SYLLABUS: M. Sc. Bioinformatics

Effective from August 2022

Semester I

BIN 401: Biological sciences, Statistics and Computer

UNIT-1: Origin and Evolution of Biology

- **Origin and evolution of life:** Introduction to living forms, classification, Phylogeny, endosymbiont theory and evolution in plants and animals.

- **Biodiversity types and distribution**: Diversity of plant and animal life: classification, distribution and types of diversity.

- **Microbial World:** Biology of bacteria, Viruses: Biology of viruses; bacteriophages, plant and animal viruses.

- **Mycology and phycology:** Introduction of fungi and pathology, Classification, structure, reproduction and importance. Phycology: Algae in diversified habitat, algal blooms, and uses of algae.

UNIT- 2: Computer - Hardware, Software and Networking

- **Computers:** Types of Computers, Input Process Output Cycle, Input / Output Devices Inside the CPU, (Motherboard, Processor, Ram, Rom) Storage Devices, S/W and Type of S/W.

- **Operating System:** Introduction to Windows, Files and Folders, Windows Explorer, MS Office.

- **Basics of Networking:** LAN-MAN-WAN, Network Components, Internet, Web Browsers, E-Mails, WWW.

UNIT- 3: Introduction to Bioinformatics

- **Bioinformatics:**An Introduction, Introduction about available Computational Tools and Databases on Bioinformatics sites, Biological Literature Information access, Storage and retrieval.

- **Bioinformatics Resources:** NCBI, EBI, ExPasy, Entrez & SRS System, Sequence analysis: Pairwise sequence alignment - NEEDLEMAN and Wunsch, Smith Waterman algorithms, Multiple sequence alignments - CLUSTAL and other different Bioinformatics Tools.

- **Database Similarity Searches**: BLAST, FASTA, PSI-BLAST algorithms

UNIT- 4: Mathematics and Biostatistics

- **Probability:** Basic concepts, Bayes's theorem. Probability Distribution: Binomial, Poisson, Normal Distributions with application in Biostatistics

- **Measures of Central Tendency and Dispersion:** Mean, Median, Mode, Variance, Standard Deviation, Quartile deviation.

- **Sampling Distributions:** Concepts, Sampling Distributions of Sample mean and proportions.

- **Hypothesis:** Z and t Distributions, F test. Chi Square Test: Goodness of fit, Independence of Attributes.

- **Correlation and Regression:** Introduction to Bivariate and Multivariate Regression using Computer softwares. Analysis of Variance: One way Classification using Computer softwares, Introduction to MS Excel and SPSS for data analysis

SUGGESTED READINGS:

1. Integrated principles of Zoology-by Cleveland P. Hickman
2. College Zoology-by Richard A. Boolootian and Karl A. Stiles
3. Bioinformatics - by David W. Mount, Cold Spring Harbor Laboratory Press
4. Bioinformatics Basics - By Hooman H. Rashidi, Lukas K. Buehler, CRC press
5. Introduction to Computers - Peter Norton, TMH6. The Internet: Christian   Crumlish
6. Textbook of Biostatistics By B Annadurai
7. A Textbook of Basic Statistics by J.P.Onyango & A.M. Plews
8. Fundamentals of Biostatistics: By W.W.Danial
9. Bioinformatics, Concepts Skills and Applications, S. C. Rastogi, Namita Mendiratta, Parag Rastogi
10. Introduction to Bioinformatics, Arthur M. Lesk

BIN 402: Biochemistry, Human physiology and immunology

UNIT- 1: Biochemistry

- **Amino acids:** Classification, protein & non-protein amino acids. Nucleic acid: Structure and types**.**

- **Proteins:** Biosynthesis, structure, properties of peptides, determination of amino acid sequence, and degradation of protein.

- **Carbohydrates:** Biosynthesis, structure, classification, function.

- **Lipids:** Structure, classification, nomenclature and degradation of lipids.

UNIT- 2: Enzymology

- **Enzymes**: Nomenclature and classification: active sites and specificity kinetics, factors affecting activity, interrelationships between initial velocity and substrate concentration,

- Michaelis-Menton, Km value, enzyme chain, multienzyme complexes, methods of plotting kinetics data, rapid reaction kinetics, relaxation kinetics.

