

BHAVNAGAR UNIVERSITY

BHAVNAGAR

(NACC Accreditation Grade “B”)

CREDIT AND SEMESTER SYSTEM

SYLLABUS

MASTER OF SCIENCE (M.Sc.)

BIO-INFORMATICS

(In Force From Academic Year: 2010-2011)

तमसो मा ज्योतिर्गमय



M.Sc.
Credit and Semester System Syllabus

NAME OF THE SUBJECT: BIO-INFORMATICS

SEMESTER – 1st

SR. NO.	PAPER NO	NAME OF THE PAPER	TOTAL MARKS EXT + INT = TOTAL	PASSING STANDARD EXT + INT = TOTAL	TOTAL TEACHING HOURS	CREDITS
1	MBI-C101(A)*	Fundamental Biology (Optional)	70 + 30 = 100	28 + 12 = 40	4	4
2	MBI-C101(B)*	Fundamental Mathematics (Optional)	70 + 30 = 100	28 + 12 = 40	4	4
3	MBI-C102	Biochemistry, Biostatistics and Genetics	70 + 30 = 100	28 + 12 = 40	4	4
4	MBI-C103	Computer Fundamentals and Relational Database Management System	70 + 30 = 100	28 + 12 = 40	4	4
5	MBI-C104	Practicals	100 + 00 = 100	40 + 00 = 40	9	9

In Paper Codes – C- Core/Compulsory Paper

1. Students from mathematics/ Computer Stream will study paper MBI-101(A)* of Basic Biology, whereas students from biology / agriculture stream will study paper MBI-101(B)* of Basic Mathematics.

<u>*INTERNAL</u>	<u>SUGGESTED DIVISION OF MARKS</u>
ASSIGNMENT	10
SEMINAR	10
TEST	10



M.Sc.
Credit and Semester System Syllabus

NAME OF THE SUBJECT: BIO-INFORMATICS

SEMESTER – 2nd

SR. NO.	PAPER NO	NAME OF THE PAPER	TOTAL MARKS EXT + INT = TOTAL	PASSING STANDARD EXT + INT = TOTAL	TOTAL TEACHING HOURS	CREDITS
1	MBI-C201	Object Oriented Programming, Biological Databases & Data Analysis	70 + 30 = 100	28 + 12 = 40	4	4
2	MBI-C202	Cell Biology, Molecular Biology and Immunology	70 + 30 = 100	28 + 12 = 40	4	4
3	MBI-C203	Computer Graphics, Networking and Programming in VB	70 + 30 = 100	28 + 12 = 40	4	4
4	MBI-C204	Practicals	100 + 00 = 100	40 + 00 = 40	12	12

***INTERNAL**

ASSIGNMENT

SEMINAR

TEST

SUGGESTED DIVISION OF MARKS

10

10

10



M.Sc.
Credit and Semester System Syllabus

NAME OF THE SUBJECT: BIO-INFORMATICS

SEMESTER – 3rd

SR. NO.	PAPER NO	NAME OF THE PAPER	TOTAL MARKS EXT + INT = TOTAL	PASSING STANDARD EXT + INT = TOTAL	TOTAL TEACHING HOURS	CREDITS
1	MBI-C301	Comparative Genomics and Proteomics and Metabolomics	70 + 30 = 100	28 + 12 = 40	4	4
2	MBI-C302	From Genome to Drug and Vaccine Design	70 + 30 = 100	28 + 12 = 40	4	4
3	MBI-C303	Structural bioinformatics and Molecular modeling	70 + 30 = 100	28 + 12 = 40	4	4
4	MBI-C304	Practicals	100 + 00 = 100	40 + 00 = 40	12	12

