SOLAPUR UNIVERSITY, SOLAPUR

M.Sc. Part-I Bioinformatics

Revised Syllabus (New CGPA Semester System)

w.e.f. June 2015

Solapur University, Solapur

M.Sc. Part-I Bioinformatics

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(w.e.f. June, 2015)

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.

7) Medium of instruction: English

8) Structure of the Course:

- Structure of M.Sc. course in faculty of Science has total of 4 semesters for 2 years.
- M. Sc. I comprise of total two semesters and M. Sc. II comprises of total two semesters.
- Each semester includes four theory papers and two practical course i.e. M.Sc. I Semester I comprises four theory papers (Paper I, II, III, and IV) carrying 100 marks each and two practical papers (Paper I and II) carrying 100 marks each. M.Sc. I Semester II comprises four theory papers (Paper V, VI, VII, and VIII) carrying 100 marks each and two practical papers (Paper III and IV) carrying 100 marks each.
- Each theory paper comprising of 5 units which are distributed in total 45 lecture hours having weightage of 4 credits.
- Practical papers are to be conducted at the end of their respective semester.

- Final year project work should begin in 3rd semester and the complete thesis should be submitted during the practical exam of the 4th and the final semester.
- Student would have to present his/her project work during the project report submission which would be evaluated by the internal as well as the external examiner.
- As per the credit system, the assessment of Theory paper of 100 marks weightage will be as: 70 marks theory assessment by University examination (UA) and 30 marks internal assessment by the college (CA). For internal assessment of candidate, periodical tests/seminars/ viva/oral / quiz etc. may be suitably adopted.
- As per the credit system, the assessment of practical paper of 100 marks weightage will be as: 70 marks theory assessment by University examination (UA) and 30 marks internal assessment by the college (CA).
- In each semester student has to give a compulsory seminar which has weightage of 25 marks in each semester.

SOLAPUR UNIVERSITY, SOLAPUR
Syllabus for M.Sc. Bioinformatics Part - I
(w.e.f. June, 2015)

STRUCTURE

	SEMESTER- I (THEORY)					
Paper No.	**Paper Code**	**Title of the Paper**	**Credits**	**Marking Scheme**		
				UA	**CA**	**Total Marks**
I	Binf 101	Basic Bioinformatics	04	70	30	100
II	Binf 102	Cell Biology and Genetics	04	70	30	100
III	Binf 103	Introduction to HTML and Biostatistics	04	70	30	100
IV	Binf 104	Introduction to Programming languages & programming through C & C++	04	70	30	100
	SEMESTER- I (PRACTICAL)					
I	Binf Pr 105	Introduction to Bioinformatics and Cell Biology and Genetics	04	70	30	100
II	Binf Pr 106	Introduction to HTML and Biostatistics and Introduction to Programming languages & programming through C & C++	04	70	30	100
	Semester Seminar		01	--	25	25
		Grand Total :	**25**			**625**

SOLAPUR UNIVERSITY, SOLAPUR
Syllabus for M.Sc. Bioinformatics Part - I
(w.e.f. June, 2015)

STRUCTURE

	SEMESTER- II (THEORY)					
Paper No.	**Paper Code**	**Title of the Paper**	**Credits**	**Marking Scheme**		
				UA	**CA**	**Total Marks**
V	Binf 201	Advanced Bioinformatics	04	70	30	100
VI	Binf 202	Microbiology and Biotechnology	04	70	30	100
VII	Binf 203	Basic Biochemistry and Immunology	04	70	30	100
VIII	Binf 204	Programming in Object Oriented languages	04	70	30	100
	SEMESTER- II (PRACTICAL)					
III	Binf Pr 205	Advanced Bioinformatics, Microbiology & Biotechnology	04	70	30	100
IV	Binf Pr 206	Basic Biochemistry, Immunology and Programming in Object Oriented languages	04	70	30	100
	Semester Seminar		01	--	25	25
	Grand Total :		**25**			**625**

SOLAPUR UNIVERSITY, SOLAPUR

M.Sc. Bioinformatics Part-I

SEMESTER-I (THEORY)

PAPER NO. I: BASIC BIOINFORMATICS **4 Credit (70 Marks)**

(45 L)

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, Principle DNA and genome Databases (NCBI-GENBANK, EMBL, DDBJ), Protein Databases (PIR, MIPS, SWISS-PROT, TrEMBL, NRL-3D, PRINTS, Pfam). **(10)**

