CH. CHARAN SINGH UNIVERSITY
MEERUT

DEPARTMENT OF MICROBIOLOGY
M.Sc. in Bio-informatics

Ordinances and Syllabi
Effective from the session 2009-2010

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Applicable from academic session 2009-10

Course No.	Course	Internal Maximum Marks	External Maximum Marks
	Semester I		
BI 101	Fundamentals of Computer System and Programming Language	50	50
BI 102	Biomathematics	50	50
BI 103	Biological Database System	50	50
BI 104	Microbiology & Immunology	50	50
BI 105	Practical 1 (Course BI 101 & BI 102)	50	50
BI 106	Practical 2 (Course BI 103 & BI 104)	50	50
	Semester II		
BI 201	Structural Biology & Molecular Modeling	50	50
BI 202	Statistical Analysis and Optimization	50	50
BI 203	Genetic Engineering	50	50
BI 204	Molecular Biology	50	50
BI 205	Practical 1 (Course BI 201 & BI 202)	50	50
BI 206	Practical 2 (Course BI 203 & BI 204)	50	50
	Semester III		
BI 301	Operating Systems & Object Oriented Programming	50	50
BI 302	Biocomputing Programming	50	50
BI 303	Sequence Analysis	50	50
BI 304	Genomics**,** Proteomics & Systems Biology	50	50
BI 305	Practical 1 (Course BI 301 & BI 302)	50	50
BI 306	Practical 2 (Course BI 303 & BI 304)	50	50
	Semester IV		
BI 401	Project VIVA	400	

All rules for examination pattern pass percentage and admissions shall be the same as for the post-graduate courses in the Faculty of Science on the University campus. Minimum eligibility for admission in this two year M.Sc. (Bioinformatics) course shall be B.Sc. (Biology group). There shall be 50% internal and 50% external assessment in all the aforesaid courses. The pattern of internal assessment shall be decided by the Department, however, it will mainly be based on tests, quizzes, seminars, term papers, group discussions and home assignments. Specialization shall be allowed in the fields of Biological Data Base System and Unix Operating System. It shall start from the very first semester and the student will have to complete a project related to his / her specialization in the final fourth semester for a period of 4 to 6 months. The student may be allowed to complete the project out side the University. At the end of the fourth semester the project report shall be submitted. It will be jointly evaluated by the Board of Examiners. One of the supervisors may be opted from outside the University where the candidate has completed the project. The candidate will make an open short presentation and will defend his/her experimental design, results and conclusions. The Department shall be free to alter the sequence of the courses in any semester depending upon the resources available.

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Course BI 101- Fundamentals of Computer System and Programming Language

Unit I- Introduction to Bioinformatics Definition & Concept; Human Genome Project; Role of Bioinformatics, Introduction of Internet in Biology & Objectivity; Services of Internet used for Biological Data (E-Mail, File Transfer Protocol, Usenet, Telnet)**.** Important bioinformatics resources (NCBI, EBI, DDBJ).

Unit II- Computer System- Definition and characteristics; Components (Input/Output unit, Control Unit, Primary Storage Unit, Arithmetic and Logic Unit); Types of Memory (Magnetic Core Memory, Semiconductor Memory *ie* RAM & ROM, Bubble Memory); Communication Pathways (Control Bus, Address Bus, Data Bus); Classification of Computers (according to logic & size), Generation of Computers; Introduction to Software; Definition; Classification of Software; Translators (Compiler & Interpreter); Applications of Number Systems (Decimal, Binary , Octal, Hexadecimal) & Logic Gates (AND, OR, NOT, NAND, NOR, XOR, XNOR).

Unit III- Networking- Definition, Client, Server, Types (LAN, WAN, MAN); Network Connecting Devices; Topologies (Ring Network, Star Network, Star Network, Tree Network, Bus Network) and their advantages & disadvantages. Elements of Networking (Network Services such as File Services, Database Services, Print Services, Application Services); Transmission Medias (Coaxial Cable, Fiber Optics, Twisted Pair).

Unit IV- Functional Structure of Programming in C: Concepts of flowcharting and algorithm development; Tokens in C (Constant, Variable & Keywords); Data types; Operators (Arithmetic Operators, Relational Operators, Increment Operators, Decrement Operators, Assignment Operators & Conditional Operators), if statement; if-else statement; switch statement; for statement; while statement; do-while statement; Odd Looping.

