Solapur University, Solapur

M.Sc. Bioinformatics
(Semester pattern)
Syllabus 2009- 2010

SOLAPUR UNIVERSITY, SOLAPUR
M. Sc. BIOINFORMATICS SYLLABUS
SEMESTER SYSTEM

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 laid down by Solapur University, Solapur will be eligible for admission to M.Sc. course in Bioinformatics. Admission will be on the basis of Entrance examination conducted by Solapur University, Solapur. The course will be of two years duration and shall be completed in FOUR semesters.

Outline of course

Semester I

Theory:

PAPER NO:

Binf 101: Introduction to Programming Languages and Programming through C 100
Binf 102: Cell Biology and Genetics 100
Binf 103: Introduction to HTML & Biostatistics. 100
Binf 104: Introduction to Bioinformatics 100

Practical

BinfPr 105: Programming Languages, Cell Biology and Genetics 100
BinfPr106: Introduction to HTML & Biostatistics & Introduction to Bioinformatics 100

Semester II

Theory

PAPER NO:

Binf 201: Programming in Object Oriented Languages 100
Binf202: Microbiology and Biotechnology 100
Binf 203: Basic Biochemistry and Immunology 100
Binf 204: Advanced Bioinformatics 100

Practical

BinfPr 205: Programming in Object Oriented Languages and Microbiology & Biotechnology. 100
BinfPr206: Basic Biochemistry & Immunology and Advanced Bioinformatics 100

M. Sc Part-1 Bioinformatics

SEMESTER- I

PAPER NO Binf 101: Introduction to Programming Languages and Programming through C 100

Section I Introduction to Programming Languages and Programming through C (45L)

Introduction to programming Languages and Paradigms, Syntactic Structure, Semantics, Data Representation, Data Abstraction, Procedure activation, Structured Programming, Block Structuring. Procedural Languages, Object-oriented Programming, Functional Programming, Logic Programming (20)

Introduction to Programming Language C, Data Type, Operators and Expressions in C, Control and Repetitive Statements: IF-THEN-ELSE, SWITCH, WHILE, FOR, DO; Break and Continue Statements, Input and Output functions, Function and Program Structure in C, Parameter passing, Pointers, Arrays, Structures, C-Library (20)

Perl (05)

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 102: Cell Biology and Genetics 100

(45L)

Section I: Cell biology

- Cell concept, structural organization of plant and animal cells, cell membrane and cell wall. (5)
- Study of cellular organelles and their genomes. (10)
- Cell cycle: Cell division and regulation, Apoptosis (5)
- Protein targeting to different organelles. (5)
- Basic concepts of signal transduction. (5)

Section II: Genetics

- Mendel's laws of inheritance and their chromosomal basis, extrachromosomal inheritenc (5)
- Organization and packaging of genetic material of prokaryotes and eukaryotes, C-Value paradox, repetitive DNA, structure of chromatin - euchromatin and heterochromatin, chromosome organization and banding patterns, structure of gene - intron, exon and their relationships, overlapping gene . (10)
- Nucleic acids: Structure and properties of different forms of DNA and RNA; DNA replication (5)
- Genetic code: A brief account (5)
- Central Dogma of Molecular Biology. (10)
- Gene expression and regulation in prokaryotes (*lac* operon) (5)
- Molecular mechanism of general recombination, homologous and site-specific recombination, gene conversion (10)
- Types of mutation, mutagens, molecular mechanisms of mutation, site-directed mutagenesis, detection and isolation of mutants, transposons in mutation, repair mechanisms (10)

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.

Binf 103: Introduction to HTML & Biostatistics. 100

Section I Introduction to HTML (45L)

Basic Concepts of HTML

- Introduction to HTML, Commands of HTML, Version,
- Programme architecture,
- MATLAB,
- Introduction to Web design.

Section II Introduction to Biostatistics

Biostatistics

Introduction, history and applications.