***INTERNAL**

ASSIGNMENT

SEMINAR

TEST

SUGGESTED DIVISION OF MARKS

10

10

10



M.Sc.
Credit and Semester System Syllabus

NAME OF THE SUBJECT: BIO-INFORMATICS

SEMESTER – 4th

SR. NO.	PAPER NO	NAME OF THE PAPER	TOTAL MARKS EXT + INT = TOTAL	PASSING STANDARD EXT + INT = TOTAL	TOTAL TEACHING HOURS	CREDITS
1	MBI-C401	Taxonomy, Phylogeny and Biodiversity Informatics	70 + 30 = 100	28 + 12 = 40	4	4
2	MBI-C402	Programming in Perl and Advanced Techniques for Bioinformatics Studies	70 + 30 = 100	28 + 12 = 40	4	4
3	MBI-C403	Project	70 + 30 = 100	28 + 12 = 40	(~2 Months)	8
4	MBI-C404	Practicals	100 + 00 = 100	40 + 00 = 40	12	12

***INTERNAL**

ASSIGNMENT

SEMINAR

TEST

SUGGESTED DIVISION OF MARKS

10

10

10



M.Sc. (BIO-INFORMATICS)
SEMESTER – I

Paper no: MBI-C101(A)*: Fundamental Biology (Optional)

Credits: 04

Total Marks: 100 Marks:
Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed syllabus	Teaching Hours	Marks/Weight
Unit1	Origin of life: Prebiological chemical evolution, proteinoids and protocells; Species concept, Kingdom to Species, the five Kingdoms, Three domain concept of Carl Woese; Endosymbiont theory	12	20
Unit2	Microbial World: Bacteria, viruses and virus related agents <u>Bacteria</u> : Structure and types of bacteria, nutritional categories, mode of reproduction, transformation, conjugation, transduction, salient features of bacteria according to Bergey's Manual <u>Viruses</u> : Classification and types of viruses – bacteriophages, plant and animal virus, replication of viral genome; virus related agents – viroids, prions, satellite viruses	12	20
Unit3	Introductory Mycology: General features of fungi, structure and reproduction, classification, importance	12	20
Unit4	Plant Diversity: Introduction to plant classification, plant physiology, metabolism and reproduction	12	20
Unit5	Animal World: Major animal phyla, introductory physiology, endocrinology and reproduction	12	20

Break up of Continuous Internal Evaluation:

1. Assignment 10 Marks
 2. Seminar 10 Marks
 3. Test 10 Marks
- Total marks 30 Marks**

Reference/Textbook/Additional Reading:

1. Stanier, R.Y. Ingraham, J.L. Wheelis, M.L. Painter, P.R.. General Microbiology. 1999. Mac Milan Edu.Ltd.
2. Dube, H.C. Introduction to Fungi. 3rd edition, Vikas Publ.
3. Dube, H.C. A Text book of Fungi, Bacteria and Viruses. 2nd edition, Vikas Publ.
4. Pelczar. Microbiology
5. Dimmock, N.J. & Primrose, S.B. Introduction to Modern Virology IV edition, Blackwell Scientific Publ. Oxford.

[* Students from mathematics/ Computer Stream will study paper MBI-101(A)* of Basic Biology]



Paper no: MBI-C101(B)* Fundamental Mathematics (Optional)

Credits: 04

Total Marks: 100 Marks:
 Semester End Examination: 70 Marks
 Continuous Internal Evaluation: 30 Marks

Unit	Detailed syllabus	Teaching Hours	Marks/Weight
Unit1	Calculus: Limits, Complete differentials, partial differentials of functions with one variable and multiple variables; Integration: Definite and non-definite integral; Series, Logarithms	12	20
Unit2	Ordinary differential equations (first order), partial differential equations – examples from biology special functions – Bessel, Legendre; 2D coordinate geometry: Equations of line, circle, ellipse, parabola, hyperbola; 3D geometry: Equation of sphere, cone	12	20
Unit3	Trigonometric Functions: Sine, Cos, tan, cot; Series expansion of these functions and related functions; Vector-addition, subtraction, dot, cross, scalar triple product, divergence, curl of a vector, equation of normal	12	20
Unit4	Matrix Algebra: Addition, subtraction, multiplication, transpose inverse, and conjugate of matrix etc.; Logic: Boolean Logic	12	20
Unit5	Addition, subtraction, multiplication and division using binary, octal and hexadecimal systems; Fundamentals of set theory; Fourier transform, Laplace Transform and other standard transforms	12	20