Unit V-Arrays in C: One Dimensional Array; Two Dimensional Array; String Handling in Array (Declaration of String Variable, Printing of a string, Concatenation of a String, Comparison of the String). Built-in Functions & User Defined Functions **(**Definition; syntax; main function; printf function; scanf function; getchar function; getche function; putchar function; strcmp function; strcpy function; strcat function; strlen function; Declaration and definition of User-Defined Function; Call by Value; Call by Reference; Recursion); Pointers in C (Definition; Objectivity; Initialization of Pointers; Pointers & Array; Pointers & Function).

References:

- *J.B. Dixit. 2006 Computer fundamentals and programming in 'C'. LP Publication*
- *Guigo R. Ed. & Gusfield. 2005. Algorithm in Bioinformatics. O.Ed. Berlin. Springer-Verlog*
- Yashwant Kanetkar. Jun 2009. Let us "C"., BTB publication.
- E. Balaguruswami. *4th Edition . 2007. Programming in ANSI 'C'. Tata Mac Graw Hill.*
- *Sharma, Munjal and Shankar.2007. A Text book of bioinformatics. Rastogi Publications.*
- *P.K. Sinha. 2004. Fundamental of computers. BPB publication.*

Note : The examiner is expected to set the question paper based on the entire course content. In Section A, the question paper shall include 5 long question (10 marks each) out of which the candidate is required to attempt 3 questions. Section B shall be based on short answers 100-200 words and shall include 4 questions of which the candidate is required to attempt 2 questions of 5 marks each. Section C shall include 10 to 20 questions of half / one mark each and shall be based on objective type / true-false / very short answers like definitions.

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Course BI 102- Biomathematics

Unit I: - Matrices: Algebra of matrices, transpose and inverse of a matrix, determinants. Arithmetic and Geometric Series, Binomial Theorem. Permutation and combinations. Introduction to set theory, Functions, Polynomials, limits and continuity.

Unit II: - Differentiation and Integration: Derivative of simple algebraic and trigonometric functions. Maxima and minima. Integration of some standard functions. Integral by parts. Applications of Integral calculus in biology. Definite integral. Ordinary differential equations (first order) - example from biology.

Unit III: - **2D Coordinate Geometry:** Equation of a line, circle, ellipse, parabola, and hyperbola. 3D geometry: Equation of sphere, cone.

Unit IV:- Numerical Analysis: Gaussian Elimination and Gauss Jordan Methods for the solution of system of linear equations. Solution of Algebraic and Transcendental Equations by Bisection Method and Newton- Raphson Method.

Unit V: - Interpolation: Newton's formulae, Lagrange's formula. Curve fitting by Method of least squares. Numerical differentiation using Newton formulae. Numerical Integration: Trapezodial rule, Simpson's 1/3 and 3/8 rules.

References:

- *J . D. Murray. 2003. Mathematical Biology. Springer Verla.*
- *Segal, L. 1988. Mathematical Models in Molecular and Cellular Biology Cambridge: Cambridge University Press.*
- *Balaguruswamy. 1999. Numerical Methods . TMH.*
- *V Rajaraman. 2007. Computer oriented numerical methods. Printice hall India.*
- *S. C. Gupta. 2009. Fundamental of Methametics . Sutanchand & Sons Publication.*
- *A.R. Vasistha. 1994. Matrices. Krishna Publication.*

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Course BI 103- Biological Database System

Unit I:- Database System- Definition; Purpose of Database System; Advantages of Database System; Components of Database System (., Hardware, Software & Users), Database Administrator; Data Administrator; Data Models (Relational, Network, Hierarchical); Three Level Architecture for Database System **(**Internal Level; Conceptual Level; External Level); Data Independence; Data Abstraction; Mapping; Data Definition Language; Data Manipulation Language; Data Sub Language; Role of Schemas in Three Level Architecture; Client/Server architecture; Distributed Processing; Database Technologies (Flat Files, Relational & Object).

Unit II:- Relational Database- Definition; Relational Data Model (Binary, Ternary, Quaternary & n-ary Relation); Important terms in Relational database system (Tuple, Records, Fields, Domain, Degrees, Cardinality); Keys(Primary Key, Candidate Key, Composite Key, Foreign Key& Alternate Key).

