reading proteins from files, Finding motifs, Counting nucleotides, Exploding strings into arrays, Operating on strings. A program to simulate DNA mutation, Generating random DNA, Analyzing DNA, Translating DNA into proteins, GenBank sequence and annotation, Parsing annotation, Indexing GenBank with database. PDB files, Parsing PDB files, Parsing BLAST output, Introduction to BioPerl, CPAN, and Python.

Text / Reference Book:

1. James D. Tisdall, "Beginning Perl for Bioinformatics", O'Riley and Associates, 2001.
2. Cynthia Gibas & Per Jamesbeck, "Developing bioinformatics Computer skills", O' Riley & Associates, 2000
3. Rex A. Dawyer, "Genomic Perl", Cambridge University Press.
4. Learning Perl, 3<sup>rd</sup> Edition: Randal L. Schwartz and Tom Phoenix, O'Riley

### **BTBI – 341: Advanced Multimedia**

Overview of Multimedia: Different Views and Perspectives. Multimedia Applications: Video-on-demand, Interactive television, Video conferencing, Hypermedia courseware, Groupware, World Wide Web, Digital libraries. Media and its Types: Static, Continuous, Time-Based.; Visual Communication

and Human Perception: visual and auditory; Multimedia Devices and Systems: Audio/Video boards, Support for Media, CMS services; User Interface Design: Need, Significance, Guidelines etc. Multimedia Development: Phases, Stages, Team etc, Multimedia Building Blocks, Text: Value and significance, Formats, style, Font Size and Type, use in MM Networking and Applications, Streaming Audio and Video, Best Effort Service, Protocols for Real Time Applications, RTP, RTCP, SIP etc. Graphics: Significance, different Image Formats, Scheduling Policing Mechanism, Integrated services and Differentiated services.

Text / Reference Book:

1. Computer Networks by A.S. Tanenbaum, 4<sup>th</sup> Edition, Pearson Education, 2000
2. Multimedia – An Introduction by Villmil., Prentice Hall (India), 1999
3. Computer Networking by J.F. Kurose and Keith W. Ross, 2<sup>nd</sup> Edition, Pearson Education, 2001

**BTBI – 351: Computer Lab - V**

Multimedia: Introduction to Photoshop, Developing multimedia application using Flash. Perl programming for Motif search, Open reading frames, Parsing, etc. Documentation of Human Genome Project. Clustering and classification software such as SOM, SVM, PCA; using visualization software such as TreeView, Sammon Mapping.

**BTBI – 312: Gene Expression & MicroArray Analysis**

DNA MicroArray: The Technical Foundations, Why are MicroArray Important? What is a DNA MicroArray. Designing a MicroArray Experiment: The Basic steps, Types of MicroArray, NCBI and MicroArray Data Management, GEO (Gene Expression Omnibus), MAML, The benefits of GEO and MAML, The Promise of MicroArray Technology in Treating Disease. MicroArray Data, Preprocessing the Data, Measuring Dissimilarity of Expression Pattern, Distance Motifs and Dissimilarity measures, Visualizing MicroArray Data; Principal Component Analysis, PCA and MicroArray Data. K-Means Clustering, Hierarchical Clustering, Self Organization Maps (SOM). Identifying Genes: Expressed usually in a sample, Expressed significantly in population, Expressed differently in two populations. Classifying Samples from two populations using Multilayer Perceptron, Support Vector Machines and their applications, Using genetic algorithm and perceptron for feature selection and supervised classification.

Text/Reference Books:w

1. Microarray Data Analysis and Visualization by Arun Jogota, Bioinformatics, The Bay Press, 2001
2. NCBI Science Premier on MicroArrays.
3. Bioinformatics Methods and Application-Genomics, Proteomics and Drug Discovery by S. C. Rostogi, N. Mendiratla and P. Rostogi, Prentice Hall (India), 2004

**BTBI – 322: Pharmacogenomics & Pharmacogenetics**

Introduction to Pharmacogenomics and Pharmacogenetics, Definition of SNP's, Role of SNP in Pharmacogenomics in clinical trails, Patenting issues in Pharmacokinetics research. Basics of Drug Pharmacokinetics and Pharmacodynamics, How the polymorphism of CYP450 enzymes effects of

drug response. Poor metabolizers, Fast metabolizers and drug response. Correlation of CYP450 alleles with adverse drug reactions, Pharmacogenomics in the treatment of various diseases.