Break up of Continuous Internal Evaluation:

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|--------------------|-----------------|
| 1. Assignment | 10 Marks |
| 2. Seminar | 10 Marks |
| 3. Test | <u>10 Marks</u> |
| Total marks | 30 Marks |

Reference/Textbook/Additional Reading:

1. T.K. Manicavachagom Pillai, T. Natarajan & K.S. Ganapathy. Algebra Vol I.
2. T.K. Manicavachagom Pillai. Calculus
3. Murray. Mathematical Biology: An Introduction. Vol I & II

[* Students from biology/ agriculture stream will study paper MBI-101(B)* of Basic Mathematics.]



Paper no: MBI-C102: Biochemistry, Biostatistics and Genetics

Credits: 04

Total Marks: 100 Marks:
Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed syllabus	Teaching Hours	Marks/Weight
Unit1	Structure, Classification and Functions of carbohydrates, proteins and lipids; Structure and types of nucleic acids, DNA denaturation, renaturation, hybridization; Biosynthesis of Proteins, Fatty acids, Gluconeogenesis and Oxidation of glucose in cell: Glycolysis, TCA cycle, Oxidative phosphorylation	12	20
Unit2	Enzymes: Nomenclature and classification, Enzyme activity, co-enzyme and co-factors, Allosteric enzymes, Isozymes, Factors affecting enzyme activity, Michaelis-Menton kinetics; Multienzyme complexes and multifunctional enzyme, Anaplerotic reactions and amphibolic pathway, Feedback control of metabolic pathway, Shuttle pathway	12	20
Unit3	Mendelian principles of inheritance, sex linked inheritance; Linkage, linkage maps and recombination; Phenotype and genotype relationship, role of environment from gene to phenotype, gene interactions; Population genetics; Types of mutations; Genetics and disease, cancer	12	20
Unit4	Collection, Classification and Tabulation of data - graphical and diagrammatic representation; Measures of central tendency-mean, median, mode; Measures of dispersion-range, standard deviation, variance, standard error; Chi-square test; Simple linear regression, Correlation co-efficient	12	20
Unit5	Multivariate analysis, Hypothesis testing, Markov models; Cluster analysis - Nearest neighbour search, search using stem number, search using text signature	12	20

Break up of Continuous Internal Evaluation:

1. Assignment	10 Marks
2. Seminar	10 Marks
3. Test	10 Marks
Total marks	30 Marks

Reference/Textbook/Additional Reading:

1. Lehninger, A.L. Principles of Biochemistry. 4th edition
2. Geoffery Norman & David Streiner .Biostatistics: The Bare Essentials, 2nd edition.
3. Warren Ewens & Geogery R. Grant. Statistical Methods in Bioinformatics. Springer.
4. Streyer, Biochemistry, 5th edition, Freeman
5. Hartle D. & Jones, Genetics Analysis of Genes and Genomes. 6th edition. Jones & Barlette
6. P.K. Gupta. Genetics. Rastogi Publ.
7. AVVS Sambamurty. Genetics. Narosa
8. S Ashcroft & C Pereira. Practical Statistics for the Biological Sciences, Palgrave Macmillan



Paper no: MBI-C103: Computer Fundamentals and Relational Database Management System

Credits: 04

Total Marks: 100 Marks:
 Semester End Examination: 70 Marks
 Continuous Internal Evaluation: 30 Marks