- **Enzyme inhibition:** reversible and irreversible inhibitions and their types, kinetics of bisubstrate reactions, active site determination, regulation of enzymes, covalent modification, pace maker enzyme and pathways, allosteric control.

UNIT- 3: General Human Physiology

- **Transport mechanisms:** Food intake, digestion, absorption and elimination of undigested food, Excretion and osmoregulation. Respiration: Respiratory pigments, lung volumes and capacities, transport of gases, control of respiration.

- **Muscle physiology:** Types of muscles, chemistry of muscle contraction.

- **Neurophysiology:** Types of Neurons, Formation and conduction of nerve impulses, Reflexes.

- **Endocrine organs and its physiology:** Types and mechanism of hormome action, *In vitro* fertilization. Physiology of heart and circulation.

UNIT- 4: Immunology and Complement System

- **Innate and acquired immunity:** Cells and organs of the immune system. Antigens: Definition, types, general properties, adjuvant. Antibodies: Basic structure, antigenic determinants, and classes of immunoglobins, Antigen-Antibody interactions.

- **Vaccines:** Preparation, types and mode of action. Cytokines: General properties and functions, Complement system.

- **B Cell and T Cell : M**aturation, activation & differentiation of T-cell and B-cell, T-cell & B-cell receptors, Antigen presentation & processing, Effector's responses of Cell-Mediated & Humoral immunity.

- **Major Histocompatibility complex (MHC):** Structure, peptide interaction with MHC, Minor Histocompatibility (H) Antigens and dysfunctional immune conditions.

SUGGESTED READINGS:

1. Principles and techniques of biochemistry and Molecular Biology-by K.Wilson and Jwalk, 2006
2. Animal Physiology – By Mohan P. Arora
3. Principles of Anatomy and Physiology-by Tortora
4. Textbook of Medical Physiology- by gyton and hall
5. Principles of Biochemistry –by Lehninger ,Fifth Edition
6. Biochemistry 6e -by Stryer
7. Kuby Immunology, Sixth Edition

BIN 403: Classical and Molecular Genetics

UNIT - 1: Mendelian Genetics

- **Genetics** – principles of inheritance, pea as a model hybrids, extra chromosomal inheritance, chloroplast, mitochondria (genome and genes).

- Gene interactions, linkage and crossing over, genetic mapping.

- Extra genome and genes, Chromosome aberrations, ploidy, variation in structure and arrangement, mutagens. physical – chemical, molecular basis, recombination, transposons.

- Gene editing, FTO genes, CRISPR, Genetic surgery.

UNIT - 2: Molecular Genetics

- Molecular basis of genetics, experiments, DNA, characteristics, structure, forms of DNA, gene – genome, replication

- Genetic expression, transcription, code, translation, modification

- DNA barcoding methods,Present status, agencies involved and tasks ahead.

- Recent advances of molecular genetics in cancer, glaucoma, malaria , epilepsy, plant improvement programmes.

UNIT - 3: Genetic Engineering

- Recombinant DNA technology, restriction enzymes, gene cloning, choice of vectors.

- DNA-types, and RNA-types, DNA barcoding-methods, status, significance and challenges,Construction of genomic/ cDNA library, PCR

- DNA analysis, Southern – Northern blotting, sequencing, molecular markers, microarrays, RNA interference, small RNAs, microRNAs, RNAi based modifications

- BIG data - characteristics, architecture, technologies and applications

UNIT - 4: Biosafety, Bioethics and Patents

- Biosafety- bioethics, concept, objectives, risk assessment, containment, NIH guidelines and biosafety regulations
- IPR, patent, benefits, GATT, WTO, TRIPS, UPOV,
- Seed certification, release of varieties, Breeder's right, legislations.
- GMO, GM foods, nanomedicines, DBT guidelines for approval of transgenics, Bioethics in biodiversity and resource management

SUGGESTED READINGS:

8. Howell, S.H.1998. Molecular Genetics of Plant Development. Cambridge University Press, Cambridge.
9. Murphy, T.M. and Thompson, W.F. 1988. Molecular Plant Development. Prentice Hall, New Jersey.

