Dr. MGR - JANAKI COLLEGE

VELS

INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University under Section 3 of the UGC Act, 1956)
(ADYAR CAMPUS)

UNDERGRADUATE DEGREE PROGRAMME

B.Sc., BIOINFORMATICS (GENOMICS, BIOTECHNOLOGY & ARTIFICIAL INTELLIGENCE) Three Years

CURRICULUM & SYLLABUS

REGULATION 2024

Learning Outcomes Based Curriculum Framework (LOCF)

Effective from the Academic Year

2026 -2027

Department of Bioinformatics

CURRICULUM STURCTURE

Programme: B.Sc. BIOINFORMATICS

(Genomics, Biotechnology & Artificial Intelligence)

	B.Sc., Bioinformatics (Genomics, Biotechnology & Artificial Intelligence) Minimum Credits to be earned: 132									
	SEMESTER I									
			Hours/Week					Maximum Marks		
Category	**Code**	**Course**	**L**	**T**	**P**	**SL**	**C**	**CIA**	**SEE**	**Total**
DSC		Fundamentals of Biology	4	0	0	2	4	40	60	100
DSC		Biomolecules & Biochemistry	4	0	0	2	4	40	60	100
DSC		Introduction to Bioinformatics	4	0	0	2	4	40	60	100
AEC		Basics of Cheminformatics	3	0	0	2	3	40	60	100
GE		Practical I – Introduction to Bioinformatics	0	0	6	2	3	40	60	100
VA		Communication Skills	2	0	0	1	2	40	60	100
SEC		Computer fundamentals for Life science	2	0	0	1	2	40	60	100
SEC		Indian Sign Language (Basic)	2	0	0	1	2	40	60	100
			21	0	6	13	24			

CIA - Continuous Internal Assessment **SEE - Semester End Examination**

***L – Lecture, *P- Practical, *SL (Self-Learning), *C- Credits**

SEMESTER 2										
Category	**Code**	**Course**	**L**	**T**	**P**	**SL**	**C**	**CIA**	**SEE**	**Total**
DSC		Molecular Cell Biology & Genetic Engineering	4	0	0	2	4	40	60	100
DSC		Microbiology & Immunology	4	0	0	2	4	40	60	100
DSC		Programming in C and C++	4	0	0	2	4	40	60	100
AEC		Practical II – Computer Programming in C and C++	0	0	6	2	3	40	60	100
GE		Environmental Studies	3	0	0	2	3	40	60	100
VA		Principles of Drug Discovery	2	0	0	1	2	40	60	100
SEC		Bioethics, Biosafety & IPR	2	0	0	1	2	40	60	100
SEC		Indian Sign Language (Advanced)	2	0	0	1	2	40	60	100
			21	0	6	13	24	-	-	-

CIA - Continuous Internal Assessment SEE - Semester End Examination

***L – Lecture, *T- Tutorial, *P- Practical, *SL (Self-Learning) *C- Credits**

SEMESTER 3										
			Hours/Week					Maximum Marks		
Category	**Code**	**Course**	**L**	**T**	**P**	**SL**	**C**	**CIA**	**SEE**	**Total**
DSC		Genomics & NGS	4	0	0	2	4	40	60	100
DSC		Fundamentals of Biotechnology	4	0	0	2	4	40	60	100
DSC		Biological Databases and Resources	4	0	0	2	4	40	60	100
AEC		Artificial Intelligence and Applications in Biological Sequence Analysis	3	0	0	2	3	40	60	100
GE		Practical III – Biological Sequence analysis and Computer Aided Drug Design	0	0	6	2	3	40	60	100
VA		Microbial Genomics	2	0	0	1	2	40	60	100
SEC		Good laboratory practice	2	0	0	1	2	40	60	100
			19	**0**	**6**	**12**	**22**			

CIA - Continuous Internal Assessment SEE - Semester End Examination

***L – Lecture, *T- Tutorial, *P- Practical, *SL (Self-Learning) *C- Credits**

SEMESTER 4										
			Hours/Week					Maximum Marks		
Category	**Code**	**Course**	**L**	**T**	**P**	**O**	**C**	**CIA**	**SEE**	**Total**
DSC		Proteomics	4	0	0	2	4	40	60	100
DSC		Systems biology	4	0	0	2	4	40	60	100
DSC		Biostatistics	4	0	0	2	4	40	60	100
AEC		Bioinformatics Algorithm and Machine Learning	3	0	0	2	3	40	60	100
GE		Practical IV – Statistical Data Analysis and R Programming	0	0	6	2	3	40	60	100
VA		Internship/mini project	2	0	0	1	2	40	60	100
SEC		Entrepreneurship in Life Sciences	2	0	0	1	2	40	60	100
			19	**0**	**6**	**12**	**22**			