Unit	Detailed syllabus	Teaching Hours	Marks/Weight
Unit1	Overview of Computer system: Input- Output devices, Storage devices (capacity & access time), Main circuit board of a PC; Introduction to operating Systems: Windows/UNIX/LINUX; The internet & its resources (www, http, Search Engine) searches on Medline, bibliographic database.	12	20
Unit2	Basic concept: Procedure oriented programming; C programming: Data types, operators and expressions, Hierarchy of operators, Control Statements: Decision (if, if-else), loop (while, do-while, for), branching (switch, break, continue), Arrays (1D, 2D- all matrix operations including inverse of a matrix)	12	20
Unit3	C programming: Functions, Pointers, Structures, Overview of linked list, File handling, C under Linux	12	20
Unit4	Data Abstraction, Data Models, Instances & Schemes, ER Models (Entity and entity sets, Relations & relationship sets, ER Diagrams, Reducing ER diagram to tables); Basic Concepts & application of multimedia Databases; Data mining and Warehousing	12	20
Unit5	Oracle Architecture; Oracle Objects- Tables, Views, Indexes, Sequences, Synonyms, Snapshots, Clusters; Database (Table space, Data files, Blocks, Extents, segments; Oracle Back ground Processes: PMON,SMON, LGWR,CKPT, Oracle Instant start up, shut down/Init. Oar. Control files; Oracle Memory Management; SGA; SQL statements (Select Statements, Data Definition statements, Data manipulation statements)	12	20

Break up of Continuous Internal Evaluation:

- | | |
|--------------------|-----------------|
| 1. Assignment | 10 Marks |
| 2. Seminar | 10 Marks |
| 3. Test | <u>10 Marks</u> |
| Total marks | 30 Marks |

Reference/Textbook/Additional Reading:

- Silberschatz A., Korth HF, S. Sudarshan, Database System Concepts. 3rd Edition. McGraw Hill
- Balagurusamy. Programming in ANSI C.
- Kanetkar. Let Us C. 6th edition, bpb.

Paper no: MBI-C104: Practicals

Credits: 09

Total Marks: 100 Marks



M.Sc. (BIO-INFORMATICS)
SEMESTER – II

Paper no: MBI-C201: Object Oriented Programming, Biological Databases & Data Analysis

Credits: 04

Total Marks: 100 Marks:
Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed syllabus	Teaching Hours	Marks/Weight
Unit1	JAVA: Introduction; Object Oriented Programming and Java; Java Basics; Class fundamentals, Working with objects; Data types, Variables and Arrays; Operators; Control statements: Selection statement (if, switch), Iteration statements (while, do-while, for, nested loops), jump statements (break, continue, return); More about Classes and Methods.	12	20
Unit2	Inheritance; Packages and interfaces; Exception handling; Multithreading; Creating Applications in Java: Streams and I/O; Java Applets Basics; Graphics, Fonts & Color; Simple Animation and Threads; Advanced Animation, Images; Managing Simple events and Interactivity; Creating User Interfaces with AWT	12	20
Unit3	Overview of available Bioinformatics resources on the web (NCBI, EBI, EXPASY etc.); Biological Databases: Nucleic Acid sequence Databases-GenBank / EMBL / DDBJ; Protein Sequence databases – NBRF – PIR, UniprotKB	12	20
Unit4	Database search Engines (Entrez, SRS); Concepts in sequence analysis: Pairwise sequence Alignment algorithm (Needleman & Wunsch; Smith & Waterman); Scoring Matrices for nucleic acids and proteins: MDM, BLOSUM	12	20
Unit5	Database similarity searches-BLAST, FASTA; Multiple sequence Alignment: CLUSTAL W; Derived data bases-Prosites, BLOCKS, Pfam/Prodom	12	20

Break up of Continuous Internal Evaluation:

1. Assignment	10 Marks
2. Seminar	10 Marks
3. Test	10 Marks
Total marks	30 Marks

Reference/Textbook/Additional Reading:

1. Mount DW, Bioinformatics: Sequence and Genome Analysis (2nd edition). Spring Harbor Press.
2. Arthur Lesk. Introduction to Bioinformatics. Oxford Uni. Press.
3. Rastogi. Bioinformatics: Methods and Applications
4. Schildt H. Java: Complete Reference. Tata M
5. Andrew S. Baxevanis, B.F. Francis Ouellette. Bioinformatics: A Practical Guide to the Analysis of Gene and Proteins. Wiley International Sci.
6. Andrew S. Baxevanis, B.F. Francis Ouellette. Bioinformatics: A Practical Guide to the Analysis of Gene and Proteins. Wiley International Sci.