- Numerical Description of Data: Mean, Median, Mode, Quantiles, Standard Deviation, Variance, Coefficient of Variation (6)
- Simple Linear Regression and Correlation: Linear Regression Model, Least Squares Method Estimating Model Parameters, Residual Sum of Squares (8)
- Probability Theory: Sample Space and Events, Axioms of Probability, Conditional Probability, Independent Events, Bayes' Formula (6)
- Random Variables: Discrete and Continuous, Expected Value, Variance (4)
- Discrete and Continuous Distributions, Chi-Square, Student's t, Snedecor's F and Z Distributions (8)
- Estimation Theory: Unbiased Estimator; Confidence Interval: Population Mean, Population Variance (4)
- Limit Theorems: Central Limit Theorem, Strong Law of Large Number, Weak Law of Large Number (4)

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.

Binf 104: Introduction to Bioinformatics

Section I Introduction to Bioinformatics

- 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 (10)
- Introduction to Principle DNA Databases, Genome and Protein Databases.
- Bioinformatics Softwares: Clustal V, Clustal W 1.7, RasMol, Oligo, Molscript, Treeview, Alscript, Genetic Analysis Software, Phylip (20)

Section II Biocomputing

- Biocomputing: Introduction to String Matching Algorithms, BLAST,FASTA Sequence Comparison and Alignment Techniques, Use of Biochemical Scoring Matrices, Automated Genome Comparison and its Implication, Automated Gene Prediction, Automated Identification of Bacterial Operons and Pathways; Introduction to Gene Arrays, Analysis of Gene Arrays (30)
- Systems Biology-an introduction (05)
- Markov chains and applications: Machine Learning Methods, Hidden

  Markov models, Applications of HMM in gene identification and Profiles HMMs, Introduction to Neural Networks and Support Vector machines (15)

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. Vyas, S.P. and Kohli, D.V., Methods in Biotechnology and Bioengineering.
8. Singer, M. and Barg, P. Exploring Genetic Mechanism.
9. Fogel, G.B. and Corne, D.W., Evolutionary Computation in Bioinformatics.
10. Genetic Library Construction and Screening: Advanced Techniques and Applications: Lab Manual
11. Patterson, B.K., Techniques in Quantification and Localization of Gene Expression.
12. Mont, D.W., Bioinformatics: Sequence and Genome Analysis.
13. Evens, W.J. and Grant, G.R., Statistical Methods in Bioinformatics: An Introduction.
14. Liu, B.H., Statistical Genomics: Linkage Mapping and QTL Analysis
15. Bowtell, D. and Sambrook, J. DNA Microarrays.
16. Pierre Baldi and Soren Brunak, Bioinformatics: The Machine Learning Approach.
17. Jae K. Lee, Statistical Bioinformatics, John Wiley & Sons Inc.

PRACTICALS

1. **Based on Paper 1 and 2 (45HRS)**
2. **Based on Paper 3 and 4 (45HRS)**

Paper Binf 105: Introduction to programming languages and Cell biology & Genetics.

1. Addition operation program using C.
2. Sum of 3 integers using C.
3. C program using If.
4. C program using If else.
5. C program using switch case.
6. C program using while.
7. C program using Do while.
8. C program using Break.
9. C program using Continue.
10. C program using different Pointers.
11. C program using Arrays.
12. C program using Structures.
13. C program using Parameter passing.
14. Basic Perl Programs.
15. Study of Mitosis.
16. Study of Meiosis.
17. Study of Genetic code.
18. Study of Polyploidy.
19. Study of Micrometry.
20. Study of cell counting methods by Haemocytometry.
21. Isolation of genomic DNA.
22. Study of giant chromosomes.
23. Analysis of monohybrid & dihybrid ratio.
24. Study of Karyotype.
25. Study of operon concept.
26. Problems related to sex linked inheritance.

Paper Binf Paper 106: Introduction to HTML & Biostatistics and Introduction Bioinformatics.