CIA - Continuous Internal Assessment **SEE - Semester End Examination**

***L – Lecture, *T- Tutorial, *P- Practical, *SL (Self-Learning) *C- Credits**

SEMESTER 5										
			Hours/Week					Maximum Marks		
Category	**Code**	**Course**	**L**	**T**	**P**	**SL**	**C**	**CIA**	**SEE**	**Total**
DSC		Metagenomics	4	0	0	2	4	40	60	100
DSC		PERL and Python Programming for Bioinformatics	4	0	0	2	4	40	60	100
DSC		Practical V – Bio programming using PERL and Python	0	0	8	2	4	40	60	100
AEC		Research Methodology	3	0	0	2	3	40	60	100
GE		HTML and Web Designing	3	0	0	2	3	40	60	100
VA		Medical Coding	2	0	0	1	2	40	60	100
SEC		Internship /Industry exposure	2	0	0	1	2	40	60	100
			18	**0**	**8**	**12**	**22**	-	-	-

CIA - Continuous Internal Assessment SEE - Semester End Examination

***L – Lecture, *T- Tutorial, *P- Practical, *SL (Self-Learning) *C- Credits**

SEMESTER 6										
			Hours/Week					Maximum Marks		
Category	**Code**	**Course**	**L**	**T**	**P**	**SL**	**C**	**CIA**	**SEE**	**Total**
DSC		Molecular Modeling	4	0	0	2	4	40	60	100
DSC		Practical VI - Genomics and Molecular Modeling and Drug Design Lab	0	0	8	2	4	40	60	100
Project		Research Project	0	0	8	2	12	40	60	100
SEC		Project Proposal Writing Skills	2	0	0	1	2	40	60	100
			6	**0**	**16**	**7**	**22**			

CIA - Continuous Internal Assessment **SEE - Semester End Examination**

***L – Lecture, *T- Tutorial, *P- Practical, *SL (Self-Learning) *C- Credits**

SEMESTER I

FUNDAMENTALS OF BIOLOGY

L	T	P	SL	C
4	0	0	2	4

Course Objectives:

- To provide fundamental knowledge of Biochemistry and the chemical basis of life.
- To understand the structure, classification, and functions of major biomolecules such as carbohydrates, lipids, proteins, and nucleic acids.
- To explain enzyme mechanisms, enzyme kinetics, and factors affecting enzyme activity.
- To develop knowledge of metabolic pathways, bioenergetics, and their regulation.
- To understand the role of vitamins, minerals, and hormones in maintaining physiological balance.

UNIT-I **12 Hours**

Introduction to cells: Cell as unit of life- Structure of prokaryotic and eukaryotic cells. Cell organelles (Mitochondria, chloroplasts, ER, Golgi, ribosomes, lysosomes and peroxysomes, nucleus and nucleolus) and their functions. Differences and similarities between plant and animal cells.

UNIT-II **12 Hours**

Cell transport: Cell transport across plasma membrane. Mechanisms of transport. Cell reproduction, cell cycle, Check points, Mitosis and Meiosis. Operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons.

UNIT-III **12 Hours**

Cell Energetics: Aerobic oxidation and photosynthesis, Utilization of glucose, Role of ATP in energy cycle- Phosphorylation. Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

UNIT-IV **12 Hours**

Taxonomic classification of Plant: Introduction-Definition and basic concepts of biosystematics and taxonomy. Plant identification – Plant ecology - Plant classification (Bentham and Hooker's) Cytotaxonomy – Chemotaxonomy – Numerical Taxonomy – Nomenclature.

UNIT-V **12 Hours**

Taxonomic classification of animals. Animal classification –Animal kingdom – Kingdom, phylum, Class, order, family, Genus, species- Importance and application of taxonomic classification.

Total Hours: 60 Self Learning : 60

Course Outcomes:

CO1: Explain the fundamental concepts of Biochemistry and the chemical basis of life.
CO2: Describe the structure, classification, and biological functions of major biomolecules including carbohydrates, lipids, proteins, and nucleic acids.
CO3: Interpret the principles of enzyme action, enzyme kinetics, and various types of enzyme inhibition.
CO4: Analyze major metabolic pathways such as glycolysis, TCA cycle, and lipid and protein metabolism along with their bioenergetics.
CO5: Evaluate the role of vitamins, minerals, and hormones in metabolic regulation and maintenance of physiological homeostasis.

TEXT BOOKS:

1. Biology by Martha R. Taylor, Neil A. Campbell, Jane B. Reece, 2007, Pearson/Benjamin Cummings.
2. Biological science-D.J.Taylor, N.P.O.Green, G.W.Stout, III-Edition Cambridge University press, New Delhi, 2007.

REFERENCE BOOKS:

1. Molecular Biology of the Cell, Bruce Alberts, 6th Edition, Garland Science, 2014 – Covers cell structure, organelles, cell cycle, and mitosis/meiosis.
2. Cell Biology, Gerald Karp, 8th Edition, Wiley, 2019 – Detailed explanation of cell transport, energetics, and ATP role in metabolism.