Paper no: MBI-C202: Cell Biology, Molecular Biology and Immunology

Credits: 04

Total Marks: 100 Marks:
Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed syllabus	Teaching Hours	Marks/Weight
Unit1	Structure of Prokaryotic and Eukaryotic cells; Cellular Organelles - Mitochondria, Chloroplast, Golgi complex, Endoplasmic reticulum, Lysosomes, Peroxisomes, Nucleus and nucleolus; Cytoskeletal elements, Cilia and Flagella	12	20
Unit2	Cell -cell interaction and signal transduction; Protein traffic in cells: protein sorting and signal sequence, protein translocation and vesicular transport, protein import; Cell cycle & its regulation events during mitosis and meiosis	12	20
Unit3	DNA replication mechanism, enzymes and proteins involved in replication process; DNA sequencing, PCR; Oncogenes and tumor suppressor genes	12	20
Unit4	Transcription mechanism, operon, RNA foot printing, RNAi; Processing of RNA and protein; stress and hormone regulated gene expression; organization of human genome, RFLP, Fingerprinting, RAPDs, Microarrays, ESTs	12	20
Unit5	Innate and acquired immunity, Autoimmunity, Antigens type and properties, structure and function of antibody molecule and TCR, genetics of antibody diversity; Major histocompatibility complex - MHC I and MHC II, polymorphism, MHC peptide interaction, affinity maturation; Application of bioinformatics in immunology and vaccine development	12	20

Break up of Continuous Internal Evaluation:

1. Assignment	10 Marks
2. Seminar	10 Marks
3. Test	<u>10 Marks</u>
Total marks	30 Marks

Reference/Textbook/Additional Reading:

1. J. Darnell, H. Lodish, & D. Baltimore. Molecular Cell Biology (2nd edition) Scientific American
2. Benjamin Lewin, Genes VIII. Prentice Hall
3. Hartle D. & Jones, Genetics Analysis of Genes and Genomes. 6th edition. Jones & Barlette
4. Richard J. Reece. Analysis of Genes & Genomes. John Wiley.
5. Immunoinformatics: Bioinformatics Strategies for Better Understanding of Immune Function, Novartiz Foundation, John Wiley & Sons
6. R.A. Goldsby, Thomas Kindt, Barbara Osbarne. Kuby Immunology. 4th edition. Freeman
7. Coico, Sunshine and Benjamin Immunology: A Short Course, 5th edition, Wiley



Paper no: MBI-C203: Computer Graphics, Networking and Programming in VB

Credits: 04

Total Marks: 100 Marks:
Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed syllabus	Teaching Hours	Marks/Weight
Unit1	Computer Graphics: Introduction, Scientific & Engineering Applications, Visualization techniques, Hardware, Graphics Software	12	20
Unit2	Geometric transformations, Raster Algorithms, 2D viewing, Viewing in 3D, Animation, Image Processing, Clipping algorithms (point clipping, line clipping), polygon filling algorithms (boundary fill & flood fill)	12	20
Unit3	OSI Reference Model; Network Topologies and Protocols; Networking gadgets (Router, Switch, etc); Data Communication (ISDN, VPN, DSL, cable modem, cellular modem, etc); Communication Links (Wire pairs, Coaxial cables, Fiber optics, Microwave, Satellite, etc); LAN, WAN, MAN	12	20
Unit4	Network Security (Firewall, Packet filtering, etc); Overview of Computer viruses: Transmission, Dangers & General Precautions; Overview of current & future technologies (Grid Computing, VPN, wireless, mobile computing, biometrics etc.)	12	20
Unit5	<u>VB</u> : Introduction to Application Development; Working with code & Forms; Variables, Procedures and controlling Program Executor; Standard Controls; Data access using data control; Connecting to Oracle Database using VB	12	20

