Solapur University, Solapur

M.Sc. Part –I Bioinformatics

(Revised Semester Pattern Syllabus)

w.e.f. June 2013

Solapur University, Solapur

M.Sc. Part-I Bioinformatics

(Revised semester pattern syllabus)

(w.e.f. June, 2013)

1) Course Title: M. Sc. Bioinformatics

2) Introduction: Recent developments of the sciences have produced a wealth of experimental data of sequences and three-dimensional structures of biological macromolecules. With the advances of computer and information science, these data are available to the public from a variety of databases on the Internet. This course will provide the knowledge of bioinformatics to interpret the rapidly expanding amount of biological information. It will discuss the basic concepts of bioinformatics and focus how to identify, seek, establish, maintain and exchange research information in biology. It will review the major scientific databases needed for research problems in biology. Students will learn Bioinformatics tools.

3) Objectives of the course:

- To equip the students with the requisite background in areas of modern biology (biochemistry, cell biology, genetics and molecular biology) and computer science (programming languages, databases, algorithms, graphics, data mining, data security, etc.).
- Gain familiarity with computational methods in order to address problems in molecular biology.
- Become knowledgeable about the storage, retrieval, sharing and use of biological data, information, and tools.
- To launch the students into core areas of Bioinformatics like multiple sequence alignment, phylogenetic trees, genomics, proteomics etc.
- To explore the students to applied areas of Bioinformatics like Protein-protein interaction, drug design, metabolic pathway engineering etc.
- To provide practical experience to students by giving them an opportunity to pursue project work in an identified area of Bioinformatics.
- Students should gain substantial competency in content, skills, and awareness within the field of bioinformatics.

4) Advantages of the course:

- Students will learn through applying the strategies and tools used in bioinformatics to topical problems drawn from ongoing research and applications in a variety of fields.
- A number of recent workforce studies have shown that there is a high current and unmet demand for people trained to various levels of expertise in bioinformatics.
- The emergence of new Internet technologies, new and more accurate algorithms and the development of High Performance Computing coupled with DNA sequencing, serial analysis of gene expression, microarrays, and new mass spectrometry has enabled bioinformatics to address the biological problems from several different angles. It is this change in paradigm that has led to the development of Bioinformatics as a separate skill-oriented discipline.
- This course provides scope for employment opportunities in various industries in the applied aspects Biotechnology, Microbiology, Molecular biology, Drug discovery and Drug design and Information technology.

5) Eligibility of the Course

Candidates who have passed (a) 10+2 with Science and (b) Bachelor's degree in Science / Engineering /Technology/ Agriculture / Medicine / Veterinary Science / Pharmaceutics from recognized University and as per the eligibility criteria lay down by Solapur University; Solapur will be eligible for admission to M.Sc. course in Bioinformatics.

6) Duration: The course will be of two years duration and shall be completed in four semesters.

SOLAPUR UNIVERSITY, SOLAPUR
Syllabus for M.Sc. Bioinformatics Part - I

(w.e.f. June, 2013)

Structure

SEMESTER- I (THEORY)

Paper	Title of the paper	Marks
Binf 101	Introduction to Bioinformatics	100
Binf 102	Cell Biology and Genetics	100
Binf 103	Introduction to HTML and Biostatistics	100
Binf 104	Introduction to Programming languages & programming through C & C++	100

SEMESTER- I (PRACTICAL)

Paper	Title of the paper	Marks
Binf Pr 105	Introduction to Bioinformatics and Cell Biology and Genetics	100
Binf Pr 106	Introduction to HTML and Biostatistics and Introduction to Programming languages & programming through C & C++	100

SOLAPUR UNIVERSITY, SOLAPUR
Syllabus for M.Sc. Bioinformatics Part - I

(w.e.f. June, 2013)

Structure

SEMESTER- II (THEORY)

Paper	Title of the paper	Marks
Binf 201	Advanced Bioinformatics	100
Binf 202	Microbiology and Biotechnology	100
Binf 203	Basic Biochemistry and Immunology	100
Binf 204	Programming in Object Oriented languages	100

SEMESTER- II (PRACTICAL)

Paper	Title of the paper	Marks
Binf Pr 205	Advanced Bioinformatics, Microbiology & Biotechnology	100
Binf Pr 206	Basic Biochemistry, Immunology and Programming in Object Oriented languages	100