BIOMOLECULES AND BIOCHEMISTRY

L	T	P	SL	C
4	0	0	2	4

COURSE OBJECTIVES

- To understand the structure and function of biological molecules
- To explain biochemical processes occurring in living systems
- To develop knowledge of metabolic pathways and their regulation
- To relate biochemical concepts to physiological functions

UNIT I: Basic Concepts and Carbohydrates — 12 Hours

Scope and importance of Biochemistry - Chemical basis of life: atoms, molecules, chemical bonds - Water: properties, pH, buffers and biological significance. Carbohydrates: Classification and structure - Isomerism and stereochemistry - Monosaccharides, disaccharides, polysaccharides - Glycosidic bonds and biological functions

UNIT II: Lipids and Proteins — 12 Hours

Lipids: Classification and properties - Fatty acids (saturated and unsaturated) - Triglycerides, phospholipids, glycolipids - Cholesterol and biological importance.
Proteins: Amino acids: classification and properties - Peptide bond and protein structure (primary to quaternary) - Protein folding and denaturation - Biological functions of proteins

UNIT III: Nucleic Acids and Enzymes — 12 Hours

Nucleic Acids: Structure of DNA and RNA - Nucleotides and nucleosides - DNA replication - Types and functions of RNA - Genetic code and protein synthesis
Enzymes: Classification and nomenclature - Mechanism of enzyme action - Enzyme kinetics (Michaelis-Menten equation) - Factors affecting enzyme activity - Enzyme inhibition

UNIT IV: Metabolism and Bioenergetics — 12 Hours

Overview of metabolism: anabolism and catabolism - Carbohydrate metabolism: Glycolysis, Tricarboxylic Acid (TCA) Cycle, Glycogen metabolism - Lipid metabolism (β-oxidation of fatty acids) Protein metabolism (transamination, deamination, urea cycle) - Bioenergetics: ATP and energy production

UNIT V: Vitamins, Hormones and Regulation — 12 Hours

Vitamins: Classification (fat-soluble and water-soluble) - Functions and deficiency disorders. Minerals: biological roles. Hormones: Types (peptide and steroid hormones) - Mechanism of hormone action - Regulation of metabolic pathways.

Total Hours: 60 Self Learning : 60

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

- **CO1**: Describe the structure and function of major biomolecules
- **CO2**: Explain enzyme kinetics and mechanisms
- **CO3**: Interpret metabolic pathways and their regulation
- **CO4**: Apply biochemical knowledge in biological and medical contexts
- **CO5**: Analyze major metabolic pathways along with their energy dynamics.

TEXT BOOKS:

1. Lehninger Principles of Biochemistry, David L. Nelson & Michael M. Cox, 8th Edition, Macmillan Higher Education, 2021.
2. Biochemistry, Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto Jr., Lubert Stryer, 10th Edition, W. H. Freeman, 2019–2023.
3. Harper's Illustrated Biochemistry, Victor W. Rodwell, David A. Bender, Kathleen M. Botham, Peter J. Kennelly, P. Anthony Weil, 31st Edition, McGraw-Hill Education, 2018.

REFERENCE BOOKS:

1. Biochemistry, U. Satyanarayana & U. Chakrapani, 5th Edition, Elsevier India, 2017.
2. Textbook of Biochemistry for Medical Students, D. M. Vasudevan, Sreekumari S., Kannan Vaidyanathan, 10th Edition, Jaypee Brothers Medical Publishers, 2021.
3. Lippincott Illustrated Reviews Biochemistry, Denise R. Ferrier, 7th Edition, Wolters Kluwer, 2017.
4. Biochemistry, Donald Voet & Judith G. Voet, 4th Edition, John Wiley & Sons, 2011.

INTRODUCTION TO BIOINFORMATICS

L	T	P	SL	C
4	0	0	2	4

COURSE OBJECTIVES

- To introduce the scope, history, and interdisciplinary nature of bioinformatics and its applications in modern biology and medicine.
- To provide knowledge of biological databases for nucleic acids, proteins, and structural data, and teach methods to retrieve and analyze information.
- To explain sequence analysis, including pairwise and multiple sequence alignment, scoring matrices, and phylogenetic analysis.
- To develop an understanding of genomics and proteomics, including genome annotation, functional analysis, and protein structure prediction.
- To familiarize students with computational tools, software, and applications of bioinformatics in molecular modeling, drug design, and systems biology.

UNIT I: Introduction to Bioinformatics 12 Hours

Introduction, scope, and Importance of Bioinformatics; Brief history and development - Role in Molecular biology, Genomics, Proteomics, and Drug discovery. Bioinformatics as an interdisciplinary field integrating biology, computer science, and statistics- Overview of Bioinformatics applications in research and medicine.

UNIT II: Biological Databases 12 Hours

Types and classification of biological databases: Primary (GenBank, EMBL, DDBJ), Secondary (Swiss-Prot, PIR), and Specialized databases; Database searching and retrieval - Introduction to Nucleotide, Protein, and Structural databases; Sequence accession numbers – Database cross-references; BLAST and FASTA search algorithms.

UNIT III: Sequence Analysis 12 Hours

Sequence alignment methods: Pairwise sequence alignment, Dot matrix analysis, Global and Local alignment; Scoring matrices (PAM, BLOSUM); Multiple sequence alignment;

Phylogenetic analysis - Introduction to Motifs, Patterns, and Domain prediction - Use of Bioinformatics tools for Sequence Visualization.

UNIT IV: Genomics and Proteomics 12 Hours

Introduction to genomics: Genome sequencing projects, Genome annotation, Comparative genomics - Transcriptomics: Microarrays and RNA-seq; Proteomics: Protein structure prediction, Protein-Protein Interaction databases, Mass Spectrometry data; Functional Genomics - Introduction to Systems biology.