10. Weshthoff, P. 1998. Molecular Plant Development: from Gene to Plant. Oxford University Press, Oxford, UK.
11. Atherly, A.G., Girton, J.R. and McDonald, J.F. 1999. The Science of Genetics. Saunders College Publishing, Fort Worth, USA.
12. Russel, P.J.1998. Genetics. The Benjamin/Cummings Publishing Co. Inc., USA.
13. Snustad, D.P. and Simmons, M.J.2000. Principals of Genetics. John Wiley & Sons, Inc., USA.
14. Stent, G.S. 1986. Molecular Genetics. CBS Publication.
15. Brown, T.A. 1999. Genomes. John Wiley & Sons (Asia) Pvt. Ltd., Singapore.
16. Chrispeels, M.J. and Sadava, D.E. 1994. Plants, Genes and Agriculture. Jones & Bartlett Publishers, Boston, USA.
17. Collin, H.A. and Edwards, S. 1998. Plant Cell Culture. Bios Scientific Publishers, Oxford, UK.
18. Primrose, S.B. 1995. Principals of Genome Analysis. Blackwell Science Ltd., Oxford, UK.

BIN 404: Fundamentals of Programming using 'C' Language

UNIT- 1: Concepts of Programming:

- **Programming concepts:** Programming domains, language evaluation criterion and language categories, evolution of the major Describing Syntax and Semantics, formal methods of describing syntax, programming languages.

- **Algorithms & Flow Charts:** Logic of programming, structure of flow chart.

UNIT- 2: Introduction to C

- **C-tokens:** Character set, variables and constants, keywords, Instructions, assignment statements, arithmetic expression, comment statements, simple input and output, Boolean expressions

- **Operators:** Arithmetic operators, Relational operators, logical operators.

- **Control statements:** Decision control structure, loop control, structure, case control structure.

UNIT- 3: Core C

- **Arrays and Strings:** Initializations, passing arrays to functions, multidimensional arrays, pointers and arrays, standard library string functions.

- **Functions:** functions, subroutines, scope and lifetime of identifiers, parameter passing mechanism, recursion.

UNIT- 4: Advanced C

- **Structures:** Defining, accessing structure elements, array of structures, structures and pointers, passing structures to a function.

- **Pointers:** Definition, pointer variables, applications, Dynamic memory allocation functions, Function returning Pointers.

- **File Handling:** File handling library functions, Input/Output operation on file; Error Handling during I/O operations.

SUGGESTED READINGS:

1. The C Programming Language by Brian W. Kernighan, Dennis M. Ritchie Publisher: Prentice Hall,Published: April 1, 1988,second edition
2. Beginner's Guide to C by Ivor Horton
3. How to Design Programs An Introduction to Computing and Programming by Matthias Felleisen Robert Bruce Findler Matthew Flatt Shriram KrishnamurthiThe MIT Press Cambridge, Massachusetts London, England
4. Programming in ANSI C by E Balagurusamy,Tata McGraw-Hill,Fourh Edition.
5. Programming With C by Byron s. Gottfried, Tata McGraw-Hill,New Delhi.

BIN 405PR: Practical – I: Based on topics covered in BIN 401 and BIN 402
BIN 406PR: Practical – II: Based on topics covered in BIN 403 and BIN 404

Semester II

BIN 407: Cytology

UNIT- 1: Membrane Systems

- **Plasma Membrane:**Structure, Models and Functions, Plasmodesmata: Structure and Functions.

- **Plant Vacuole:** Tonoplast Membrane; functions.

- **Nucleus:** Structure; Nuclear Pores; Nucleosome Organization.

UNIT– 2: Cytoskeleton and Organelles

- **Structure and function:** Microbodies, Golgi apparatus, Lysosomes and Endoplasmic Reticulum.

- The Cytoskeleton; Organization and Role of Microtubules and Microfilaments; Control Mechanisms; Role of Cyclins and Cyclin - dependent Kinases.

- **Cell Cycle and Apoptosis:** Mechanisms and types of PCD, PCD in plant life cycle.

UNIT– 3: Analytical Techniques

- **Spectroscopy:** Principle, types, components of spectrophotometer, type of detectors; UV-Visible Spectrophotometry, Beer-Lambert relationship, advanced spectroscopy, techniques and its applications.