Break up of Continuous Internal Evaluation:

1. Assignment 10 Marks
 2. Seminar 10 Marks
 3. Test 10 Marks
- Total marks 30 Marks**

Reference/Textbook/Additional Reading:

1. Hern & Baker: Computer Graphics
2. JD Foley, A.VanDam. Fundamentals of Interactive Computer Graphics.
3. Bayross E. PL/SQL
4. Computer Network by Andrew S. Tanenbaum, PHI
5. Holzner. Visual Basic 6 Programming Black Book. Dreamtech.

Paper no: MBI-C204: Practicals

Credits: 12

Total Marks: 100 Marks



M.Sc. (BIO-INFORMATICS)
SEMESTER – III

Paper no: MBI-C301: Comparative Genomics and Proteomics and Metabolomics

Credits: 04

Total Marks: 100 Marks:
Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed syllabus	Teaching Hours	Marks/Weight
Unit1	Importance of Genome Comparison; Genome Alignments-BLAST2, MUMmer, PipMaker, VISTA; Comparison of Gene Order: GeneOrder	12	20
Unit2	Comparative Genomics: Viruses, Microbes, Pathogens, Eukaryotes; Understanding and exploration of Comparative Genomics databases; Single Nucleotide Polymorphism, dbSNP and SNP related databases	12	20
Unit3	Overview of Proteomics: Experimental techniques and Bioinformatics approaches; Protein-Protein Interaction Networks, databases and software: DIP, PPI server, BIND, PIM -Hybrigenics, Path Calling Yeast Interaction Database	12	20
Unit4	Classification of enzymes; Enzymes, compounds and reaction databases - LIGAND - Biochemical compounds and reactions, ENZYME - Enzymes, BRENDA- comprehensive Enzyme Information System	12	20
Unit5	Metabolic pathway databases - EMP, KEGG, EcoCyc and Meta Cyc, Boehringer Mannheim - biochemical pathways; Full Genome Annotation through knowledge of metabolic pathways; Comparison of Metabolic Pathways; Engineering of Metabolic Pathways	12	20

Break up of Continuous Internal Evaluation:

1. Assignment	10 Marks
2. Seminar	10 Marks
3. Test	<u>10 Marks</u>
Total marks	30 Marks

Reference/Textbook/Additional Reading:

1. Saccone, A Handbook of Comparative Genomics
2. Mount DW, Bioinformatics: Sequence and Genome Analysis (2nd edition).



Paper no: MBI-C302: From Genome to Drug and Vaccine Design

Credits: 04

Total Marks: 100 Marks:
Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed syllabus	Teaching Hours	Marks/Weight
Unit1	Genome databases and related data resources (EST, STS, GSS, HSS, etc.): Nature and type of data, organization of data in databases, genome data visualization (with emphasis on human genome)	12	20
Unit2	Tools for Genomic Data Mining- Basic aspects of genome annotation; Prediction of ORFs and Genes, Gene Modeling; Prediction of signal sequences (primers, promoters, splice sites, UTRs)	12	20
Unit3	Identification of disease gene (in context of Human genetics and Genetics of model animals): Identification of drug targets, gene expression analysis, structural genomics, functional genomics	12	20
Unit4	Pharmacokinetics- ADMET: Drug metabolism; Role of cytochromes P450; Elimination half-life; Toxicity screening Pharmacogenetics- Genetics of drug metabolism, Genetics of therapeutic targets Proteome analysis and Prediction of epitopes on Genomic scale Vaccine designing approaches – peptide/DNA vaccine, polytope vaccine, Recombinant vaccine	12	20
Unit5	Drug-receptor interactions, Structure based drug design, Molecular Docking, Design of ligands for known macromolecular target site, 2D and 3D database searching, Pharmacophore identification, QSAR studies and their application;, High throughput/ combinatorial approach, Enzyme inhibition strategies	12	20