1. Study of Sampling techniques using biological data.
2. Mean
3. Median
4. Mode
5. Mean deviation
6. Standard deviation
7. Variance
8. Coefficient of Variance.
9. Graphical representation of biological data.
10. Bar diagram
11. Histogram
12. Frequency curves.
13. Study of Simple linear Regression & Corelation with examples.
14. Study of Chi-square test.
15. Introduction to Genome Information resources- EMBL, DDBJ, GENBANK
16. Introduction to Protein Information resources- PIR, SWISS-PROT, PRINTS, PFAM
17. Structure of database entry.
18. Analysis of biological data using
19. BLAST
20. FASTA
21. Clustal W

22. Treeview
23. Phylip
24. Structure visualization using Rasmol.
25. Automated gene prediction using any 3 tools.
26. Identification of bacterial operons and pathways.
27. Vector analysis using SVM.
28. Primer analysis.

M.Sc Bioinformatics, Part-1

SEMESTER- 2

PAPER Binf 201: Programming in Object Oriented Languages (45L)

Section I Basics Concepts of C++

- **Basics Concepts of C++**: OOPs concepts, structure of C++ program, applications of C++, Classes and Objects, Functions in C++, Constructors and Destructors, Operator overloading types and conversions, Inheritance, Pointers, Polymorphism& Virtual functions, Files, I/O operations.

- Working with files, Templates, Exception Handling (15)

BIOPERL, JAVA/BIOJAVA

• Introduction: What is Perl? Why use Perl in Bioinformatics? History of Perl, Availability, Support, Basic Concepts (1)

• Scalar Data: What Is Scalar Data? Numbers, Strings, Scalar Operators, Scalar Variables, Scalar Operators and Functions (1)

• Arrays and List Data: What Is a List or Array? Literal Representation, Variables, Array Operators and Functions, Scalar and List Context (2)

• Control Structures: Statement Blocks (1)

• Hashes: What Is a Hash? Hash Variables, Literal Representation of a Hash, Hash Functions, Hash Slices (1)

• Basic/O (1)

• Regular Expressions: Concepts About Regular Expressions, Simple Uses of Regular Expressions, Patterns, More on the Matching Operator, Substitutions, The split and joinFunctions (1)

• Subroutines: System and User Functions, The local Operator, Variable-length Parameter Lists, Notes on Lexical Variables (1)

Section I JAVA/ BIOJAVA (15)

- Fundamentals of OOPs in JAVA, JAVA – history, features, Overview of JAVA, Constants, Variables and Data Types, Operators & Expressions, Decision making_ Branching & Looping, Classes, Objects & methods, Arrays, Strings & Vectors, INTERFACES- Multiple inheritance, Multithreaded Programming, Managing Errors& Exceptions in brief.
  • Applet Programming (15)

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 Binf 202: MICROBIOLOGY AND BIOTECHNOLOGY (45L)

Section I Microbiology

- Major groups of micro-organisms: General characteristics of Archaea, Eubacteria, Mycoplasma, Rickettsiae and Chlamydias (05)
- Bacterial classification ; construction of phylogenetic tree (05)
- General structure of prokaryotic cell (02)
- Growth kinetics in batch cultures (03)
- General characteristics and classification of plant and animal viruses; Structure and replication of Bacteriophage (T_2, and λ), Viroids & Prions (15)
- Organization of viral and bacterial genomes; Plasmids (05)
- Genetic recombination in bacteria: Conjugation, Transformation and Transduction; Construction of genetic maps in bacteria (05)

Section II Biotechnology

- Plant and animal cell and tissue culture: General introduction, concept of cellular differentiation and totipotency (05)
- Cloning vectors(05)
- Enzymes used in DNA technology(02)
- Gene transfer in plant and animal systems (05)
- Application of PCR in cloning, Role of molecular markers and nucleic acid probes in gene analysis, selection and expression (08)
- Techniques of DNA sequencing, chemical synthesis of oligonucleotides (05)
- 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 (10)

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

Paper Binf 203: BASIC BIOCHEMISTRY AND IMMUNOLOGY

(45L)

Section I Biochemistry

- Bioenergetics: Laws of Thermodynamics and its Applications; Concept of free energy; High energy compounds; ATP as the main source of free energy in biological systems (10)