UNIT-II-Bioinformatics softwares: Clustal W, Clustal X, RasMol, Primer 3, Oligo, Treeview, Genetic Analysis Software, Phylip, Keyword-based searches using tools like ENTREZ and SRS, Various file formats for bio-molecular sequences: Plain, GenBank, FASTA, GCG, MSF, Ig, EMBL. **(08)**

UNIT-III-Biocomputing: Introduction to String Matching Algorithms, BLAST & FASTA Sequence Comparison and Alignment Tools, Use of Biochemical Scoring Matrices, Automated Gene Prediction, Introduction to Gene Arrays, Analysis of Gene Arrays. **(10)**

UNIT-IV-Systems Biology: Introduction, History, Associated disciplines, Markov chain, Machine Learning Methods, Hidden Markov models, Applications of HMM in gene identification and Profiles HMMs. **(10)**

UNIT-V- Introduction to Neural Networks: Architecture of neural networks, Application of neural networks and Support Vector machines-introduction and applications. **(07)**

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. II: CELL BIOLOGY AND GENETICS **4 Credit (70 Marks)**

(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. An overview of organelles (Mitochondria, chloroplasts, ER, Golgi, ribosomes, lysosomes and peroxysomes, nucleus and nucleolus). Differences and similarities in plant, animal and microbial cells. **(10)**

UNIT-II: 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). 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. **(10)**

UNIT-III: 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. **(08)**

UNIT-IV: Replication in prokaryotes and eukaryotes - D-loop and rolling circle mode of replication, replication of linear viral DNA. Transcription- features of promoters and enhancers, transcription factors, transcription initiation, elongation and termination in prokaryotes and eukaryotes, inhibitors, post-transcriptional modification - RNA editing. Translation- ribozyme, initiation factors, translation initiation, elongation and termination in prokaryotes and eukaryotes. Elucidation of genetic code, Process of translation, posttranslational modifications. Recombination process. **(12)**

UNIT-V: Regulation of gene expression - Lac and trp operons. Molecular mechanism of general recombination, homologous and site-specific recombination, gene conversion. 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. **(05)**

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. III: INTRODUCTION TO HTML AND BIOSTATISTICS

4 Credit (70 Marks)

(45 L)

UNIT-I- Introduction to HTML: The World Wide Web (WWW), HTML History, Hypertext and Hypertext Markup Language, Introduction to Web design, Basic tags, Body attributes. **(10)**

UNIT-II- Basic tags of HTML: Headers tags, Body tags, Text fonts and styles, background colors, Marquee Behavior, Paragraphs, Formatting tags, Image tags, Lists, Numbered list, Non-Numbered lists, Anchor tag, Name tag, Hyperlinks: FTP/HTTP, Links with images and buttons. **(08)**

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, Introduction to MATLAB. **(10)**

UNIT-IV- Fundamentals of Biostatistics: Introduction, history and applications of statistics for the biological problems. Data representation: Introduction to data, collection of data, different types of data and types of data representation. Graphical representation of data. **(10)**

UNIT-V- Measures of central tendency: Mean, Median, Mode, Standard Deviation, Variance, Coefficient of Variation, test for significance: Chi square test, Z – test, T – test, ANOVA, Random variable, Introduction, generation of random variables, types of random variables (discrete and continuous), expected value, and importance of random variables in biological simulations. **(07)**

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.
6. Thomas Powell, The Complete *Reference HTML* & XHTML.
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.

PAPER NO. IV: INTRODUCTION TO PROGRAMMING LANGUAGES AND PROGRAMMING THROUGH C & C++ **4 Credits (70 Marks)**

(45 L)

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

UNIT-III: **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, Pointers and Structures. Introduction to Disk I/O Function, File Manipulation, Declaring and Opening a File, Closing file. **(08)**

UNIT-IV: **Introduction to Object Oriented Programming**: Introduction of object oriented programming, Difference between OOP and Modular programming, Features Of C++, Difference between C and C++, Classes and Objects & function in C++, 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. **(12)**

UNIT-V: **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, Pointers in C++, pure virtual function. 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. **(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.

SEMESTER-I (PRACTICAL)

PAPER NO. I: INTRODUCTION TO BIOINFORMATICS AND CELL BIOLOGY & GENETICS. (4 Credits, 70 Marks)

(45L)

Introduction to Bioinformatics

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.