M.Sc Part-I Bioinformatics

SEMESTER- I

PAPER NO. Binf 101: INTRODUCTION TO BIOINFORMATICS 100

Section I- Introduction to Bioinformatics (45L)

UNIT I:
Introduction to Bioinformatics: Definition and History of Bioinformatics, Internet and Bioinformatics, Introduction to Data Mining, Applications of Data Mining to Bioinformatics Problems and Applications of Bioinformatics. (4)
UNIT II:
Biological Databases: Principle DNA and genome Databases (NCBI-GENBANK, EMBL, DDBJ), Protein Databases (PIR, MIPS, SWISS-PROT, TrEMBL, NRL-3D, PRINTS, Pfam). (6)
UNIT III:
Bioinformatics Softwares: Clustal W, Clustal X, RasMol, Primer3, Oligo, Treeview, Genetic Analysis Software, Phylip. (9)
UNIT IV:
Database Searches: Keyword-based searches using tools like ENTREZ and SRS, Various file formats for bio-molecular sequences: GenBank, FASTA, GCG, MSF, etc. (3)

Section II- BIOCOMPUTING

UNIT I:
Biocomputing: Introduction to String Matching Algorithms, BLAST & FASTA Sequence Comparison and Alignment Tools, Use of Biochemical Scoring Matrices, Automated Genome Comparison and its Implication, Automated Gene Prediction, Introduction to Gene Arrays, Analysis of Gene Arrays (9)
UNIT II:
Systems Biology: Introduction, History, Associated disciplines. (3)
UNIT III:
Markov chains and applications: Machine Learning Methods, Hidden Markov models, Applications of HMM in gene identification and Profiles HMMs (6)
UNIT IV:
Introduction to Neural Networks: Architecture of neural networks, Application of neural networks and Support Vector machines: introduction and applications (5)

Suggested Readings

1. Claverie, J.M. and Notredame C. 2003 Bioinformatics for Dummies. Wiley Editor.
2. Letovsky, S.I. 1999 Bioinformatics. Kluwer Academic Publishers.
3. Baldi, P. and Brunak, S. 1998 Bioinformatics. The MIT Press.
4. Setubal, J. and Meidanis, J. 1996 Introduction to Computational Molecular Biology. PWS Publishing Co., Boston.
5. Lesk, A.M. 2002 Introduction to Bioinformatics. Oxford University Press.
6. Rastogi, S.C., Mendiratta, N. and Rastogi, P. 2004 Bioinformatics: Concepts, Skills & Applications. CBS Publishers & Distributors, New Delhi.
7. Fogel, G.B. and Corne, D.W., Evolutionary Computation in Bioinformatics.
8. Patterson, B.K., Techniques in Quantification and Localization of Gene Expression.
9. Mont, D.W., Bioinformatics: Sequence and Genome Analysis.
10. Evens, W.J. and Grant, G.R., Statistical Methods in Bioinformatics: An Introduction.
11. Pierre Baldi and Soren Brunak, Bioinformatics: The Machine Learning Approach.

PAPER NO. Binf 102: CELL BIOLOGY AND GENETICS 100

Section I: Cell biology (45 L)

Unit I – Biology of cells: Cells as a unit of life, structure of prokaryotic and eukaryotic cells. Cellular membrane: structure, transport, channels, carriers, receptors, endocytosis, membrane potentials. (3)

Unit II – An overview of organelles (Mitochondria, chloroplasts, ER, Golgi, ribosomes, lysosomes and peroxysomes, nucleus and nucleolus). Differences and similarities in plant, animal and microbial cells. (5)

Unit III –Cell cycle: Cell division (Mitosis & Meiosis), Molecular events in cell cycle and regulation. Cell senescence and death: molecular basis and pathways of cell ageing and programmed cell death (Apoptosis). (7)

Unit IV – Cell-cell interactions and signal transductions: Intercellular junctions, signaling by hormones and neurotransmitters; receptors, G-proteins, protein kinases and secondary messengers. Protein traffic in cells. (5)