UNIT V: Bioinformatics Tools and Applications 12 Hours

Computational tools for Molecular Modeling, Structural Bioinformatics, Docking studies, Molecular dynamics - Introduction to software packages like Clustal Omega, MEGA, PyMOL, and Swiss-Model - Applications in drug design, Evolutionary biology, Molecular medicine, and Personalized genomics - Challenges and Future directions in Bioinformatics.

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1: Explain the scope, history, and applications of bioinformatics in modern biology and medicine.
CO2: Describe the organization, types, and usage of biological databases for nucleic acids and proteins.
CO3: Apply sequence alignment methods, including pairwise and multiple sequence alignment, and interpret results.
CO4: Analyze genomic and proteomic data using bioinformatics tools for functional annotate on and structural prediction.
CO5: Demonstrate the use of computational tools and software in molecular modeling, phylogenetics, and biological data visualization.

Total Hours: 60 Self Learning : 60

TEXT BOOKS:

1. Introduction to Bioinformatics, Arthur Lesk, 5th Edition, Oxford University Press, 2019 – Covers databases, sequence analysis, genomics, and proteomics with practical examples.

2. Bioinformatics: Sequence and Genome Analysis, David W. Mount, 2nd Edition, Cold Spring Harbor Laboratory Press, 2004 – Classic reference for sequence alignment, genomics, and database searching.

3. Essential Bioinformatics, Jin Xiong, 3rd Edition, Cambridge University Press, 2014 – Provides a concise introduction to bioinformatics concepts and applications for beginners.

REFERENCE BOOKS

1. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Andreas D.
2. Baxevanis & B. F. Francis Ouellette, 3rd Edition, Wiley-Interscience, 2005 – Practical examples and hands-on exercises.

3. Fundamentals of Bioinformatics and Computational Biology, S. C. Rastogi, N. Mendiratta, P. Rastogi, 2nd Edition, PHI Learning, 2013 – Covers fundamentals, algorithms, and computational methods.

4. Computational Biology: A Practical Introduction to BioData Processing and Analysis with Linux, MySQL, and R, Röbbe Wünschiers, 1st Edition, Springer, 2016 – Provides practical computational approaches and programming tools for bioinformatics.

BASICS OF CHEMINFORMATICS

L	T	P	SL	C
3	0	0	2	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- To make the students understand the basics of cheminformatics and their application.
- To aware the various chemical information sources.
- To analyze the pharmacokinetic properties of small molecules using ADMET calculation.
- To understand the steps in pro drug design.
- To utilize the bioinformatics tools and software in different aspects.

UNIT I: Basic Mathematics and Statistics 9 hours

Graph theory and molecular numerology; Logic, sets and functions; Algorithms, integersand matrices; Mathematical reasoning, induction and recursion; Counting; graphs, trees and sets, basic probability and statistics; Markov processes.

UNIT II: Foundations of Chemistry and Biology 9 hours

Basic Stereochemistry, Group Theory, Amino acids and Proteins and Properties; pKa, pH and ionization of acids and bases; Protein structure - Primary structure, Secondary structure - helix & sheet; Tertiary structure; Quaternary structure; covalent and non-covalent forces that maintain structures. Physical properties of proteins - charge, size, hydrophobic, protein binding – structural aspects; antibodies; transport; nucleotide binding; catalytic enzymes; basic concepts of combinatorial chemistry. Introduction to drug action, pro drug design and applications.

UNIT III: Chemical information sources 9 hours

History of scientific information communication-chemical literature-chemical information-chemical information search-chemical information sources-chemical name and formula searching-analytical chemistry-chemical history-biography-directories and industry sources.

UNIT IV: Bioinformatics **9 hours**

Introduction; Experimental sources of biological data; Publicly available databases; Gene expression monitoring; Genomics and Proteomics; Metabolomics; Visualization of sequence data; Visualization of structures using Rasmol or SPDB Viewer or CHIME; Genetic basis of disease; Personalized medicine and gene-based diagnostics; Legal, ethical and commercial ramifications of bioinformatics**.**

UNIT V: Pharmaceutical applications of molecular modeling **9 hours**

Introduction to drugs, structure-based drug design. QSAR and 3D-QSAR Methods. Pharmacophore Design, Ligand-Based Design and De Novo Drug Design Virtual screening/docking of ligands. Protein structure. Drug action enzymes. Drug action receptors. Drug design target interaction. Prediction of Binding Modes, Protein– ligand binding free energies, Fragment-Based Drug Design; Absorption, Distribution, Metabolism, Ex cretion & Toxicology (ADMET) prediction; Calculation of Physico-Chemical Properties, Biological and Physico-Chemical Predictive Model Building.

COURSE OUTCOMES:

On the successful completion of the course, student will be able to:
CO1: To make the students understand the basics of cheminformatics and their application.
CO2: To aware the various chemical information sources.
CO3: To analyze the pharmacokinetic properties of small molecules using ADMETcalculation.
CO4: To understand the steps in pro drug design.
CO5: To utilize the bioinformatics tools and software in different aspects.