Unit III:- Structured Query Language- Creating Table; Applying Column & Table Constraints; Inserting Values in Table; Deletion(of Rows & Table); Updating Values; Altering Table; Retrieving Values from Table; Revoke Command; Drop Command; Grant Command; Commit Command; Rollback Command.

Unit IV:- Biological Database- Primary Database & Secondary Database; Submitting Sequence to the Database and Information Retrieval through LocusLink; Sequence Databases (EMBL, GenBank, DDBJ.

Unit V:- Protein and other databases: SWISS-PROT, PIR, TrEMBL); Protein Family/Domain Databases (PROSITE, Pfam, PRINTS & SMART), cDNA Libraries and ESTs & Structure Database (PDB, CATH, SCOP).

References:

- *Ivan Bayross. 2003. SQL, PL/SQL the programming language of Oracle., BPB Publication*
- *C.J. Date. 2008. An indroduction to database systems. Addison Wesely*
- *Orpipa Bosu and Simminder Kaur, Thukaral. 2009. Bioinformatics: Database, tools and algorithms. Oxford Publications*
- *Hanery Korth and Abraham Silberchalz. 2005. Database system concepts. Tata Mac Graw Hill*
- *Baxevanis, A.D. and Ouellette. 1998. Bioinformatics: A practical guide to the analysis of the gene and protein b. B.F.F, New York, John Wiley and Sons, Inc Publication*
- *Atwood, T.K. and Aprry-Smith. 1995. Introduction to Bioinformatics. D.J. Delhi, Pearson education (Singapore)*

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Course BI 104- Microbiology & Immunology

Unit I : Discovery of microbial world, controversy over spontaneous generation; origin of life. Microbial evolution and diversity; five kingdom and eight-kingdom classification.

Unit II : General account of prokaryotes: structural organization of Eubacteria and Archae (cell membrane, cytoplasmic matrix, inclusion bodies, nucleoid, flagella, pilli and endospore); General characters of eukaryotic microbes, structure and organization of a typical eukaryotic cell, Evolutionary relationship of each group based on modern systems of classification.

Unit III : History and discovery of viruses; nature of viruses; General characters of viruses; Nomenclature and Classification of viruses; Bacteriophage: Structure and life cycle pattern of T-even phage; Genome organization of viruses.

Unit IV : Introduction to the immune system: Innate immunity; anatomic, physiological, phagocytic & inflammatory barriers. Adaptive immunity; natural & artificial immunity. Cells involved in immune response: lymphoid lineage (producing B & T lymphocytes) & Myeloid lineage (phagocytes: macrophages, neutrophils & eosinophils. And auxillary cells; basophils, mast cells & platelets). Organs involved in immune system: primary & secondary lymphoid organs.

Unit V : Types of antigens; Structure & types of Immunoglobulins, genetic diversity of immunoglobulins; Cytokines: B-cell biology: Antigen-Antibody binding, B-cell activation. T-cell biology: major histocompatibility complex molecules; Types of vaccines & their characteristics; Immune disorders; Hybridoma technology, applications of monoclonal antibodies. Antigen-antibody reactions *in vitro*.

References:

- *Prescott - Harley - Klein -2007- Microbiology - IV Edition - International edition - McGraw Hill - ISBNO-07-115830-8.*
- *D. J. Taylor - N. P. O. Green - G. W. Stout – 1999- Biological Sciences - III Edition - Ed. - R. Soper - Cambridge University Press - ISBNO - 521 - 639239 (Low Price Paperback)*
- *K. P. Talaro & A. Talaro, 1999. Foundations in Microbiology, HI - International Edition. WCB / McGraw Hill –ISBNO, 697, 35452 . 0*
- *Guntram Seltmann, Otto Holst (2001) Bacterial cell walls. Springer ISBN:3540426086*
- *Nelson D. L. and Cox M. M. (2005) Lehninger's Principles of Biochemistry, Fourth edition, W. H. Freeman & Co. New York.*
- *White David (2000) Physiology and Biochemistry of Prokaryotes. 2nd Ed. Oxford University Press, New York.*
- *Berg Jeremy, Tymoczko John, Stryer Lubert (2001) Biochemistry 4th Ed, W. H. Freeman, New York.*

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Course BI 105- Practical 1 (Course BI 101 & Course BI 102)

Course BI 106-Practical 2 (Course BI 103 & Course BI 104)

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Course BI 201- Structural Biology & Molecular Modeling

Unit I: Macromolecular Structures: Protein - Primary, Secondary, Supersecondary, Tertiary and Quaternary structure, Enzymes- Introduction, Michaelis Menton Kineteis, Enzyme regulation; Classification, Structure and function of Carbohydrates and lipids; 3D Viral structures.