Cell biology & Genetics

10. Study of Mitosis.
11. Study of Meiosis.
12. Study of Micrometry and measurement of given biological sample.
13. Study of cell counting methods by Haemocytometry.
14. Isolation of cell organelles (Mitochondria & Chloroplast).
16. Microtomy, staining and observation.
15. Isolation of genomic DNA.
16. Study of giant chromosomes.
17. Strain improvement by physical & chemical methods.
18. Analysis of monohybrid & dihybrid ratio.
19. Study of Karyotype.
20. Problems related to sex linked inheritance.

PAPER NO. II: INTRODUCTION TO HTML& BIOSTATISTICS AND INTRODUCTION TO PROGRAMMING LANGUAGES & PROGRAMMING THROUGH C & C++ **(4 Credits, 70 Marks)**

(45L)

HTML& BIOSTATISTICS

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 (using MS. Excel)
8. Graphical representation of biological data.(using MS. Excel)
9. Study of Chi-square test.

INTRODUCTION TO PROGRAMMING LANGUAGES & PROGRAMMING THROUGH C & C++

10. C program using operators.
11. C program using conditional statements. (If, else if, nested if, switch case)
12. C program using Iterative Statements (while, do while, for loop)
13. C program using Arrays (one dimensional, two dimensional, multidimensional)
14. C program using String.
15. C program using function.
16. C program using structure.
17. C program using file handling.
18. C++ program using class & object.
19. C++ program using constructor & destructor
20. C++ program using constructor overloading
21. C++ program using function overloading & operator overloading.
22. C++ program using virtual function
23. C++ program using friend function
24. C++ program using operator overloading
25. C++ program using inheritance
26. C++ program using file
27. C++ program using template

SEMESTER-II (THEORY)

PAPER NO. V: ADVANCED BIOINFORMATICS **4 Credit (70 Marks)**

(45 L)

UNIT-I- Sequence analysis: Detailed method of derivation of the PAM and BLOSUM matrices. Pairwise sequence alignments: Needleman & Wuncsh, Smith & Waterman, Multiple sequence alignments (MSA), Use of HMM-based Algorithm for MSA (e.g. SAM method) **(10)**

UNIT-II-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, GCG utilities and EMBOSS. **(07)**

UNIT-III- Taxonomy and phylogeny: Phylogenetic analysis algorithms such as Maximum Parsimony, UPGMA, Transformed Distance, Neighbors-Relation, Neighbor-Joining; Probabilistic models of evolution and Maximum likelihood algorithm, Bootstrapping method, use of tools such as Phylip, Mega, PAUP. **(08)**

UNIT-IV- Genomics: Prediction of genes, promoters, splice sites, regulatory regions, basic principles and application to prokaryotic and eukaryotic genomes and interpretation of results, DNA microarray, SAGE database and basic database tools, Protein arrays: basic principles and applications. Basic concepts on identification of disease genes, OMIM database, reference genome sequence, gene expression profiling, identification of SNPs, SNP database, MUMmer, BLAST2, MegaBlast algorithms, Suffix tree, synteny. **(10)**

UNIT-V- Proteomics: Metabolic pathways such as KEGG, EMP. Plant, animal and pathogen databases, Identification of secondary structural elements (SSE) from the knowledge of 3-D structure of macromolecule, Prediction of protein structure, its secondary structure by PHD and PSI-PRED methods. **(10)**

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 4thEdition. 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. VI: MICROBIOLOGY AND BIOTECHNOLOGY

4 Credit (70 Marks)

(45 L)

UNIT-I: Biodiversity: Introduction to microbial biodiversity – distribution, abundance, ecological niche. Three domains of life. Major groups of micro-organisms: General characteristics of Archaea, Eubacteria, Mycoplasma, Rickettsiae and Chlamydias. Bacterial classification based on 16S rRNA, cellular metabolism and fatty acids. The International Committee on Systematic Bacteriology (ICSB). Construction and analysis of phylogenetic tree. **(9)**

UNIT-II: General structure of prokaryotic cell. Growth kinetics in batch cultures. Genetic recombination in bacteria: Conjugation, Transformation and Transduction; Construction of genetic maps in bacteria General characteristics and classification of plant and animal viruses; Structure and replication of Bacteriophage (T4 and λ), Viroids & Prions. **(9)**