Section I: Genetics

Unit I- Mendel's laws and DNA as genetic material

Mendel's laws of inheritance and their chromosomal basis, extrachromosomal inheritenc. DNA as genetic material, classical experiments – Hershey and chase; Avery McLeod & McCarty. Prokaryotic and eukaryotic genome organization, C-Value paradox, repetitive DNA. Structure of gene-intron, exon and their relationships, overlapping genes.
(8)

Unit II- Replication and Transcription

Replication in prokaryotes and eukaryotes - D-loop and rolling circle mode of replication, replication of linear viral DNA. Transcription- initiation, elongation, termination, features of promoters and enhancers, transcription factors, inhibitors, post-transcriptional modification - RNA splicing, ribozyme. RNA editing. (8)

Unit III- Translation and Recombination

Elucidation of genetic code, Process of translation in prokaryotes and eukaryotes, posttranslational modifications, Regulation of gene expression - Lac and trp operons. Molecular mechanism of general recombination, homologous and site-specific recombination, gene conversion.
(5)

Unit IV- Mutation and DNA repair

Types of mutation, mutagens, site-directed mutagenesis, transposons in mutation, repair mechanisms-photoreactivation repair, Base excision repair (BER), Nucleotide excision repair (NER), Mismatch repair (MMR) and SOS repair.
(4)

Suggested Readings

1. Alberts *et. al.,* 2002, Molecular Biology of the Cell. Garland.
2. Lewin 2004, Genes VIII. Pearson.
3. Lodish *et. al.,* 2004, Molecular Cell Biology. Freeman.
4. Karp 2002, Cell and Molecular Biology. John Wiley.
5. Pollard & Earnshaw 2002, Cell Biology. Saunders.
6. Tobin & Morcel 1997, Asking about Cells. Saunders.
7. Watson *et. al.,* 2004, Molecular Biology of the Gene. Pearson.
8. Atherly *et. al.,* 1999, The Science of Genetics. Saunders.
9. Griffiths *et. al.,* 2004, An Introduction to Genetic Analysis.
10. Hartl & Jones 1998, Genetics - Principles & Analysis. Jones & Bartlett.

11. Snustad *et. al.,* 1998, Principles of Genetics. Wiley & Sons.
12. Strickberger 1985, Genetics. Macmillan.
13. Russell 2002, Genetics. Benjamin.

PAPER NO. Binf 103: INTRODUCTION TO HTML & BIOSTATISTICS. 100

Section I - Introduction to HTML (45L)

Unit I: Introduction to HTML: The World Wide Web (WWW), HTML History, Hypertext and Hypertext Markup Language, Introduction to Web design. (20)

Unit II: Basic tags of HTML: Basic tags, Body attributes. (10)

Unit III: Table Frameset & Form Table definition, border thickness, cell spacing, and table size, Design a frame template, Introduction to form, types of all form tags, get & post methods (10)

Unit IV: Introduction to MATLAB, Applications of HTML (5)

Section II - Introduction to Biostatistics

Unit I–Fundamentals of Biostatistics: Introduction, history and applications of statistics for the biological problems. (3)

Unit II–Data representation: Introduction to data, collection of data, different types of data and types of data representation. (5)

Unit III–Measures of central tendency: Mean, Median, Mode, Standard Deviation, Variance, Coefficient of Variation, test for significance: Chi square test, Z – test, T – test, ANOVA (7)

Unit IV–Random variables: Introduction, generation of random variables, types of random variables (discrete and continuous), expected value, and importance of random variables in biological simulations. (5)

Suggested Readings

1. Ewens, W.J. and Grant, 2001 Statistical Methods in Bioinformatics: An Introduction. Springer- Verlag.
2. Devore, J.L., 2002 Probability and Statistics, 5th edition, Thomson Asia.
3. Hoel, Port and Stone, Introduction to Statistics.
4. Miller & Freund: Probability and Statistics for Engineers, 7th Edition.
5. Chung, Kai Lai, Elementry Probability Theory with Statistical Processes (Student Edition) Springer International
6. Feller, W., An Introduction to Probability :Theory and its Applications, Wiley Eastern Limited.
7. Larson, H.J., Introduction to Probability Theory and Statistical Inference, John Wiley & Sons.
8. Warren J.J., Ewens Warren, Ewens Gregory Grant, Statistical Methods in Bioinformatics: An Introduction, Springer-Verlag.
9. Gupta, S.C. and Kapoor, V.K.: Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
10. Goon, A.M., Gupta, M.K. and Dasgupta B.: Fundamental of Statistics - Vol. 1, The World Press Pvt. Ltd.
11. Ayers, F. , Matrices and Vectors, Schaum
12. Prasad, G.: Differential Calculus, 2003 Poothisala Publication .
13. Prasad, G.: Integral Calculus, 2003 Poothisala Publication.
14. Boas: Mathematical methods in the Physical Sciences, Wiley Publication