Unit II: Methods to study 3D structure, Principles of crystallography, Co-ordinate systems, Fitting and refinement, Validation, Analysis of 3D structures, Methods for 3D structure prediction, Knowledge based & Fold recognition; Principles of protein folding and methods to study protein folding.

Unit III: Basic concept of Bioenergetics; Thermodynamics principle in biology; energy rich bonds, Computational approaches in structural biology; Macromolecular interactions, Protein - Protein, Protein – Nucleic acids, Protein – carbohydrates.

Unit IV: Overview of molecular modelling - Introduction and challenges, Molecular modelling methods, Conformational searching, Potential energy maps, Ramachandran maps, Ab-initio methods, Semi-empirical methods, Empirical methods- Conformational analysis, Introduction and Methods, Molecular fitting, Energy Minimization, Non-derivative and derivative methods.

Unit V: Global optimization (simulated annealing, Tabu search, genetic algorithms), Applications of energy minimization, Molecular Mechanics, Conformations: global vs. local, Force fields: expressions for stretch, bond, torsion, etc., Description of various force fields: MM3, Dreiding, AMBER, CHARMM, Mechanics of Bio-macromolecules, Molecular Dynamics- Newton's equations for many particles, Verlet and related algorithms, Types of dynamics simulations: adiabatic, constant T, annealed, etc., Conformational searching using MD and other methods, Free energy calculations, Dynamics of Bio-macromolecules

References:

- *Philip E. Bourne (Editor), Helge Weissig (Editor). 2003. Structural Bioinformatics - Methods of biochemical Analysis V. 44. New Jersey. Wiley-Liss.*
- *Jan Drenth. 1994. Principles of protein X-ray Crystallography Springer-Verlag.*
- *Branden, Carl & Tooze, John. , 1991. Introduction to Protein Structure. Garland Publishing.*
- *Andrew Leach. 2001. Molecular Modeling: Principles and Applications. Prentice Hall,*
- *Friesner, R.A. Ed., Prigogine, L. Ed. & Rice, S.A.New York. John wiley & sons. 2002. Computational methods for protein folding : advances in chemical physics vol. 120. Inc. publication.*
- *Hans Dieter and Didier Rognan. 2003. Molecular Modeling: Basic Principles and application. Wiley VeH Gmbh and Co. KGA.*
- *Heilmeyer, L. & Friedrich, P. Amsterdam . 2001. Protein modules in cellular signaling edited. IOS Press.*
- *Hill, H.A.O., Sadler, P.J. & Thomson, A.J Berlin. 1999. Metal sites in proteins and models. Springer.*

Note : The examiner is expected to set the question paper based on the entire course content. In Section A, the question paper shall include 5 long question (10 marks each) out of which the candidate is required to attempt 3 questions. Section B shall be based on short answers 100-200 words and shall include 4 questions of which the candidate is required to attempt 2 questions of 5 marks each. Section C shall include 10 to 20 questions of half / one mark each and shall be based on objective type / true-false / very short answers like definitions.

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Course BI 202- Statistical Analysis and Optimization Techniques

Unit I: Frequency distribution. Measures of central tendency and measures of dispersion. Correlation and regression: Scatter Diagram, Coefficient of Correlation, Rank correlation. Lines of Regression.

Unit II : Probability theory: Classical and Statistical definitions, conditional probability, Bayes' Theorem. Random variable, mathematical expectation. Probability Distributions: Binomial, Multinomial, Poisson and Normal Distribution. Introduction and Properties of 't', Chi-square and F distribution.

Unit III : Estimation: Population and sample, Different kinds of sampling. Fundamental concepts of estimation, Maximum Likelihood Estimation, Interval Estimation. Hypothesis testing: students t-test, Paired t-test, large sample tests, F-test, Chi-square test, Analysis of variance.

Unit IV: Multivariate analysis: Multiple correlation and Regression. Introduction to Principal component analysis, Discriminant analysis and Cluster Analysis. Applications: extracting clusters of functionally related genes from microarray results.