Total Hours: 45 Self Learning : 45

TEXT BOOKS:

1 Mathematical Methods for Physicists Arfken, Academic Press1985
2 Molecular Modeling: Basic Principles and Applications, 3rd Edition,Hans-Dieter Höltje, Wolfgang Sippl, Didier Rognan,GerdFolkers

REFERENCE BOOKS:

1 Introduction to Bioinformatics, Teresa K. Attwood, DavidParry-Smith
2 Combinatorial Chemistry and Molecular Diversity in Drug Discovery, Eric M. Gordon, James F.Kerwin
3 Introduction to Protein Structure: Second Edition, Carl Branden, JohnTooze

PRACTICAL I – INTRODUCTION TO BIOINFORMATICS

L	T	P	SL	C
0	0	6	2	3

COURSE OBJECTIVES:

- To learn about the bioinformatics databases, databanks and data format data retrieval from the online sources.
- To make students understand the essential features of the interdisciplinary field of science for better understanding biological data.

1. Literature Database Search – PubMed, BioMed Central, Public Library of Sciences (PloS)
2. Introduction to NCBI and EBI
3. Protein Sequence Database - PIR and Swissprot / UniProt
4. Nucleotide Sequence Database – GenBank, EMBL, DDBJ
5. Protein Structure Database – PDB
6. Protein 3D molecule viewer – VMD
7. Pairwise sequence alignment - Dotplot
8. Pairwise sequence alignment - lalign
9. Multiple sequence alignment – Clustalw
10. Database search – BLAST

COURSE OUTCOMES:

After completion of this course student would be able to

CO1: Search the literature data of the given protein using PubMed.

CO2: Search the nucleotide sequence data of the given species using NCBI / EMBL / DDBJ.

CO3: Search the protein sequence of the species using PIR and Swissprot / UniProt.

CO4: Find the structure of protein using PDB.

CO5: View the 3D structure of a protein using RASMOL software.

Total Hours: 30 Self Learning : 30

TEXT BOOKS:

K. Mani and N. Vijayaraj, Bioinformatics a Practical Approach, Aparna Publications, Coimbatore.

REFERENCE BOOKS:

Shanmughavel.P and GulshanWadhwa (2009), Practicals in Bioinformatics, Pointers Publishers.

COMMUNICATION SKILLS

L	T	P	SL	C
2	0	0	1	2

COURSE OBJECTIVES:

- To introduce students to the principles and importance of effective communication in academic, research, and professional contexts in life sciences and bioinformatics.
- To develop scientific writing skills, including research papers, reports, abstracts, proposals, and documentation of experimental data.
- To enhance oral communication skills for presentations, seminars, and group discussions in scientific and bioinformatics settings.
- To provide training in the use of digital communication tools, visualization software, and bioinformatics reporting platforms.
- To familiarize students with ethical, cultural, and professional practices in scientific communication, including citation, referencing, and avoiding plagiarism.

Unit I: Introduction to Scientific Communication **9 Hours**

Definition, scope, and importance of communication in life sciences and bioinformatics; verbal, non-verbal, and visual communication; barriers to effective communication; communication process; role of communication in research and collaboration.

Unit II: Writing Skills in Life Sciences and Bioinformatics **9 Hours**

Scientific writing principles; structure of research papers, reports, abstracts, proposals, and project documentation; clarity, conciseness, coherence; sentence construction, paragraph structure, and technical vocabulary; editing, proofreading, and formatting for journals and conferences.

Unit III: Oral Communication and Presentation Skills **9 Hours**

Oral presentations, seminars, and group discussions; designing slides and visual aids; use of graphs, tables, and illustrations; audience engagement and Q&A sessions; effective communication in meetings, conferences, and webinars.

Unit IV: Digital Tools for Scientific Communication **9 Hours**

Use of bioinformatics and scientific software for communication of research findings; data visualization tools (GraphPad, R, Python plots); bioinformatics reporting platforms; online collaboration tools and e-learning platforms for research communication.

Unit V: Ethics and Professional Practices in Communication **9 Hours**

Hours Ethical issues in scientific communication; plagiarism, citation styles (APA, MLA, Vancouver, Chicago); proper referencing and bibliography; intellectual property rights; responsible authorship and collaborative communication; communicating science to the public and lay audiences.

Total Hours: 45 Self Learning : 45

COURSE OUTCOMES:

- **CO1:** Explain the principles, scope, and significance of effective communication in life sciences and bioinformatics.
- **CO2:** Demonstrate proficiency in writing scientific documents such as research papers, reports, abstracts, and proposals.
- **CO3:** Apply oral communication skills to deliver effective presentations, seminars, and participate in scientific discussions.
- **CO4:** Utilize digital tools and software for data visualization, scientific reporting, and bioinformatics communication.
- **CO5:** Practice ethical scientific communication, proper referencing, and professional conduct in research and collaborative projects.

TEXTBOOKS:

1. **Scientific Writing and Communication: Papers, Proposals, and Presentations**, Angelika H. Hofmann, 3rd Edition, Oxford University Press, 2017 – Comprehensive guide for writing and presenting scientific research.
2. **Communicating Science: A Practical Guide for Engineers and Physical Scientists**, Anthony L. Young, 2nd Edition, Cambridge University Press, 2016 – Practical strategies for oral and written scientific communication.
3. **Essentials of Writing Biomedical Research Papers**, Mimi Zeiger, 3rd Edition, McGraw-Hill Education, 2008 – Focused on biomedical and life sciences writing, including bioinformatics reporting.