PAPER NO. Binf 104: INTRODUCTION TO PROGRAMMING LANGUAGES AND PROGRAMMING THROUGH C & C++ 100

Section 1: Basics of C language (45L)

Unit I: Introduction to Programming Languages

Introduction to programming Languages and Paradigms, Syntactic Structure, Semantics, Data Representation, Data Abstraction, Procedure activation, Structured Programming, Block Structuring. Procedural Languages, Functional Programming, OOP basics, Logic Programming (10)

Unit II: Introduction to C Programming

Introduction to Program, Programming Language, Types of Programming Language, History of C, Algorithm, flowchart, Data types, Operators, Decision Control Statements, simple if, if else, switch case, nesting of switch case ,Iterative Statements, loops, Entry & exit controlled loop, Break and Continue Statements, Input and Output functions. (10)

Unit III: Array, String & pointers

Intro to Arrays, One-dimensional array, two-dimensional array, Multi dimensional array, Intro to Strings, Use of gets() and puts() functions, Manipulating Strings, String Handling Functions, Intro to Pointers, Pointers Arithmetic, Pointers and Arrays, Pointers and Strings (5)

Unit IV: Functions structure & file handling

Introduction to functions, Creating simple functions, Library and User-defined functions, Types of functions, Call by value and Call by reference, Introduction to Structures, working with structure, Structure and union, Pointers and Structures.

Introduction to Disk I/O Function, File Manipulation, Declaring and Opening a File, Closing file. (5)

Section II- Basics of C++ language

Unit 1: Introduction to Object Oriented Programming

Introduction of object oriented programming, Difference between OOP and Modular programming, Features of C++, Difference between C and C++, Programming in C++ using C logic (5)

Unit II: Classes and Objects & function in C++

Introduction to Classes, C Structures and C++ classes, Specifying a class, Defining member Function and member Variable of class, Call-by-value, Call-by-reference, Static Variables and function, friend function, Introduction to Constructor, types of constructor, Constructor Overloading. (2)

Unit II: Polymorphism & Inheritance

Introduction to Static Polymorphism, Function Overloading, Operator Overloading, Operator Overloading using Relational operator, type conversion, Introduction to Inheritance and its types, Virtual Base Class, Abstract classes, Pointers in C++, pure virtual function, This pointer. (5)

Unit IV: Working with files, Templates

Opening a file with open (), Opening a file with Constructors, End-of-file detection, File modes and pointers Introduction to Templates, Generic Functions (3)

Suggested Readings

1. Sethi, R., 1996, Programming Languages, Addison-Wesley.
2. Appleby, D. and Vandkopple, J.J., 1991, Programming Languages, Tata McGraw-Hill.
3. Kernighan, B.W. and Ritchie, D.M., The C Programming Language, PHI.
4. Hutchinson, R.C. and Just, R.B., Programming using the C Language, McGraw-Hill.
5. Gottfried, B.S., Schaum's Outline of Theory and Problems of Programming with C, McGraw- Hill.
6. Schildt, H., C Made Easy, Osborne McGraw-Hill.
7. Tisdall, J.D. 2001 Beginning Perl for Bioinformatics. O'Reilly & Associates

PAPER NO. Binf Pr-105: Introduction to Bioinformatics and Cell biology & Genetics. 100 (45L)

1. Introduction to Genome Information resources- EMBL, DDBJ, GENBANK
2. Introduction to Protein Information resources- PIR, SWISS-PROT, PRINTS, PFAM
3. Structure of database entry.
4. Search engines: Entrez, SRS.
5. Analysis of biological data using: BLAST, FASTA, Clustal W, Treeview, Phylip,
6. Structure visualization using Rasmol
7. Primer analysis using OLIGO, Primer3
8. Automated gene prediction using any 3 tools.
9. Vector analysis using SVM.
10. Study of Mitosis.
11. Study of Meiosis.
12. Study of Micrometry.
13. Study of cell counting methods by Haemocytometry.
14. Isolation of genomic DNA.
15. Study of giant chromosomes.
16. Analysis of monohybrid & dihybrid ratio.
17. Study of Karyotype.
18. Problems related to sex linked inheritance.