UNIT-III: Techniques in Microbiology: Aseptic techniques in microbiology- different methods of sterilization. Techniques for isolation of microorganisms- serial dilution, streak plate, spread plate and pour plate methods. Staining techniques (simple staining, differential staining). Structural staining- cell wall, capsule and endospore staining. **(9)**

UNIT-IV: 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. Cloning vectors: pUC18, pBR322, Cosmids, phagemids, expression vectors, bacterial artificial chromosomes (BACs) and yeast artificial chromosomes (YACs). Enzymes used in rDNA technology. Gene transfer in plant and animal systems. **(9)**

UNIT-V: 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. Single Cell Protein (SCP) and Single Cell Oil (SCO); GMOs and their advantages and disadvantages. **(9)**

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. VII: BASIC BIOCHEMISTRY AND IMMUNOLOGY

(4 Credits, 70 Marks)
(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. **(3)**

UNIT II - Amino Acids, Peptides and Proteins: Structure of Proteins: Primary, Secondary, Tertiary and Quaternary; Protein Folding; Structure-Conformation Function relationship Enzymes: Classification, nomenclature, mechanism of action, binding of substrate, lowering of activation energy, factors controlling enzyme activity, allosteric enzymes, isoenzymes, Multi-enzyme complex. **(10)**

UNIT III - Carbohydrates and Lipids: Introduction to carbohydrates, classification, basic structures and functions. Classification of Lipids and their biological functions. Metabolic disorders and diseases. Nucleic acids - structure, diversity and function. Vitamins & Secondary metabolites: general classification and importance. Hormones and their importance. **(12)**

UNIT IV – Introduction to Immunology: Innate and adaptive immunity; Cells, tissues and organs of immune system - macrophages, B and T lymphocytes, dendritic cells, eosinophils, basophils, mast cells, haematopoiesis; Humoral and cell-mediated immunity, Cytokines and their function. **(10)**

UNIT V – Antigens and Antibodies: Molecular structure of antibodies and their interactions with antigens; Complement system and its activation; Hybridoma technology Major Histocompatability Complex: Introduction, classes of MHC, antigen processing and presentation. Disorders of Human Immune System: Self tolerance and autoimmunity; Acquired immunodeficiency; Hypersensitivity and its types. **(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 NO. VIII: PROGRAMMING IN OBJECT ORIENTED LANGUAGES

(4 Credits, 70 Marks)

(45L)

UNIT I: History of Java, Features of Java, JVM, JRE and JDK. Java Quick Start: Learning the basics of Java in comparison to C++. Object Oriented Programming in Java: Classes, interfaces and packages; access modifiers; constructors; this and super references; inner classes and nested classes; Constants, Variables and Data Types, Operators & Expressions, Decision making_ Branching & Looping, Classes, Objects & methods, Arrays, Strings & Vectors. Concept of exception handling, multiple inheritance, interfaces and multithreading. **(10)**

UNIT II: Applets: introduction to Applets: Applications of applet, the applet lifecycle; loading applets. introduction to AWT, Event handling: Action Event; Introduction to JDBC, Connecting to databases using JDBC; creating and executing statements; working with result sets, Java Drivers, java.sql Package**.** Concepts of Biojava: Symbols, reading sequences, Basic Sequence Manipulation (DNA to RNA, Reverse Complement, motif as regular expression). **(10)**

UNIT III: Perl Basics**:** History of Perl, Introduction to Perl - Data types – Operators – variables –Variable Interpolation- If, If-else, else if, For loops ,While loops , Until loop–Scalars, Lists, Hashes - Arrays – Array functions – Push and Pop , Shift and un shift – Hashes. **(10)**

UNIT IV: Subroutines**:** Subroutines for calculation, Reference to subroutine, Passing arrays and hashes to subroutines. File Handling – Writing to Files. Perl and Databases – Perl and DBM. Regular Expression – Working with regular expression.