### **BTBI- 332: MicroSoft Visual Basic**

Introduction to Visual Basic: Introduction, VB Application Development Cycle, Loading VB, VB Current Interface, VB Controls, Drawing Objects on the Form, Event procedures. Programming Fundamentals: Variables, Scope and Life Time of Variables, Data types; Modules: Form Modules, Standard Modules, Class Module; Procedures: Sub procedures, Function procedures, Property procedures. Control Structure: Decision structure (If, Select Case), Loop structure (Do While ...Loop, Do...Loop While, For...Next, For Each...Next), Exit statement; Control Array, Arrays; Functions. Menu Editor, Writing Code for Menu Controls; Dialog Boxes; MDI Application, Menu in MDI Applications; Adding Status bar; Adding a Tool bar; Data Files Handling. Database Access: accessing Database, Data Control; Data Access Object (DAO), Active Data Objects (ADO), Remote Data Object (RDO); Visual Basic and Oracle.

### **BTBI- 342: Computer Lab - VI**

Gene expression and MicroArray: Pre-processing of datasets; using clustering and classification software such as SOM, SVM, PCA using visualization Software such as Tree View, Sammon Mapping. Developing modules and software in Visual Basic with background in Oracle for Biological database and front end tools as studied in existing Bioinformatics tools.

### **BTBI- 411: Information Theory & Stochastic Process**

Overview: Probabilities defined on events, Random variable, Binomial, Geometric, Poisson variates, Uniform, Exponential, Gamma, Normal Variates, Expectation. Introduction to stochastic process, Stationary process Poisson process, Non-homogeneous Poisson process, Brownian motion process. Markov Chain: Chapman-Kolmogorov equation, Classification of states, Limiting Probabilities, Time Reversible Markov Chain, Markov Chain Monte Carlo Method, Continuous Time Markov Chain, Birth and Death Process, Time reversibility, Uniformization. Information and Entropy, Joint and Conditional Entropies, Mutual information, Chain rules for entropy, Relative entropy. Entropy rules of stochastic process, Entropy rate, Hidden Markov Models. Channel Capacity, Noiseless binary channel, Symmetric, Gaussian channel.

#### **Text / Reference Book:**

1. Element of Information Theory by Cover and Thomas, New York: Wiley, 1991.
2. A First Course in Stochastic Process by Samuel Karlin and Howard M. Taylor, Academic Press Inc. (London) Ltd., 1988.
3. Stochastic Processes by Sheldon M. Ross, John Wiley & Sons, 2000.
4. An Introduction to Stochastic Processes by Edward P. C. Kao, Duxbury, 1999.

### **BTBI – 421: Advanced Algorithm for Computational Biology**

Algorithms and Complexity, Algorithm Design Techniques, Tractable versus Intractable Problems. Restriction Mapping, Graphs, Measuring Fragment Size, Restriction Mapping Algorithms, Double Digest Problem, Classifying multiple solutions, NP-Completeness, Regulatory motifs in DNA sequences, Profiles, Motif finding Greedy algorithms, Divide and Conquer Algorithms. Markov Chains, Hidden Markov Models, CG-Islands, Forward & Backward Algorithm, HMM Parameter estimation, Profile HMM, Building viterbi Algorithm, Multiple Sequence Alignment by profile HMM's. DNA Sequencing, Shortest Superstring Problem, DNA Arrays as an Alternative Sequencing Technique, Sequencing by Hybridization, SBH as a Hamiltonian Path Problem, SBH as an Eulerian Path Problem, Fragment assembly in DNA Sequencing. Phylogenetic Reconstruction, Gene Expression Analysis, Hierarchical Clustering, *k*-Mean Clustering, Distance Based Tree Reconstruction, Additive Metrics, Metrics on Tree, Ultrametric Trees, Character-Based Tree Reconstruction, Parsimony Method, Evolutionary Methods, Maximum Likelihood Method, Model Comparison. Protein Folding: Levels of Proteins Structures, Prediction by Profile HMMs, Molecular Modeling.

#### Text / Reference Book:

1. An Introduction to Bioinformatics Algorithms, Neil C Jones & Pavel A. Pevzner, Ane Books, 2005.
2. Introduction to Computational Molecular Biology , Setubal and Meidanis, Thomson, 2003.
3. Biological Sequence Analysis Probabilistic Models of Proteins and Nucleic Acid, R. Durbin, Eddy, A. Krogh and Mitchison, Cambridge University Press, 1998.
4. Introduction to Mathematical Method in Bioinformatics, Alexcender Isaev, Springer Universitext, 2004

### **BTBI- 431: ASP**

Introduction to Active Server Page, ASP differs from Client-Side Scripting Technologies, Running ASP: Setting Personal Web server (PWS) and Internet Information Server (IIS), Creating ASP Page. ASP Script: Writing ASP Code in different ways, Comments, Return value of Asp script to the Browser; Variables; Data types; Constants; VBScript Operators. Control Structure: Conditional, Looping, Branching; VBScript Built-in Functions: Formatting Functions, Math Functions, Date Functions, String Functions, Other Functions. Building Block of Objects: Properties, Methods, Instances of Objects; Built-in Objects: Response object, Request object, Application object, Session object, Server object, Object Context objects, ASPError object; Events. Reading and Writing Files on Web Server; Debugging and Error Handling; Database Handling using ASP: Connecting with Database; Reading, Inserting, Updating, and Deleting Database Records.