PAPER NO. Binf Pr-106: Introduction to HTML & Biostatistics and Introduction to programming languages & programming through C & C++. 100

(45L)

1. Design a simple web page using basic tags.
2. Design a simple web page using frameset.
3. Design a simple web page using Image tag with attributes.
4. Design simple login page using form with attributes.
5. Design simple registration form using all form tags.
6. Design simple website using hyperlink
7. Study of sampling techniques using biological data: Mean, Median, Mode, Mean deviation, Standard deviation, Variance, Coefficient of Variance.
8. Graphical representation of biological data.
9. Study of Chi-square test.
10. C program using operators.
11. C program using If.
12. C program using If else.
13. C program using switch case.
14. C program using while.
15. C program using Do while.
16. C program using Break.
17. C program using Continue.
18. C program using different Pointers.
19. C program using Arrays.
20. C program using Structures.
21. C program using Parameter passing.
22. C++ program using class & object.
23. C++ program using constructor
24. C++ program using destructor
25. C++ program using constructor overloading
26. C++ program using Inheritance
27. C++ program using virtual function
28. C++ program using friend function
29. C++ program using operator overloading
30. C++ program using pointers
31. C++ program using template
32. C++ program using file

M.Sc Bioinformatics, Part-1

SEMESTER- 2

PAPER NO. Binf- 201: ADVANCED BIOINFORMATICS 100

Section I- Sequence Analysis (45L)

UNIT I - Scoring matrices: Detailed method of derivation of the PAM and BLOSUM matrices. **Pairwise sequence alignments:** Needleman & Wuncsh, Smith & Waterman algorithms for pairwise alignments and their implementation. **Multiple sequence alignments (MSA):** Use of HMM-based Algorithm for MSA (e.g. SAM method). (6)

UNIT II - Taxonomy and phylogeny: Phylogenetic analysis algorithms such as Maximum Parsimony, UPGMA, Transformed Distance, Neighbors-Realtion, Neighbor-Joining; Probabilistic models of evolution and Maximum likelihood algorithm, Bootstrapping method, use of tools such as Phylip, Mega, PAUP. (7)

UNIT III - Sequence patterns and profiles: Algorithms for generation of sequence profiles: Profile Analysis method of Gribskov, PSI-BLAST, HMMer (4)

UNIT IV - Protein and nucleic acid properties: e.g. Proteomics tools at the ExPASy server and GCG utilities and EMBOSS. (5)

Section II GENOMICS AND PROTEOMICS

UNIT V - Prediction of genes, promoters, splice sites, regulatory regions: basic principles, application of methods to prokaryotic and eukaryotic genomes and interpretation of results. **DNA microarray**, the databases (SAGE) and basic database tools. **Protein arrays**: basic principles, applications. (6)

UNIT IV - Basic concepts on identification of disease genes, role of bioinformatics- OMIM database, reference genome sequence, integrated genomic maps, gene expression profiling; identification of SNPs, SNP database (dbSNP). **Metabolic pathways**: databases such as KEGG, EMP. **Plant, animal and pathogen databases**. (8)

UNIT VII - Comparative Genomics: Basic concepts and applications, MUMmer, BLAST2, MegaBlast algorithms, applications of Suffix tree in comparative genomics, synteny and gene order comparisons. Identification/ assignment of secondary structural elements from the knowledge of 3-D structure of macromolecule. (6)

UNIT VIII - Structural Biology: Prediction of protein structure. Secondary structure: PHD and PSI-PRED methods. (3)

Suggested Readings

1. K. Rosen, 2001 Application of Discrete Mathematics, 5th Edition, New York, McGraw Hill.
2. S. Wiitala, 1987 Discrete Mathematics, A Unified Approach, McGraw Hill.
3. C.L. Liu, 2000 Elements of Discrete Mathematics, McGraw Hill Book Co.
4. Jain, Iyenger & Jain, 2003 Numerical Methods for Scientific & Engineering Computation 4th Edition. Wiley Eastern Limited.
5. S.S. Sastry, 2003 Introductory Methods of Numerical Analysis 3rd Edition. Prentice Hall.
6. Pierre Baldi and Soren Brunak, Bioinformatics: The Machine Learning Approach.
7. Jae K. Lee, Statistical Bioinformatics, John Wiley & Sons Inc.