Unit V: Dynamic Programming, Gibbs sampling, Markov chains, Hidden Markov Model, Simulated annealing, Genetic algorithm. Applications of these methods in sequence alignments, Protein classification and structure prediction.

- *Boca Raton, Ayyub B. M. & McCuen, R H. 1997. Probability statistics, and reliability for engineers. CRC Press.*
- *S.C.Gupta & V.K. Kapoor.1986. Fundamentals of Mathematical Statistics. Sultan Chand publication*
- *Ewens, W. J. & Grant, G. R.. 2001. Statistical methods in bioinformatics: an introduction. New York. Springer,.*
- *S.C.Gupta & V.K. Kapoor.2001. Fundamentals of Applied Statistics Sultan Chand publication*
- *Ghosh, Subir.. 1990. Statistical design and analysis of industrial experiments.*
- David W. Mount, David Mount. *2004.* Bioinformatics: Sequence and Genome Analysis.

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Course BI 203- Genetic Engineering

Unit I: Basic steps of r-DNA technology, Enzymes used in r-DNA technology; Restriction endonucleases and their types (I, II & III); Restriction mapping. Ligation- joining of DNA molecules together: blunt end ligation, joining with linkers, adapters & homopolymer tailing.

Unit II: Cloning vectors: general properties , plasmids, bacteriophages, cosmids, shuttle vectors, bacterial artificial chromosomes. Eukaryotic cloning vectors for yeast, higher plants & animal cells.

Unit III: Introduction of recombinant vectors into bacterial & non-bacterial cells. .Selection of clones: colony hybridization, plaque hybridization, immunochemical methods & southern blotting. Gene libraries: genomic library (Shot gun approach), cDNA library (Different methods for synthesizing c DNA molecules).

Unit IV: Expression vectors for expressing foreign genes in E.coli:problems associated with the production of r- proteins in E.coli, production of r protein by eukaryotic cells. Non-radioactive & radioactive labeling of probes. RFLP, RAPD, northern blotting & western blotting.

Unit V: PCR methods & applications, DNA sequencing methods: dideoxy and chemical methods, automated sequencing, sequence assembly.DNA finger printing, Applications of gene techonology: production of pharmaceuticals- humulin, somatotropin, somatostatin, recombinant vaccines.

References:

- *T.A. Brown. 2006. Gene Cloning,. Blackwell publishing.*
- *David Freifelder. 2009. Essentials of Microbiology. Narosa publishing.*
- *Freifelder, O. Microbila.2006. Genetics. Narosa publishing House.*
- *Benjamin.. A. Pierce. 2007. Genetics (A Conceptual Approach). H.W. Publication.*
- *Lewin B., Person Prentine Hall. 2007. Genes IX. Oxford University Press.*
- *Nancy Trun..2004. Fundamental Bacterial Genetics. B. K. Publication.*
- *Freifelder, O. Microbila. 2006. Genetics. Narosa publishing House.*

Note : The examiner is expected to set the question paper based on the entire course content. In Section A, the question paper shall include 5 long question (10 marks each) out of which the candidate is required to attempt 3 questions. Section B shall be based on short answers 100-200 words and shall include 4 questions of which the candidate is required to attempt 2 questions of 5 marks each. Section C shall include 10 to 20 questions of half / one mark each and shall be based on objective type / true-false / very short answers like definitions.

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Course BI 204- Molecular Biology

Unit I: Nucleic acids as genetic information carriers: experimental evidence. DNA structure: historical aspects & current concepts, melting of DNA, types of DNA. DNA replication in prokaryotes: types of polymerases, steps: initiation, elongation (Asymmetric & dimeric nature of DNA Polymerase III & simultaneous synthesis of leadind & lagging Strands), termination. DNA replication in eukaryotes: types of polymerases, replication origins & initiation, steps involved, synthesis of telomeric DNA.Various modes of replication. Superhelicity in DNA, linking number, topological properties, mechanism of action of topoisomerases.

Unit II: Mutation; Spontanaous Mutation and Induced Mutagenesis. Mutagens (Physical Mutagens: non-ionizing radiation & ionizing radiation. Chemical Mutagens; Base analogs, Alkylating Agents, Deaminating Agents, Intercalating Agents and others). Molecular Mechanism of Mutagens. Suppressor Mutation: Intragenic and Intergenic Mutation. DNA Repair Mechanism; Repair by Direct Reversal, Excision Repair, Recombination Repair & SOS Repair.