- **Separation methods:** Principles of separation techniques, general methods of separation; methods based on polarity, ionic nature and shape.

- **Electrophoresis:** Principle, types, techniques, factors affecting electrophoresis, supporting medium, applications of electrophoresis in biology.

- **Centrifugation:** Principle, different density, types and applications.

- **Techniques in Cell biology**: FISH and Confocal microscopy

UNIT- 4: Plant Growth and Development

- **Photosynthesis:** Significance, historical aspects, PS I &PS II, mechanism of electron- Proton transport, carbon fixation (C3/C4/CAM), factors affecting photosynthesis, photorespiration.

- **Growth and Development**: Phase of growth and development; kinetics of growth; seed dormancy, seed germination and factors of their regulation; plant movements; photoperiodism; physiology of flowering; biological clocks; senescence, fruit ripening.

- **Plant hormones:** Growth regulators, history, biosynthesis and mechanism of action; photomorphogenesis; phytochromes and cryptochromess, their discovery, physiological role and mechanism of action.

Suggested Readings

1. Burgess, J. 1985. *An Introduction to Plant Cell Development.* Cambridge University Press, Cambridge.
2. Lyndon, R.F. 1990. *Plant Development. The Cellular Basis.* Unnin Hyman, London.
3. Gunning, B.E.S. and Steer, M. W. 1996. *Plant Cell Biology; Structure and Function*. Jones and Barlett Publishers, Boston, Massachusetts.
4. Hall, J.L. and Moore, A.L. 1983. *Isolation of Membranes and Organelles from Plant Cells*. Academic Press, London, UK.
5. Harris, N. and Oparka, K. J. 1994. *Plant Cell Biology: A Practical Approach*. IRL Press, at Oxford University Press, Oxford, U. K.
6. Molecular Biology of the cell- by B. ALberts, 2002
7. Molecular cell biology- by Lodish, 2002

BIN 408: Algorithms and Data Structure

UNIT- 1: Data Structure

- **Introduction to Data Structures**: Information and Meaning, Arrays in C.

- **Recursion:** Recursive definition and Processses, Recursion in C.

UNIT- 2: Computer Algorithms

- **Stack:** Defination and Examples, Representing Stacks in C.

- **Queues and Lists:** The queue and its sequential representation, linked lists, lists in C, Other list structures.

- **Trees:** Binary trees, Binary Tree Representations, Trees and their applications.

UNIT- 3: Design and Efficiency of Algorithm

- **Computer Algorithms**: Introduction to Computer Algorithms and Complexity, Algorithm Design Techniques.

- **Efficiency of Algorithms:** (O – Notations), Types of Algorithms.

UNIT- 4: Sorting and Searching of Algorithms

- **Sorting Algorithms and Searching Algorithms:** Bubble sort, selection sort, Insertion sort, merge sort, sequential search, binary search.

- **Bio Algorithms:** Dynamic programming algorithms, Genetic algorithms.

SUGGESTED READINGS:

1. An Introduction to Bioinformatics Algorithms, Neil C Jones & Pavel A. Pevzner, Ane Books, 2005.
2. Introduction to Computational Molecular Biology , Setubal and Meidanis, Thomson, 2003.
3. Data Structures Using C by Aaron M. Tenenbaum
4.Data Structures and Algorithms: Annotated Reference with Examples by Granville Barnett and Luca Del Tongo, Publisher: DotNetSlackers 2008
5. Algorithms in C, Parts 1-4: Fundamentals, Data Structures, Sorting, Searching (3rd Edition) (Pts. 1-4) by Robert Sedgewick (Paperback - Sep 27, 1997)
6. Data Structures, Algorithms, and Software Principles in C [Paperback] Publisher: Addison Wesley, October 10, 1994

BIN 409: Data Base Management System (DBMS)

UNIT- 1: DBMS and SQL

- **Introduction**: Types of DBMS, DBMS Architecture.

- **DBMS**: Introduction to Database Management Systems, Database Design using E/R Diagrams and normalization, forms of normalization.

UNIT- 2: SQL and PLSQL

- **Using a DBMS:** Creating a Database, Dropping a Database, Database properties.