PAPER NO. Binf-202: MICROBIOLOGY AND BIOTECHNOLOGY 100

Section I Microbiology (45L)

Unit I - Major groups of micro-organisms: General characteristics of Archaea, Eubacteria, Mycoplasma, Rickettsiae and Chlamydias. (5)

Unit II - Bacterial classification based on 16S rRNA, cellular metabolism and fatty acids. The International Committee on Systematic Bacteriology (ICSB). Construction and analysis of phylogenetic tree. (5)

Unit III – General structure of prokaryotic cell. Growth kinetics in batch cultures. Genetic recombination in bacteria: Conjugation, Transformation and Transduction; Construction of genetic maps in bacteria (6)

Unit IV – General characteristics and classification of plant and animal viruses; Structure and replication of Bacteriophage (T4 and λ), Viroids & Prions, Organization of viral and bacterial genomes; Plasmids (6)

Section II Biotechnology

Unit I-Plant and animal cell & tissue culture: General introduction, concept of cellular differentiation and totipotency. Introduction to aseptic techniques, different media used for plant and animal tissue culture, tissue culture techniques. (3)

Unit II-Cloning vectors: pUC18, pBR322, Cosmids, phagemids, expression vectors, bacterial artificial chromosomes (BACs) and yeast artificial chromosomes (YACs). Enzymes used in DNA technology. Gene transfer in plant and animal systems. (8)

Unit III - Application of PCR in cloning, Role of molecular markers and nucleic acid probes in gene analysis, selection and expression. (3)

Unit IV-Techniques of DNA sequencing, chemical synthesis of oligonucleotides. Applications of recombinant DNA Technology: Crop and live-stock improvement; Molecular genetic analysis of human diseases; Gene therapy- somatic and germline gene therapy; DNA drugs and vaccines. (8)

Suggested Readings

1. Prescott, L.M., Harley, J.P. and Klein, D.A. Microbiology. 5th Ed. 2002 WmC Brown Publishers, McGraw.
2. Madigan, M.T., Martinko, J.M. and Parker, J. Brocks. Biology of Micro-organism. 10th Ed. 2003, Prentice Hall.
3. Snyder, L and Champress, W.. Molecular Genetics of Bacteria .2nd Ed. 2003. ASM, Washington.
4. J.G. Black. Microbiology Principles and Explorations. 5th Ed. 2002. John Wiley and Sons.
5. Stanier, R.Y., Ingrahm, J.L. Wheelis, M.L. and Painter, P.R. General Microbiology 5th Ed. 1987, Macmillan.
6. Tortora, C.J., Funke, B.A. and Case, C.L. Mircrobiology An Introduction. 8th Ed. 2004. Pearson Education.
7. Streips & Yasbin 2002 Modern Microbial Genetics. Wiley.
8. Turn & Trumpy 2004 Fundamental of Bacterial Genetics. Blackwell.
9. Vold et. al. 1991 Essentials of Medical Microbiology. Lippincott & Co.
10. Jackson, J.F. and Linskens 2003 Genetic Transformation of Plants. Springer.
11. Butler 2004 Animal Cell Culture and Technology.
12. Bhojwani, S.S. and Rajdan, M.K. 2004 Plant Tissue Culture. Elswea
13. Glick – Molecular Biotechnology
14. Primrose 7th Edtn. & Twyman – Blackwell publication.