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

- Enzymes: Classification, nomenclature, mechanism of action, binding of substrate, lowering of activation energy, factors controlling enzyme activity, allosteric enzymes, isoenzymes (15))

- Carbohydrates and Lipids: Basic Structure and functions (05)

Section II Immunology

- General properties of immune responses: 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; Clonal selection and expansion; Cytokines and their function (20)

- Antibodies and Antigen: Molecular structure of antibodies and their interaction with antigens; Complement system and its activation; Hybridoma technology (10)

- Disorders of Human Immune System: Self tolerance and autoimmunity; Acquired immunodeficiencies; Hypersensitivity (10)

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 Binf 204: ADVANCED BIOINFORMATICS (45L)

Section I SEQUENCE ANALYSIS

- **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).

- **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.

- **Sequence patterns and profiles:** Algorithms for generation of sequence profiles: Profile Analysis method of Gribskov, PSI-BLAST, HMMer.
- **Protein and nucleic acid properties:** e.g. Proteomics tools at the ExPASy server and GCG utilities and EMBOSS.

Section II GENOMICS AND PROTEOMICS

- 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 and basic database tools.
- Protein arrays: basic principles.
- 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.
- DNA microarray- SAGE database.
- Plant, animal and pathogen databases.
- **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.
- **Structural Biology:**
  Prediction of protein structure.
  Secondary structure: PHD and PSI-PRED methods.

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.
8. Goon, A.M., Gupta, M.K. and Dasgupta, B., Fundamental of Statistics – Vol. I & II, The World Press Pvt. Ltd.
9. Medhi, J., Stochastic Process, Wiley Eastern Ltd.
10. Gupta, S.C. & Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
11. Anderson, T.W., An Introduction to Multivariate Statistical Analysis, John Wiley & Sons.

PRACTICALS

1. **Based on Paper 5 and 6 (45 HRS)**
2. **Based on Paper 7 and 8 (45 HRS)**

Paper 205: Programming with Object-oriented Languages and Microbiology & Biotechnology

Experiments:

1. C++ programs: 10 programs
2. Bioperl Programs: 10 programs
3. JAVA & BIOJAVA Programs: 15 programs
4. By using all types of Operators, Classes, Objects, Functions, Arrays, Pointers, Applets, Exceptions, and Files. Etc……
5. Isolation of bacteria from given sample.
6. Differential staining technique.
7. Study of microbial growth kinetics.
8. Isolation of plasmid DNA.
9. Study of gene transfer methods in bacteria.
10. Study of antibiotic sensitivity of bacteria.
11. Preparation of stock solutions.
12. Preparation of MS Medium & explant inoculation.
13. Isolation & quantification of DNA from animal tissue.
14. Isolation & purification of proteins.
15. Restriction Digestion.
16. Polymerase Chain Reaction (PCR).
17. Automated DNA sequencing.

Paper Binf 206: Basic Biochemistry & Immunology and Advanced Bioinformatics.

1. Separation of amino acids by TLC.
2. Separation of amino acids by paper chromatography.
3. Estimation of proteins by FCR method.
4. Estimation of reducing sugar by DNS method.
5. Determination of activity & specific of enzyme.
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
12. Mantock's test.
13. Sequence analysis using: a) BLAST2 & b) BLAST3web tools.
14. Phylogenetic analysis using a) Omega, b) Phylip & PAUP tools.
15. Sequence patterns and profile analysis using: HMMer, PSI-
16. BLAST and methods.
17. Finding Protein and nucleic acid properties by EMBOSS,
18. Proteomics tools at the ExPASy server and GCG utilities.

GENOMICS AND PROTEOMICS Analysis

19. Gentool & Peptool.
20. Basic concepts on identification of disease genes, role of bioinformatics- OMIM, SNP database (dbSNP).
21. Metabolic pathway analysis using KEGG, EMP, EC databases.
22. DNA micro array analysis using SAGE database.
23. Plant, animal and pathogen databases.
24. Prediction of protein structure by DALI server.
25. ORF finding, Rasmol, Jmol, Cn3D.