- **Tables:** Creating a table, Altering a table, Table Contraints and Keys.

- **SQL Commands:** Select Command, DML Commands (Insert-Update-Delete), Nested Queries.

UNIT- 3: Biological Databases

- **Primary Sequence & Structure Databases:** Genbank, SwissProt/Uniprot, EMBL, PIR, PDB, MMDB, NDB, CSD, KEGG.

- **Derived (Secondary) Databases of Sequences and Structure:** Prosite, PRODOM, PRINTS, Pfam, BLOCK, INTERPRO, SSOP, CATH, DSSP, FSSP, RNAbase.

- **Genome Databases**: At NCBI, EBI, TIGR, SANGER, High-throughput genomics.

- Sequences (EST, STS, GSS), ENSEMBL

UNIT- 4: Advance Databases Concepts and Applications

- **Data Mining**: Data Mining on relational databases, Data Warehouses, Transactional databases,

- Data Mining Functionalities, Pattern Mining, Data Mining on Biological data

SUGGESTED READINGS:

1. Introduction to Database Management Systems by Henry F. Korth
2. Ivan Bayross, Database Technologies, Sybex Computer Books Inc
3. Database Systems, Raghu Ramakrishnan
4. Developing Bioinformatics Computer Skills. Oreilly Publications
5. Managing Scientific Data, Zoe Lacroix, Morgan Kaufmann Publishers
6. Bioinformatics, Kenneth Baclawski, Tianhua Niu
7. Fundamentals of Data Mining in Genomics and Proteomics, Werner Dubitzky, Martin Granzow, Daniel P. Berrar Springer Publications

BIN 410: Java and Advanced Java

UNIT- 1: OOP and JAVA

- **Introduction to OOP:** Introduction to Java Language: History, Features of JAVA.

- **Elements of Java Language:** Data types, Literals, Operators.

- **Programming Constructs:** Conditional Constructs, Looping Constructs.

- **Arrays:** Single Dimension Arrays, Two Dimension Arrays, Multi Dimension Arrays.

- **Classes and Objects:** Encapsulation, Access Modifiers, Data Members and Acessor Methods and Parameter passing, using polymorphism using Method Overloading.

UNIT- 2: Core Java

- **Constructors and Destructors:** Default Constructors, Overloaded constructors, Finalize method and garbage collection.

- **Inheritance and Interfaces:** Types of inheritance, Method overriding, Abstraction, Interfaces.

- **Exception Handling:** Exception Hierarchy, Try Catch block, Finally block, Throwing exceptions declaratively.

- **Streams in Java:** File handling in Java using java.io package, Reading and writing files byte by byte, Reading and writing files char by char, File object.

Unit – 3: GUI and Applets in JAVA

- **GUI in Java**: Difference between AWT and windows, Controls in JAVA, MVC structure.

- **Event Handling in Java:** Event Delegation Model, Listeners, Adapters.

- **Applets**: Use of AppletViewer, Creating and using Events in Applets.

Unit – 4: Advance Java and Applications

- **Collections:** Collection Hierarchy, Lists, Sets and Hash Maps, Threads.

- **JDBC – ODBC:** Types of JDBC ODBC Drivers, Connection Object, Statement and ResultSet Objects, Practical application of concepts gathered in JAVA.

Suggested Readings:

1. The Complete Reference Java 2Tata McGraw Hill
2. Thinking in Java By Bruce Eckel
3. Java in NutShell Oreilly Media
4. Java Secretes, Ellootte Rusty Harold
5. Effective Java, Joshua Brocks
6. Core Java Volume I & II, Cay S. Horstmann

BIN 411PR: Practical – I: Based on topics covered in BIN 407 and BIN 409
BIN 412PR: Practical – II: Based on topics covered in BIN 408 and BIN 409

Semester III

BIN 501: Perl Programming

UNIT- 1: Introduction to Perl

- **Getting started with PERL:** Scalar values and scalar variables, strings and numbers, Assignment statements, Operators.

- **Control Structures:** Conditional constructs and Loops, Input from STDIN.

UNIT- 2: Core Perl

- **Collections:** Blocks, Arrays, Hashes**.**

- **File Handling**: Input from file named in command line, IO, Input from file.