PAPER NO. Binf- 203: BASIC BIOCHEMISTRY AND IMMUNOLOGY 100

Section I Biochemistry (45L)

Unit I - Bioenergetics: Laws of Thermodynamics and its Applications; Concept of free energy; High energy compounds; Cellular metabolism and ATP as the main source of free energy in biological systems (5)

Unit II - Amino Acids, Peptides and Proteins: Structure of Proteins: Primary, Secondary, Tertiary and Quaternary; Protein Folding; Structure-Conformation Function relationship (10)

Unit III - Enzymes: Classification, nomenclature, mechanism of action, binding of substrate, lowering of activation energy, factors controlling enzyme activity, allosteric enzymes, isoenzymes (5)

Unit IV - Carbohydrates and Lipids: Introduction to carbohydrates, classification, basic structures and functions. Classification of Lipids and their biological functions. Metabolic disorders and diseases. (5)

Section II Immunology

Unit I – Introduction to Immunology: Innate and adaptive immunity; Cells and tissues of immune system - macrophages, B and T lymphocytes, dendritic cells, eosinophils, basophils, mast cells, haematopoiesis; Humoral and cell-mediated immunity, Cytokines and their function (6)

Unit II – Antigens and Antibodies: Molecular structure of antibodies and their interactions with antigens; Complement system and its activation; Hybridoma technology (5)

Unit III – Major Histocompatability Complex: Introduction, classes of MHC, antigen processing and presentation. (5)

Unit IV – Disorders of Human Immune System: Self tolerance and autoimmunity; Acquired immunodeficiencies; Hypersensitivity and its types. (4)

Suggested Readings

1. Murray et. al., 2003 Harpers Illustrated Biochemistry. Prentice Hall Int.
2. Nelson, D.L. & Cox, M.M., 2004 Lehninger's Principles of Biochemistry 4th Edition. Macmillan UK, Worth Publishers, USA.
3. Berg, J.M., Tymoczko, J.L., Stryer, L., 2002 Biochemistry 5th Edition. W.H. Freeman & Co. New York.
4. Zubay, Geoffrey L., 1998 Biochemistry 4th Edition. Wm C. Brown Publishers, USA.
5. Lodish, H., Berk, A., Matsudaira, P., Kaiser, C.A., Krieger, M., Scott, M.P., Zipurskey, S.L., Darnell, J., 2004 Molecular Cell Biology 5th Edition, Freeman.
6. Voet, Donald & Voet, J.G.., 2004 Biochemistry 3rd Edition. John Wiley & Sons Inc., USA.
7. Roitt et. al., 2000 Immunology. Mosloy.
8. Roitt et. al., 2003 Essential Immunology. Blackwell.
9. Kuby, 2003 Immunology. Freeman.
10. Benjamin et. al., 2000 Immunology – A Short Course. Wiley-Liss.
11. Barrett, 1988 Text Book of Immunology. Mosloy.
12. Abbas et. al., 2001 Cellular and Molecular Immunology. Saunders.
13. Rodney M.J. Cotterill, Biophysics an Introduction 1st Edition. John Wiley & Sons.
14. Fung, Y.C., Biomechanics: Mechanical Properties of Living Tissues 2nd Edition. Springer.
15. Becker Robert & Selden Gary, The Body Electric: Electromagnetism and the Foundation of Life 1st Quill Edition. Perennial Currents.
16. Daune Michel, Molecular Biophysics: Structures in Motion. Oxford University Press.
17. Roy, R.N., A Text Book of Biophysics. 1st Edition. New Central Book Agency.
18. Brijlal and Subramaniam, Heat and Thermodynamics.
19. Halliday, Resnick and Walker. Fundamental of Physics 6th Edition. John Wiley & Sons.

PAPER NO. Binf 204: PROGRAMMING IN OBJECT ORIENTED LANGUAGES 100

Section I - Biojava (45L)

Unit I: Introduction of java- History of java, features, Overview of JAVA. (3)

Unit II: Fundamentals of OOPs in JAVA- History of java, features, Overview of JAVA, Constants, Variables and Data Types, Operators & Expressions, Decision making_ Branching & Looping, Classes, Objects & methods, Arrays, Strings & Vectors. (8)

Unit III: Interfaces & multithreading - Multiple inheritance, Multithreaded Programming, Managing Errors& Exceptions in brief. (8)

Unit IV: Applet Programming- Introduction to applet, applet lifecycle, applet methods. (6)

Section II - Bioperl

Unit I: Introduction to perl- What is Perl? Why use Perl in Bioinformatics? History of Perl, Availability, Support, Basic Concepts, intro Scalar Data, Numbers, Strings, Scalar Operators, Scalar Variables, Scalar Operators and Functions. (5)