REFERENCE BOOKS:

1. **The Craft of Scientific Communication**, Joseph E. Harmon & Alan G. Gross, 2nd Edition, University of Chicago Press, 2010 – Focus on clarity, style, and effectiveness in science communication.
2. **How to Write and Publish a Scientific Paper**, Robert A. Day & Barbara Gastel, 8th Edition, Cambridge University Press, 2016 – Step-by-step guidance for writing and publishing research papers.
3. **Practical Guide to Scientific Communication**, L. F. Lenhard, 1st Edition, Springer, 2015 – Covers writing, presenting, and ethical issues in scientific communication.
4. **Communicating Science Effectively**, National Academies of Sciences, 1st Edition, National Academies Press, 2017 – Strategies for effective communication to both specialist and general audiences.

COMPUTER FUNDAMENTALS FOR LIFE SCIENCE

L	T	P	SL	C
2	0	0	1	2

COURSE OBJECTIVES:

- To understand the **fundamentals of computer organization**, including components, memory devices, and evolution of computers.
- To gain knowledge of **operating system concepts**, architecture, functions, and different types of operating systems.
- To develop skills in **number systems and computer codes**, including conversions and data representation.
- To understand **information systems and data processing**, including storage techniques and DBMS concepts.
- To familiarize students with **network and internet technologies**, terminology, and practical applications.

UNIT – I: **6 Hours**

Computer Organization: Fundamentals of computers – Block diagram of computer (input and output devices) – History - Generations – Memory devices – Advantages, Limitations and Applications of Computers.

UNIT – II: **6 Hours**

Operating System Concepts: Definition – Architecture – Functions and Services of operating system– Different types of operating system – Single user OS, Multi user OS, Multiprocessing OS, Multitasking OS & Real Time OS. Comparison of Client Server & Peer to peer OS.

UNIT – III: **6 Hours**

Number Systems: Non – positional and Positional number system – converting from one number system to another – Fractional numbers. Computer Codes: BCD, EBCDIC, ASCII, Unicode.

UNIT – IV: **6 Hours**

Information system and data storage system: Data – Information –Qualities of information –Data processing cycle – Types of data processing – Data processing system, Data storage system:

Files - File organization-DBMS Advantage.

UNIT –V: **6 Hours**

Network & Internet Technologies: Network – Different types - Internet definition – Brief History - Services – Internet Terminologies (WWW, web page, website, web browser, Domain name, HTML, HTTP, TCP/IP, URL, search engine) – Web browsers – Uses of Internet.

Total Hours: 30 Self Learning : 30

COURSE OUTCOMES:

At the end of the course, students will be able to:

1. **CO1:** Explain the **basic structure and functioning of computers**, including input/output devices, memory, and generations.
2. **CO2:** Describe and differentiate various **operating systems and their functionalities**.
3. **CO3:** Perform **number system conversions** and understand different **computer coding schemes**.
4. **CO4:** Analyze **data processing systems, information systems, and database concepts**.
5. **CO5:** Understand and apply **network and internet concepts**, including web technologies and services.

TEXT BOOKS:

1. Computer Fundamentals – Fourth Edition – Pradeep K. Sinha, Priti Sinha, BPB Publication-2007.

2. Basic Computer Skills made easy, by Sherman, J., 2001 Butterworth-Heinemann Ltd, USA.

REFERENCE BOOK:

1. Computer Fundamentals – Authors: Pradeep K. Sinha & Priti Sinha; Edition: 6th; Publisher: BPB Publications; Year: 2013; ISBN: 978-8176567523.
2. Fundamentals of Computers – Author: V. Rajaraman; Edition: 5th; Publisher: PHI Learning Pvt. Ltd.; Year: 2010; ISBN: 978-8120339770.
3. Operating System Concepts – Authors: Abraham Silberschatz, Peter B. Galvin & Greg Gagne; Edition: 10th; Publisher: Wiley; Year: 2018; ISBN: 978-1119456339.
4. Digital Fundamentals – Author: Thomas L. Floyd; Edition: 11th; Publisher: Pearson Education; Year: 2015; ISBN: 978-1292025687.

Indian Sign Language (Basic)

L	T	P	SL	C
2	0	0	1	2

Course Objectives

- To understand Deaf culture and recognize the importance of Indian Sign Language (ISL) in ensuring equality, accessibility, and social inclusion.
- To develop basic conversational skills for effective communication with the hearing-impaired community using sign language.
- To acquire the ability to express everyday concepts such as daily routines, needs, food, people, and descriptive elements like color, shape, and size.
- To promote the use of ISL in educational institutions, workplaces, and public services for creating an inclusive environment.
- To encourage continuous practice and skill development in ISL to support and advocate for the hearing-impaired community.

Unit I: Basics of ISL

Alphabets (finger-spelling), numbers, days of the week, colors, and expressions for greetings and wishes.

Unit II: People and Food

Months of the year, common food items, family members, and types of human behavior.

Unit III: Feelings and Festivals

Use of facial expressions in communication; signs related to fruits, vegetables, and major festivals.

Unit IV: Home and Nature

Clothing and cosmetics, natural elements (earth and sky), parts of a house, and identification of animals and birds.