UNIT- 3: Advance Perl

- **Regular expression**: Pattern matching, Meta symbols, Pattern modifiers.

- **Subroutines & Modules:** User Defined Functions, Parameter passing.

UNIT- 4: Perl Applications

- **Built-in functions in Perl:** String Functions, Creating and managing Packages.

- **CPAN:** Introduction to CPAN, How to use CPAN.

- **Introduction to Bio Perl**: Introduction to BioPerl, BioPerl Components.

SUGGESTED READINGS:

1. Perl 6 Essentials - O'Reilly Press
2. The Complete PERL Training Course, Deitel Deitel Nieto and McPhie
3. Beginning Perl for Bioinformatics, James Tisdall, Oreilly Media
4. Learning Perl, Tom Phoenix, Randall Schwartz, Oreilly Media
5. Programming Perl, Larry Wall, , Oreilly Media
6. Sams Teach Yoursel Perl in 21 days, Laura Lemay
7. Mastering Regular Expressions, Jeffrey E. F. Friedl, Oreilly Media

BIN 502: Linux and System Development

UNIT- 1: Introduction to Linux O.S.

- **Introduction to O.S:** Types, Charateristics, Available Options**.**

- **Linux as O.S:** Benfits of Linux, Structure, Kernal, file System, available options.

- **Working with Linux Desktop**: Installation of Linux, Installing softwares, creating users, printing, etc.

UNIT- 2: Linux Commands and Filters

- **General Commands**: ls, clear, man, date, cal, echo, cat.

- **File and Directory Commands**: mv, rm, cp, pwd, mkdir, file comparision commands, cuting and pasting.

- **Advance Commands:** head, tail, wc, bc, tee, uname, sudo, ispell, sort, merge, uniq, tr, granting previllages.

Unit –3: Linux Shell Scripts and Advance Topics

- **Filters:** pipe, grep, sed, awk.

- **Shell Scripts:** shell, bash, essentials - command line arguments, using arguments in Shell scripts.

- **Controls Structures**: if-elif-else-fi, case-esac, for loop, while loop.

- **Network Utilities**: Network Configuration and Utilities, FTP clients, Terminal Servers Client.

- **Development Environment:** Introduction to various Development Tools – Eclipse.

- **Advancement in Linux:** Advancements, Currrent Research and Developments in Linux, Applicaiton in research.

Unit –4: System Development Concepts, Analysis and Designing

- **Basic concepts of System development:** System development life cycle.

- **System analysis tools:** System designing tools.

SUGGESTED READINGS:

1. Operating Systems by Galvin, Addison Wessely
2. Modern Operating Systems by S. Tanenbaum, Prentice Hall (India)
3. Operating Systems Concept and Design by Milan Milenkovic,Tata McGraw Hill
4. Linux Pocket Guide Oreilly Media
5. Unix Concepts and Apllications by Sumitabha Das, Tata McGraw Hill
6. Modern Operating Systems – Andrew S. Tanenbaum, PHI Publications

BIN 503: Genomics and Proteomics

UNIT- 1: Computational Genomics

- **Concepts of genomics:** Importance of genome comparison: Genome alignments, BLAST2, Mummer, Pipmaker, VISTA.

- **Comparison of Gene Order**

- **Genome database:** Understanding of and exploration of comparative Genomics database (SNP, dbSNP and SNP related databases).

- Genome databases and related resources (EST, STS, GSS).

UNIT- 2: Protein Structure and Computational Proteomics

- **Structure Analysis:** Prediction of secondary structure: STRIDE, PHD, PSI-PRED.

- **Tertiary structure prediction**: Homology modeling, Threading approaches, Ab-initio methods.

- **Anatomy of Proteins:** Ramachandran plot, Protein structure Motif, Domains, Folds, principal of protein folding.

- **Concept of proteomics:** Studies of protein related databases and DIP, PPI server, BIND, PIM.

UNIT- 3: Molecular Interactions and Gene Expression Studies

- **Molecular interactions:** Protein–protein interaction, Protein–DNA interaction, DNA–Small molecule interaction, Protein – carbohydrate interaction.