Break up of Continuous Internal Evaluation:

1. Assignment	10 Marks
2. Seminar	10 Marks
3. Test	10 Marks
Total marks	30 Marks

Reference/Textbook/Additional Reading:

1. Lengauer T. From Genome to Drug (Vol. I & II).
2. Larsen, Liljefors, Madsen. Textbook of Drug Design and Discovery. Taylor & Francis



Paper no: MBI-C303: Structural Bioinformatics and Molecular Modeling

Credits: 04

Total Marks: 100 Marks:
Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed syllabus	Teaching Hours	Marks/Weight
Unit1	Overview of macromolecular x-ray crystallography: Methods to study 3D structure, Principles of crystallography, Co-ordinate systems, Fitting and refinement, Validation, Analysis of 3D structures; Data submission to PDB	12	20
Unit2	Anatomy of proteins: Ramchandran plot, secondary, tertiary and quarternary structures, motif, domains; Principles of protein folding; Anatomy of DNA: A, B, Z DNA, DNA binding, etc.; RNA structure, Ribosome structure Structural data banks – PDB, NDB, CSD Calculation for conformational energy of biomolecules	12	20
Unit3	Protein Classification: CATH, SCOP; Protein structure prediction: Ab initio methods, Homology modeling, Fold recognition; Prediction of RNA secondary structure	12	20
Unit4	Energy Minimization; Molecular Mechanics - Conformations: global vs. local, Force fields; Basic concepts in quantum mechanics; Computer simulation techniques: Molecular dynamics Simulation and Monte Carlo methods	12	20
Unit5	Molecular interaction of protein – protein, protein-carbohydrate, protein-DNA, DNA-small molecules	12	20

Break up of Continuous Internal Evaluation:

1. Assignment 10 Marks
 2. Seminar 10 Marks
 3. Test 10 Marks
- Total marks 30 Marks**

Reference/Textbook/Additional Reading:

1. Creighton TE, Protein Structure: A Practical Approach
2. Creighton TE, Protein Structure and Molecular Properties, Freeman
3. Leach AR, Molecular Modeling: Principles and Application
4. Bourne PE, Weissig H, Structural Bioinformatics, Wiley Schlick T. Molecular Modelling and Simulation An Inter disciplinary Guide, Springer
5. Pevzner PA Computational Molecular Biology An Algorithmic Approach. Prentice Hall

Paper no: MBI-C304: Practicals

Credits: 12

Total Marks: 100 Marks



M.Sc. (BIO-INFORMATICS)
SEMESTER – IV

Paper no: MBI-C401: Taxonomy, Phylogeny and Biodiversity Informatics

Credits: 04

Total Marks: 100 Marks:
Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Unit	Detailed syllabus	Teaching Hours	Marks/Weight
Unit1	Basic concepts in Taxonomy and Phylogeny, Concepts in classical taxonomy, concepts in molecular evolution; Nature of data used in Taxonomy and Phylogeny: Morphological and molecular character data; Phylogenetic trees	12	20
Unit2	Phylogenetic analysis algorithms (Maximum Parsimony, Distance based: UPGMA, transformed Distance, Neighbour relation, Neighbour joining); Probabilistic models and associated algorithms (Probabilistic models of evolution, Maximum likelihood algorithm)	12	20
Unit3	Application of Phylogeny Analysis: Comparative methods for detection of species/ organism relationship; gene duplication, horizontal transfer, Domain evolution; study of co-evolution; viral evolution	12	20
Unit4	Biological diversity of life, taxonomic information on plants, animals microbes and viruses, species diversity, genetic diversity, ecosystem diversity, urban diversity, Metabolic diversity among microbes, methods for species identification	12	20
Unit5	Importance of organizing biological species information; Datasets in biodiversity informatics, Accessing existing database on the world wide web, software for identification of species	12	20

Break up of Continuous Internal Evaluation:

1. Assignment	10 Marks
2. Seminar	10 Marks
3. Test	10 Marks
Total marks	30 Marks

Reference/Textbook/Additional Reading:

1. RDM Page & EC Holmes. Molecular Evolution A Phylogenetic Approach. Blackwell Scientific.
2. D. Graur, WH Li. Fundamentals of Molecular Evolution. 2nd edition Sinauer Associates
3. Felsenstein, Inferring Phylogeny. Sinauer.
4. Krishnamurthy, K.V. An Advanced Textbook of Biodiversity. Oxford.
5. Xia. Data Analysis in Molecular Biology and Evolution. Kluwer Acad. Publ.

**Paper no: MBI-C402: Programming in Perl and Advanced Techniques for Bioinformatics Studies****Credits: 04**

Total Marks: 100 Marks:
 Semester End Examination: 70 Marks
 Continuous Internal Evaluation: 30 Marks

Unit	Detailed syllabus	Teaching Hours	Marks/Weight
Unit1	Introduction to Perl, Use of Perl in Bioinformatics, Scalar data; Arrays and list data; Control structures; Hashes; Regular Expressions, Subroutines.	12	20
Unit2	File handles and file tests, formats, Directory access, file and directory manipulations, Perl-script, Bioperl: Introduction, architecture and Basic modules	12	20
Unit3	Foundations for Machine Learning Techniques: Hidden Markov Model, Neural Network, Bayesian Modeling, The Cox- Jayne's Axiomes	12	20
Unit4	Advanced Techniques for sequence Analysis: sequence Profiles: Derivation, Databases, Application; Gapped BLAST, PSI-BLAST, PHI-BLAST; Advance techniques in Prediction of 3D Structure- Hidden Markov Model, Neural networks, Rossetta Stone	12	20
Unit5	Genetic Algorithms-sequence Alignments, Prediction of protein structure, Docking Simulations; Dynamic Programming-sequence alignment, structure alignment	12	20

Break up of Continuous Internal Evaluation:

1. Assignment 10 Marks
 2. Seminar 10 Marks
 3. Test 10 Marks
- Total marks 30 Marks**

Reference/Textbook/Additional Reading:

1. Tisdall JD, Beginning Perl for Bioinformatics, O'Reilly
2. Wallace, Perl Graphics Programming, O'Reilly
3. Srinivasan. Advanced Perl Programming.
4. Baxevanis A, Ouellette FE, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 2nd edition, Arthur Lesk. Introduction to Bioinformatics. Oxford Uni. Press.
5. CA Orenge, DT Jones & JM Thornton. Bioinformatics: Genes, Proteins, Computers. BIOS Sci. Publ. Ltd.
6. Schlick T. Molecular Modelling and Simulation An Inter disciplinary Guide, Springer
7. D. Higgins & W.Taylor. Bioinformatics: Sequence, Structure and Databanks: Practical Approach. Oxford Uni.Press.
8. Page G & Benson R. Algorithms in Bioinformatics. Springer
9. Mount DW, Bioinformatics: Sequence and Genome Analysis (2nd edition).
10. Baldi P, Brunak, S. Bioinformatics: The Machine Learning Approach, MIT Press.



Paper no: MBI-C403: Project

Credits: 08

Total Marks: **100 Marks:**
Semester End Examination: 70 Marks
Continuous Internal Evaluation: 30 Marks

Continuous internal evaluation: The project supervisor / guide will evaluate the student from 30 marks.

Term End examination: A project Viva to be conducted by external and/or internal examiners.

Each student will be required to carry out a mini project in an academic or industry location in the area of bioinformatics. The duration of the project will be 2 - 3 months. The student will have to make a presentation and submit a dissertation of the project work.

The objective of the project work is to provide students with practical experience in implementing substantive research project in bioinformatics and to practice the skills they have learnt from the taught components of the M.Sc. course.

Paper no: MBI-C404: Practicals

Credits: 12

Total Marks: **100 Marks**