Unit III: Structural features of RNA (mRNA, tRNA, rRNA). Transcription in prokaryotes: RNA polymerase, promoter, steps: initiation, elongation & termination, antitermination. Trancription in eukaryotes: types of RNA polymerases (I, II & III), promoter, enhancer & silencer sites for initiation, transcription factors, steps: initiation, elongation & termination. Inhibitors of RNA synthesis. Post trancriptional modification of mRNA: capping, polyadenylation & splicing (group I introns, group II introns, hn RNA using spliceosome/snurposome). Ribozymes.

Unit IV: Basic features of the genetic code. Protein synthesis in prokaryotes and eukaryotes; Structure of ribosomes, steps-details of initiation, elongation & termination, roles of various factors in the above steps, inhibitors of protein synthesis. Synthesis of exported proteins on membrane bound ribosomes: signal hypothesis. Post translational modification of proteins.

Unit V: Regulation of gene expression : operon concept, negatve & positive regulation, instability of bacterial mRNA, inducers and corepressors, catabolite repression. Negative regulation-E. coli. lac operon; positive regulation- E. coli. ara operon; regulation by attenuation- his and trp operons; anti-termination-N protein and nut sites in lambda. Global regulatory responses; heat shock response, stringent response and regulation by small molecules such as cAMP and ppGpp. Regulation of rRNA and tRNA synthesis.

References:

- *Lewin B. 2007. Genes IX, Pearson Prentine Hall, Oxford University press*
- *Freifelder, O. Microbial. 2007. Genetics, Narosa Publishing House*
- *Gupta, P.K. 2008. Cell and Molecular Biology, Rastogi Publications*
- *Singh, B.D. 2006. Genetics, Kalyani Publication.*
- *Brown, T.A. 2006. Gene Cloning and DNA analysis, An introduction, Blackwell Science*
- *Old, R.W. and Primrose, S.B. 2001. Principles of Gene Manipulations, Blackwell Science*
- *Bruce Albert, 2007. Molecular Biology of The Cell*

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Course BI 205- Practical 1 (Course BI 201 & Course BI 202)

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Course BI 206-Practical 2 (Course BI 203 & Course BI 204)

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Course BI 301: Operating Systems & Object Oriented Programming

Unit I- Operating System: Introduction: Windows and Unix/Linux, Definition; Concepts; Function of Operating System; Batch Processing; Multiprogrammed Batch System; Time Sharing System; Parallel System; Distributed System; Real Time System.

Unit II- Process & Memory Management: Process; Process State(New, Running, Waiting, Ready, Termination); Process Control Block; Process Scheduling (Round Robin Scheduling, Priority Scheduling, Multiple Queues, Shortest Job Scheduling); Operations on Process; Basic Management of Memory; Swapping Virtual Memory; Paging.

Unit III- Input/Output Management: I/O Devices; Device Controllers; I/O Software; Device Drivers; Deadlock; Resources; Principles of Dead Lock; Detection and Recovery; Deadlock Prevention; Deadlock Avoidance.

Unit IV- UNIX/LINUX Operating Systems: Introduction; Concepts; Layers of UNIX; Role of System Administrator and Ordinary User; Tree Structure of UNIX; Root File System; /bin Directory; /dev Directory; /bin Directory; /etc Directory; /lib Directory; /proc Directory; /mnt Directory; /root Directory; /sbin Directory; /tmp Directory; /var Directory; Relative Path; Absolute Path; Creation of Directory; Creating file; removing file; Listing Files and Directories copying file; renaming file; Changing File Permission; Changing Directory Permission; Changing Group; Changing Owner; Pipe; Filters; pwd command; date command; head command; tail command less command; more command; grep command; VI Editor (Creating a new File; Inserting Text in File; Deleting Text in File; Copy , Cut & Paste Text; Save File).

Unit V– Introduction to Object-oriented programming & concepts: Object Modeling, Object-Oriented Databases, Object Database Languages, Object Database Design, Object-oriented programming with C++ (Objects, Classes, Data Abstraction & Inheritance).