Unit V: Society and Education

Names of states and cities, religions, basic educational terminology, and commonly used school-related items.

Total Hours: 30 Self Learning : 30

Course Outcomes

CO 1: Master the Basics

Students will be able to use finger-spelling for the alphabet and communicate numbers, days of the week, and months effectively.

CO 2: Develop Vocabulary

Students will be able to sign common words related to food items, family members, clothing, and household objects.

CO 3: Understand Nature-related Signs

Students will be able to identify and sign names of animals, birds, fruits, vegetables, and natural elements such as earth and sky.

CO 4: Social Communication Skills

Students will be able to express greetings and well-wishes, describe behaviors, and communicate about festivals and religions.

CO 5: Apply ISL in Social and Educational Contexts

Students will be able to sign names of states and cities, and use commonly used terminology related to education and school environments.

Text Book

1. *Indian Sign Language Dictionary* – Ramakrishna Mission Vidyalaya, IHRDC, Coimbatore

Reference Books

1. *Sign Language in India: A Linguistic Exploration* – Dr. Sandeep Sharma Jat
2. *The Indian Sign Language* – William P. Clark

SEMESTER – II

MOLECULAR CELL BIOLOGY AND GENETIC ENGINEERING

L	T	P	SL	C
4	0	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- Make the students understand the central dogma of molecular biology
- Familiarize the students to versatile tools and techniques employed in genetic engineering and recombinant DNA technology.
- Provide an understanding on the different structural form of biomolecules.

UNIT I: Molecular Biology of the cell **12 hours**

Chromatin organization and packaging; DNA Replication in Prokaryotes and Eukaryotes: Mechanism of Replication – Initiation, events at Ori C, Elongation – replication fork, semi discontinuous replication, Okazaki fragments, and termination. Bidirectional replication, Inhibitors of replication. Models of replication-theta, rolling circle and D loop model, extrachromosomal replicons, Homologous and non- homologous recombination, site specific recombination. Transcription in Prokaryotes and Eukaryotes: Transcription factors, transcription machinery, activators and repressors of transcription, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing (splicing, polyadenylation), RNA transport in eukaryotes. Translation in Prokaryotes and Eukaryotes: Ribosome, initiation complex, aminoacylation of tRNA, post- translational modification of proteins in eukaryotes.

UNIT I: Molecular Genetics and Gene Expression **12 hours**

Experimental evidences by Griffith's transforming principle, Avery, McLeod and Mc Carthy's experiment, and Hershey and Chase Experiment. Meselson and Stahl's experimental proof for semiconservative replication. Genetic Code and its characteristics, Wobble hypothesis. Translation: Adaptor role of tRNA, Activation of amino acids. Regulation of Gene Expression in Prokaryotes – Principles of gene regulation, negative and positive regulation, concept of operons, regulatory proteins, activators, repressors, regulation of lac operon and trp operon.

UNIT III: Genetic Engineering **12 hours**

Gene cloning Techniques – Cloning Vectors, types, properties; Enzymes in gene cloning – restriction endonucleases, ligases, reverse transcriptase, polymerase, terminal transferases - Homopolymer tailing, linkers and adaptors. Methods of gene transfer: Microinjection, electroporation, gene gun, liposome and viral- mediated delivery, Agrobacterium-mediated delivery. Strategies for selection and screening- marker and reporter genes, positive and negative selection, insertion inactivation, α complementation. Polymerase chain reaction –Primer design tools, Fidelity of thermostable enzymes, Types of and its applications.

UNIT IV: Sequencing and Cloning strategies **12 hours**

DNA sequencing - Sanger‟s method, Maxam and Gilbert method and Automated method, Construction of genomic and cDNA libraries; Cloning strategies – TA cloning, Gateway cloning, DNA fingerprinting by RFLP and RAPD, Site- directed mutagenesis. Gene silencing techniques – siRNA, microRNA, principles and application, Gene knockouts andGene Therapy, Genome editing by CRISPR/Cas9 system.

UNIT V: Cell cycle and control **12 hours**

Phases of Cell Cycle - Cyclin dependent kinases, Mechanisms of Checkpoint regulation; Signal transduction: Intercellular junctions, signaling by hormones and neurotransmitters; Receptors - GPCR, protein kinases and second messengers. Cell-cell interaction; Cell-matrix interaction - Integration of cellular function - pathways of Apoptosis and Autophagy.

Total Hours: 60 Self Learning : 60

COURSE OUTCOMES:

On the successful completion of the course, student will be able to:

CO1:1 Understand the cell cycle and molecules of life in various aspects.

CO2: Evaluate the changes in the transcription and translation.

CO3: Describe the different structures of carbohydrate, lipids, nucleotides, DNA and Protein

CO4: Know the various components and events of Gene expression

CO5: Design and conduct experiments involving genetic manipulation.

TEXT BOOKS:

1 Molecular Biology of the Gene, 7th edition - Watson, Baker, Bell, Gann, Levine, LosickJames D. Watson, Pearson publishers, 2014.

2 Gene Cloning, an introduction – T. A. Brown, Chapman and Hall, 3rd Edition, 1995.

3 Lewin's GENES XII - Elliott S. Goldstein, Jocelyn E. Krebbs, and Stephen T. Kilpatrick, Jones and Bartlett Publishers, Inc, 2017.