(5)

UNIT V: Perl object oriented: BioPERL: Sequences (Bio::Seq Class, Sequence Manipulation), Features and Location Classes (Extracting CDS), Alignments (AlignIO), Analysis (Blast, Genscan), Perl database access, Databases (Database Classes, Accessing a local Database). Sequences and Strings – Representing Sequence data, store a DNA sequence, concatenating DNA fragments, Transcription. Motifs – Finding motifs. **(10)**

Suggested Readings

1. Object Oriented 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. Object oriented Programming through Java, E.BALAGURUSWAMY McGrawa Hill.
9. Simon Cozens and Peter Wainwright, "Beginning Perl", Shroff publishers, Mumbai,2005.
10. Perl By Examples, Ellie Quigley
11. James Tisdall, "Beginning Perl for Bioinformatics", Fourth Indian reprint, O'Reilly Publications, USA, 2005.

SEMESTER-II (PRACTICAL)

PAPER NO. III: ADVANCED BIOINFORMATICS AND MICROBIOLOGY & BIOTECHNOLOGY

(4 Credits, 70 Marks)
(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. Aseptic technique- Disinfection, preparation of cotton plugs, sterilization of used & unused glassware's.
2. Isolation of bacteria from given sample (water, soil & air).
3. Simple and Differential staining technique.
4. Study of motility of bacteria by Hanging drop technique.
5. Study of microbial growth kinetics.
6. Isolation of plasmid DNA.
7. Study of gene transfer methods in bacteria.
8. Study of antibiotic sensitivity of bacteria.
9. Preparation of stock solutions.
10. Preparation of MS Medium & explants inoculation.
11. Isolation & quantification of DNA from animal tissue.
12. Restriction Digestion.
13. Automated DNA sequencing.

PAPER NO. IV: BASIC BIOCHEMISTRY & IMMUNOLOGY AND PROGRAMMING IN OBJECT ORIENTED LANGUAGES. (4 Credits, 70 Marks)
(45L)

Basic Biochemistry & Immunology

1. Qualitative and Quantitative analysis of carbohydrates.
2. Qualitative and Quantitative analysis of amino acids and proteins.
3. Quantitative analysis of nucleic acids
4. Determination of activity & specific activity of salivary amylase by maltose Std. Curve.
5. Effect of various physicochemical parameters on enzyme activity.
6. Differential WBC count.
7. Blood grouping.
8. Ouchterlony Double Diffusion test.
9. Widal test for typhoid antigens.
10. Test for Rh Factor.

Biojava Practicals

11. Java Program using operators
12. Java Program using classes & objects
13. Java Program using constants.
14. Java Program using array.
15. Java Program using vector class.
16. Java Program using string functions.
17. Java Program using thread.
18. Java Program using interface.
19. Java Program using applet.
20. Java Program using exception.
21. Programs based on Biojava.

BioPerl Practicals

1. Program to store a DNA sequence
2. Program to convert DNA to RNA.
3. Program to calculate reverse compliment of DNA sequence
4. Program to read protein sequence data from a file
5. Program to take an element off the end of an array
6. Program to take an element off the beginning of an array
7. Program to put an element at the beginning of an array
8. Program to put an element at the end of an array
9. Program to reverse an array
10. Program to get the length of an array
11. Program to find motifs in a protein sequence
12. Program to count nucleotides in a sequence
13. Program to find the percentage of hydrophobic amino acids in a sequence
14. Program to find the percentage of G and C in a DNA sequence
15. Program to count the number of given motifs
16. Program to convert DNA to RNA using subroutines
17. Program to find if a DNA is stable or not

Examination Pattern (UA - University assessment)

The examination for theory / practical (70 marks) are conducted semester wise by university as per University Time Table.

Nature of Theory question paper for each theory paper.

Solapur University, Solapur

Nature of Question Paper for Semester Pattern

(New C.G.P.A.)

Faculty of Science

M.Sc. Bioinformatics

Time:- 3 hrs **Total Marks-70**

Note: 1) Section - I Compulsory

2) Answer any four questions from Section - II

Section - I

Q. 1 A) Multiple choice questions **(07)**

i) ----------

a) b) c) d)

ii)

iii)

iv)

v)

vi)

vii)

B) Define the following terms **(07)**

i)

ii)

iii)

iv)

v)

vi)

vii)

Section - II

Q. 2) Long answer type question **(14)**

Q. 3) Long answer type question **(14)**

Q. 4) Long answer type question **(14)**

Q. 5) Answer any *TWO* of the following **(14)**

i) Short answer type question

ii) Short answer type question

iii) Short answer type question

Q. 6) Write Short notes on any *TWO* of the following **(14)**

i) Short note

ii) Short note

iii) Short note