References:

- *Ramesh Bangia. 2000. Learning Unix. BPB Publication.*
- *Peter Baer Galvin. 2003. Operating System Concepts. BPB Publication*
- *Stuart E. Madnick. 2001. Operating System. Tata Mac Graw Hill.*
- *Kenneth H. Roshan. 2001. The complete reference Unix Tata Mac Graw Hill..*
- *D. M. Dhamethire. , 1996. System Programming and Operating Systems. Tata Mac Graw Hill.*
- *Kirrgcox. 2001. Red Hat Linux by. Printice Hill India.*
- *Andrew S. Talenbaum. 2001. Modern Operating system. Printice Hill India.*
- *Sumetabha Das. 2003. Unix (Concept and Application). Tata Mac Graw Hill.*
- E. Balaguruswami. *4th Edition . 2007. Programming in 'C++'. Tata Mac Graw Hill.*

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Course BI 302: Biocomputing Programming

Unit I- Hyper Text Programming Language: Structure of HTML program(<HTML>, <HEAD>, <TITLE>, <BODY>); Titles & Footer; Text Formatting(Paragraph break<P>, line break
); Text Styles(Bold<B>, Italics<I>, Underline<U>); Font Style, Color & Size; Image Tag(<IMG>); Table (<TABLE>, <TR>, <TH>, <TD>) & Attributes(Border, Width, Align); Frames; Forms (Text Box, Check Box, Command Button, List Box); Anchors.

Unit II- Java Script- Data Types; Literals; Variables; Arrays; Operators (Arithmetic, Comparison, Logical, String, Assignment); Condition Check(if-then-else); looping(for, while); Functions(Built-in, user defined); scope of functions; Dialog Boxes(Alert Dialog Box, Prompt Dialog Box; Confirmed Dialog Box).

Unit III- PERL- Scalar Data; Scalar Variable; List Data & Variable; Creating List Operators (Arithmetic, Relational, Increment & Decrement, Assignment, Logical); <STDIN>; print, printf & sprintf; Arrays; Assigning values to Array elements.

Unit IV-Arrays & Hashes- Accessing Array elements; Finding the length of an Array; Hashes; Accessing Hash elements; Deleting Hash elements; Processing the values of Hashes; Conditionals (if, if…else, if…elseif); while loop(while, until & do); for loop; controlling loop (last, next & redo); Manipulating Lists and Strings (Sorting, Searching, Modifying List Elements such as: push & pop, shift & unshift, splice, reverse, index, substr).

Unit V-Pattern Matching- Simple Pattern Matching, Matching group of Characters, Extracting Matches; File Handling(Creating, renaming removing files); Using PERL for CGI Scripting.

References:

- *Dick Oliver. 2009. HTML 4 in 24 hrs. Techmedia Publication*
- *Dick Oliver. 2009. JavaScript 4 in 24 hrs. Techmedia Publication*
- *Ivan Bayross. 2005. Web Enabled commercial application development using HTML, DHTML, JavaScript and PERL CGI. BPB Publication*
- *James Tisdall. 2003. Beginning perl for Bioinformatics. O-Reilly*
- *Cynthia Gibos, Per Jambeck. 2001. Developing Bioinformatics Computer Skills. O-Reilly*
- *Randal L. Schwartz, Tom Phoenix. 2008. Learning Perl. O-Reilly*
- *Sriram Srinivasn. 1997. Advanced Perl. O-Reilly*
- *Chrisbate, Wiley. 2002. Web programming. Publication..*
- *Techmedia Aldo. 2002. Perl programming, Wiley Publication.*
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- *Eric C. Hermamm.2008. Mastering Perl 5. BPB Publication.*

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Course BI 303- Sequence Analysis

Unit I: Sequence comparison algorithm, sequence scoring schemes (weight matrix as Identify scoring, genetic code scoring scheme chemical scoring, observed substation matrix and Gap penalties.)

Unit II: Sequence database similarity searching algorithms, local alignment, global alignment, FASTA, BLAST (BLASTP, BLASTN, BLASTX, TBLASTN, TBLASTX) and similarity searching scores and their statistical interpretation.

Unit III : Motifs and Domains, algorithm for multiple alignments (CLUSTALx and CLUSTALW) Biological motifs (consensus, regular expression, profiles, PSSMs, HMMs and application for biological sequence similarity searching(PSI- & PHI BLAST, motifs, patterns)).