Unit II: Intro to Arrays and List Data, Literal Representation, Variables, Array Operators and Functions, Scalar and List Context , intro to Hash, Hash Variables, Literal Representation of a Hash, Hash Functions, Hash Slices (1) (5)

Unit III: Regular Expressions- Concepts about Regular Expressions, Simple Uses of Regular Expressions, Patterns, More on the Matching Operator, Substitutions, The split and join Functions (5)

Unit IV: Subroutines- System and User Functions, The local Operator, Variable-length Parameter Lists, Notes on Lexi cal Variables, Basic/O (5)

Suggested Readings

1. Objecroriented Programming through C++ , E.BALAGURUSWAMY McGrawa Hill.
2. Letus C++, Yeswanth Kanetkar, BPB publications.
3. Tisdall, J.D. 2001 Beginning Perl for Bioinformatics. O'Reilly & Associates.
4. Hutchinson, R.C. and Just, R.B., Programming using the C++ Language, McGraw-Hill.
5. Gottfried, B.S., Schaum's Outline of Theory and Problems of Programming with C++, McGraw- Hill.
6. Schildt, H., C++ Made Easy, Osborne McGraw-Hill.
7. The Complete Reference in C++, McGraw-Hill.
8. Objecroriented Programming through Java, E.BALAGURUSWAMY McGrawa Hill.

PAPER NO. Binf Pr-205: Advanced Bioinformatics and Microbiology & Biotechnology **100**

(45L)

Advanced Bioinformatics

1. Sequence analysis using: a) BLAST & b) WU-BLAST tools.
2. Phylogenetic analysis using a) Omega, b) Phylip & c) PAUP tools.
3. Sequence patterns and profile analysis using: HMMer, PSI-BLAST
4. Finding Protein and nucleic acid properties by EMBOSS and GCG utilities.
5. Proteomics tools at the ExPASy server.
6. Gentool & Peptool.
7. OMIM, SNP database (dbSNP).
8. Metabolic pathway analysis using KEGG, EC databases.
9. DNA micro array analysis using SAGE database.
10. Plant database (MIPS) animal database (Association of zoos and aquarium database) and pathogen databases (PathoPlant, PHI-base).
11. Prediction of protein structure by DALI server.
12. ORF finding database.
13. Structure visualization using Jmol and Cn3D.

Microbiology & Biotechnology

1. Isolation of bacteria from given sample.
2. Differential staining technique.
3. Study of microbial growth kinetics.
4. Isolation of plasmid DNA.
5. Study of gene transfer methods in bacteria.
6. Study of antibiotic sensitivity of bacteria.
7. Preparation of stock solutions.
8. Preparation of MS Medium & explant inoculation.
9. Isolation & quantification of DNA from animal tissue.
10. Isolation & purification of proteins.
11. Restriction Digestion.
12. Polymerase Chain Reaction (PCR).
13. Automated DNA sequencing.

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(45L)

1. Separation of amino acids and carbohydrates by TLC.
2. Separation of amino acids and carbohydrates by paper chromatography.
3. Preparation of Std. Calibration curve and estimation of unknown proteins by FCR.
4. Preparation of Std. Calibration curve and estimation of unknown sugars by DNS.
5. Determination of activity & specific activity of salivary amylase by maltose Std. Curve.
6. Effect of various physicochemical parameters on enzyme activity.
7. Differential WBC count.
8. Blood grouping.
9. Ouchterlony Double Diffusion test.
10. Widal test for typhoid antigens.
11. Test for Rh Factor

Biojava Practicals:-

1. Java Program using operators
2. Java Program using classes & objects
3. Java Program using constants.
4. Java Program using array.
5. Java Program using vector class.
6. Java Program using string functions.
7. Java Program using thread.
8. Java Program using interface.
9. Java Program using applet.
10. Java Program using exception.

BioPerl Practicals

1. Perl program using simple Perl script.
2. Perl program using scalar variable.
3. Perl program using if control structure.
4. Perl program using for loop statement.
5. Perl program using array.
6. Perl program using hash variable.
7. Perl program using split function.
8. Perl program using while loop.
9. Perl program using string
10. Perl program using basic I/O functions.