- **Path calling yeast interaction**

UNIT- 4: Phylogeny

- **Phylogeny:** Distance methods (UPGMA, Neighbour joining, felestein), Distance models (Juke Cantor model, Kimura, Feleistein), Character methods (Max. Likelihood, Max parsimony).

- **Algorithms and Techniques:** Algorithm and sums of all the distance method to calculate the genetic distance, Tree evaluation techniques (Boot strap, Jack knife, Jumbling Sequence).

- **Application of phylogenesis**

- **Gene duplication, Horizontal Gene transfer**

SUGGESTED READINGS:

1. The Phylogenetic Handbook: A Practical Approach to DNA and Protein Phylogeny -by Marco Salemi and Anne-Mieke
2. Bioinformatics - by David W. Mount, Cold Spring Harbor Laboratory Press
3. Bioinformatics, Concepts Skills and Applications, S. C. Rastogi, Namita
   Mendiratta, Parag Rastogi
4. Introduction to Bioinformatics, Arthur M. Lesk

BIN 504: Drug Discovery and Pharmacogenomics

UNIT- 1: Drug Discovery Concepts

- **Computer aided molecule modeling and drug discovery:** *In silico* drug designing.

- Identification of disease gene.

- Genetics of drug metabolism therapeutic targets.

- Interaction of molecules and gene based drug target.

UNIT- 2: Drug Design Techniques and Molecular Modeling

- **Analysis of protein sequences and epitope predictions:** Interactions of epitope with antibody, MHC molecule and TCR**.**

- Design of ligands for known macromolecules.

- **Ligand based computational approaches:** QSAR and Pharmacophore methods.

- **Molecular modeling and simulations:** Concept of molecular simulation, Simulation techniques, application with molecular docking.

UNIT- 3: Pharmacogenetics And Pharmacogenomics

- **Introduction:** Historical perspectives, current view of Pharmacogenetics, Pharmacogenetics.

- **Biomarkers:** Promise of personalized medicine. Genetic drug response profiles, effect of drug on gene expression.

- **Pharmacogenomics**: In drug discovery and drug development. Current status of pharmacogenetics, drug metabolism.

UNIT- 4: Advancements in Bioinformatics

- **Epigenetics and biological software:** Tools and databases.

- **Advance biological databases and tools:** DNA microarray**:** Understanding of microarray data, normalizing microarray data, detecting differential gene expression, co-relation of gene expression data to biological processes and computational analysis tools**.**

- Databases and basic tools, gene expression omnibus (GEO), Array express, SAGE database

SUGGESTED READINGS:

1. Bioinformatics - by David W. Mount, Cold Spring Harbor Laboratory Press
2. Bioinformatics: From Genomes to Drugs, T. Lengauer, et al., Wiley-VCH, 2002
3. Burger's Medicinal Chemistry and Drug Discovery @ 6th ed.c Volume 1

4. Drug Discovery Handbook, S. Gad, John Wiley & Sons,2005
5. Bioinformatics, Concepts Skills and Applications, S. C. Rastogi, Namita
   Mendiratta, Parag Rastogi

BIN 505PR: Practical – I: Based on topics covered in BIN 501 and BIN 502
BIN 506PR: Practical – II: Based on topics covered in BIN 503 and BIN 504

Semester IV

BIN507E: Competence enhancement

UNIT- 1: Knowledge Enhancement

- Seminars- in house 0.25/sem.

- Attend participate elsewhere with certificate.

- Assignment with write-up and documentation under guidance.

UNIT- 2: Skill Development

- Workshop-training- on techniques/Industrial training.

- Certificate of completion.

- For 3 days

- For 6 days

UNIT- 3: Capacity Building

- Excursion-with report

- For 3 days

- For 6 days

- Visit to institute-for industrial/institutional with certificate of completion.

- For 2 institutions

- For 4 institutions

UNIT- 4: Proficiency

- Scientific Writing 1 period/15 days.

- Soft skill 1 period/15 days.

- Communicative English 1 period/15 days.

BIN508E: Seminar/Presentation/Tutorial

BIN 509PT: Project Proposal

- Completion under guidance with write –up including introduction, problem, aim, Literature survey, methodology, probable outcome, bibliography and enclosures.