Unit IV: Functional genomics Strategies for generating EST and full length insert, EST clustering and assembly, statistical analysis of EST and EST data, micro array (target selection/design, image analysis, data validation, statistical analysis.)

Unit V: Phylogenetic prediction: Relationship of phylogenetic analysis to sequence alignment, Genome complexity and phylogenetic analysis, concept of evolutionary trees. Maximum parsimony method, distance method, maximum likelihood method.

References:

- *Heijne, Gunnar Von. 2004. Sequence Analysis in Molecular biology: treasure troureor trivial Pursuit*
- *Koski, T. Dordrecht Kluwer. 2008. Hidden Markou Modles for Bioinformatics. Academic Publishers*
- *Darbin, R. Eddy, S. Krogh, A. & Mithchison G.. 2005. Biological Sequence Analysis: Probabilistic models of Proteins and Nuclic acid Cambridge University Press, Cambridge*
- *Sharma, Munjal and Shankar. A Text book of bioinformatics.2007. Rastogi Publications*
- *Advances in Bioinformatics by M. S. Krishna Kumar*

Note : The examiner is expected to set the question paper based on the entire course content. In Section A, the question paper shall include 5 long question (10 marks each) out of which the candidate is required to attempt 3 questions. Section B shall be based on short answers 100-200 words and shall include 4 questions of which the candidate is required to attempt 2 questions of 5 marks each. Section C shall include 10 to 20 questions of half / one mark each and shall be based on objective type / true-false / very short answers like definitions.

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Course BI 304- Genomics, Proteomics & Systems Biology

Unit I: Objective and Overview of Genome Comparisons, Genome Alignments, BLAST2, MUMmer, PipMaker, VISTA, Comparison of Gene Order, Comparative Genomics— Viruses, Microbes, Pathogens, Eukaryotes,

Unit II: Comparative Genomics Databases- COG, VirGen, CORG, HOBACGEN, Homophila, XREFdb, Gramene, Single Nucleotide Polymorphism, dbSNP and other SNP-related databases; An overview of pharmocogenomics.

Unit III: Definition, History and Scope of Proteomics, Experimental Techniques (SDS-PAGE, 2D-PAGE, X-ray crystallography, NMR spectroscopy, isoelectric focusing, mass spectroscopy, (MALDI), differencial display, protein chips and antibody microarrays, functional protein microarrays; resolution and identification of proteins), analysis of post translational modifications of proteins; Bioinformatics Approaches, Protein-Protein Interaction Networks, databases and software, DIP (Database of Interacting Proteins).

Unit IV: PPI Server, BIND - Biomolecular Interaction Network Database, PIM – Hybrigenics PathCalling Yeast Interaction Database, MINT - a Molecular Interactions Database, GRID - The General Repository for Interaction Datasets, InterPreTS - protein interaction prediction through tertiary structure.

Unit V: Systems Biology: Biological Systems--System of Molecular Networks; Ecosystem, Elements of systems modeling, Gene regulatory network and the models; Computational modeling in biology.

References:

- Hecker, M. & Mullner, S., Berlin. 2003. Proteomics of microorganisms. Springer-Verlag.
- *Liebler, D.C. & Yates, J.R. III. 2002. Introduction to proteomics: tools for the new biolog. New York. Humana Press.*
- *Pennington, S. R. & Dunn, M. J. 2002. Proteomics: from protein sequence to function New Delhi, Viva Books Private Ltd.*
- *David Mount. 2004. Bioinformatics: sequence and genome analysis. cold springer harbour press.*
- *by Sankoff, D. & Nadeau, J.H., Netherlands. 2000. Comparative genomics: empirical and analytical approaches to gene order dynamics, map alignment and the evolution of gene families. Kluwer Academic Publishers.*

Note : The examiner is expected to set the question paper based on the entire course content. In Section A, the question paper shall include 5 long question (10 marks each) out of which the candidate is required to attempt 3 questions. Section B shall be based on short answers 100-200 words and shall include 4 questions of which the candidate is required to attempt 2 questions of 5 marks each. Section C shall include 10 to 20 questions of half / one mark each and shall be based on objective type / true-false / very short answers like definitions.

Course BI 305- Practical 1 (Course BI 301 & Course BI 302)

Course BI 306-Practical 2 (Course BI 303 & Course BI 304)

Course BI 401- Project VIVA **400 marks**

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