#### Text / Reference Book:

1. Teach Your Self: Active Server Pages 3.0 by Scott Mitchell and James Atkinson, Techmedia

### **BTBI – 441: Core Java**

Introduction to Java: Importance and Features of Java, Keywords, Constants, Variables and Data Types, Operators and Expressions, Decision Making, Branching and Looping: if..else, switch, while,

do, for Statements, Labeled loops, Jump statements: break, continue, return. Introducing Classes, Objects and Methods: Defining a class, Adding Variables and Methods, Creating Objects, Constructors, Class Inheritance; Arrays and String: Creating an array, one and two dimensional arrays, String array and methods; Classes: String and String Buffer classes, Wrapper classes: Basics types, using super, Multilevel hierarchy abstract and final classes, Object class, Packages and interfaces, Access protection, Extending Interfaces, packages. Exception Handling: Fundamentals exception types, Uncaught exceptions, throw, throw, final, built in exception, Creating your own exceptions, Multithreaded Programming: Fundamentals, Java thread model: Priorities, Synchronization, Messaging, Thread classes, Runnable interface, Inter thread Communication, Suspending, Resuming and Stopping threads. Input/Output Programming: Basics, Streams, Byte and Character Stream, Predefined Streams, Reading and Writing from console and files; Using Standard Java Packages (lang, util, io, net). Event Handling: Different Mechanism, the Delegation Event Model, Event Classes, Event Listener Interfaces, Adapter and Inner Classes, Working with windows, Graphics and Text, Using AWT controls, Layout managers and Menus, Java Applet. Beans: Introduction to Java Beans and Swings; Servlets

#### Text / Reference Book:

1. E. Balaguruswamy, "Programming with Java: A Primer", TMH, 1998.
2. Horstmann, "Computing Concepts with Java 2 Essentials", John Wiley.
3. Decker & Hirshfield, "Programming Java: A introduction to programming using JAVA", Vikas Publication, 2000.
4. Patrick Naughton and Herbertz Schildt, "Java-2 The Complete Reference", TMH, 1999.

#### **BTBI – 451: Computer Lab - VII**

Developing Biological Algorithm using Asp and Perl Script. Oracle and MS-Access Database Handling using ASP (VBScripting language). Programs and Module development using Java.

#### **BTBI- 251: Minor Project – I**

#### **BTBI – 352: Minor Project – II**

#### **BTBI – 412: Major Project**

#### **Project Guideline**

- Students must submit his/her project synopsis to the concern supervisor along with his/her Name, Father's Name, ID Number, Title of Project, etc and get it approved by them.
- Project must be done by individually or in group of maximum three students.
- Approval by the supervisor is based on the directions given by the Department.
- After scrutinizing the same by the supervisor, students must complete their project and submit the final report within the stipulated time in the form of soft and hard copy to the Department.
- The Department will evaluate project.
- Students must demonstrate their project in their Department to the concern persons on the date fixed by the learning center.

**Objectives of the project proposed:**

1. To provide the scope to apply the concept of Bioinformatics, computer programming language, database used and application of computer science in biology.
2. To analyze biological problems and provides good exposure to development & implementation of software database by following the software engineering concepts.

**Marks Distribution (Minor Project):**

• **Internal Assessment:** 60 Marks

Project Supervisor:	20
Presentation & Viva Voce – I:	15 + 5 = 20
Presentation & Viva Voce – II:	15 + 5 = 20
.....	
Total:	60

• **Semester Assessment:** 40 Marks

Presentation & Viva Voce - Final:	10 + 10 = 20
Project Report:	20
.....	
Total:	40

**Marks Distribution (Major Project):**

• **Internal Assessment:** 100 Marks

Project Supervisor:	40
Presentation & Viva Voce Internal	40 + 20 = 60
.....	
Total:	100

• **Semester Assessment:** 300 Marks

Presentation & Viva Voce - Final:	150 + 50 = 200
Project Report:	100
.....	
Total:	400