REFERENCE BOOKS:

1 An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods and Applications in Modern Biotechnology - M. Wink. Wiley, ed. 2, 2011.

2 Horton, Moran, Ochs, Rawn, Scrimgeour Principles of Biochemistry Prentice Hall Publishers.

MICROBIOLOGY & IMMUNOLOGY

L	T	P	SL	C
4	0	0	2	4

COURSE OBJECTIVES:

- To understand the **diversity and characteristics of microorganisms**.
- To study the **structure, life cycle, and genomic biology** of selected microbes.
- To explain **antimicrobial agents, drug resistance, and biofertilizers**.
- To develop knowledge on the **immune system and immunoglobulins**.
- To familiarize with **immunological techniques and their applications**..

UNIT – I: **12 Hours**

Diversity of Microorganisms – Salient features of Bacteria, Virus, Phages, Algae, Fungi and Protozoan. Industrial applications of microorganisms in various fields.

UNIT – II: **12 Hours**

Structure, Life history and Genomic Biology of E. coli, Helicobacter, Salmonella, Influenza, Polio, Poxvirus, Diatoms, Chlorella, Spirulina, Aspergillus, Penicillum, Plasmodium, Entamoeba.

UNIT – III: **12 Hours**

Biological control of microorganisms – Antimicrobial agents in therapy – Mode of action and side effects – Mechanism of drug resistance – Symbiotic and Asymbiotic N_2 fixation – Bio fertilizer.

UNIT – IV: **12 Hours**

Types of Immunity – Lymphoid organs – Lymphocytes – Cell maturation and differentiation – Immune response – Structure and Biological properties of Immunoglobulin. Antigen, Antibodies. Humoral and cell mediated immunity. Monoclonal antibody. Hypersensitivity.

UNIT – V: **12 Hours**

Immunological techniques: Precipitation test – Immunodiffusion – Immunoelectrophoresis – Immunofluorescence – HLA typing – ELISA – RIA. Commonly used toxoid vaccines, killed vaccines, live attenuated vaccines, rDNA Vaccines, DNA and subunit vaccines.

Total Hours: 60 Self Learning : 60

COURSE OUTCOMES

- CO1: Explain the diversity and industrial applications of microorganisms.
- CO2: Describe the structure, life cycle, and genomic biology of microbes.
- CO3: Analyze antimicrobial mechanisms, drug resistance, and nitrogen fixation.
- CO4: Understand immune system components and immune responses.

CO5: Apply immunological techniques such as ELISA, RIA, and immunodiffusion

TEXTBOOKS:

1. Microbiology – Authors: M.J. Pelczar Jr., E.C.S. Chan & N.R. Krieg; Edition: 5th; Publisher: Tata McGraw-Hill Education; Year: 2001.
2. Textbook of Microbiology – Authors: R. Ananthanarayan & C.K. Jayaram Paniker; Edition: 8th; Publisher: Universities Press; Year: 2010.

REFERENCE BOOKS:

1. I.M.Roitt, J.Brostoff and D.K.Male, Immunology, Gower Medical Publishing, London, VII- Edition, Elsevier Health Sciences, 2006.
2. M.J.Pelczar, Jr.,E.C.S. Chang and N.R.Krieg, Microbiology, V-Edition Tata McGraw-Hill Education, 2001.
3. Kuby Immunology by Thomas J.Kindt , barbaraA. Osborne and Richard A. Goldsby, VI Edition, 2006. W.H.Freeman Publications
4. Text Book of Microbiology by Ananthanarayan, R. & paniker, CK Jayaram, VIII edition, 2010, Universities Press.

PROGRAMMING IN C AND C++

L	T	P	SL	C
4	0	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To make the students understand the basic aspects of programming.
- Develop an in-depth understanding of functional, logic, and object-oriented programming paradigms.
- Explain and be able to use fundamental programming constructs such as sequencing, decisions and iteration.
- To enhance problem solving and programming skills in C & C++.

UNIT I: Introduction to Programming Languages 12 hours

Introduction– Programming languages –Problem solving Technique: Algorithm, Flowchart, Compiling, Testing and Debugging, Documentation – Data structures: Array, Stack, Queue, Linked list concepts.

UNIT II: Programming in C 12 hours

C language Introduction – Tokens – Keywords, Identifier, Variables, Constants, Operators, Expression, Data types –Operator precedence – Statement: Input statement, Output statement, Conditional and Unconditional Control Statement – Looping Statement: while, do–while, for –nested loop – Arrays.

UNIT III: Procedural Concepts in C 12 hours

C – Procedural Concepts: Structured Programming – Built-in library function – User defined functions – Pointer introduction – Passing pointer in a function – Structure – Union – File handle: Read and Write character from a file.

UNIT IV: Object Oriented Programming and C++ **12 hours**

Basic concepts of OOPS– Data hiding–Encapsulation–Inheritance, Polymorphism - Introduction to C++, C vs C++ – data types, variables, constants, operators and statements in C++ – Conditional and looping statements

UNIT V: Programming and C++ **12 hours**

C++ classes - Classes & Objects – Functions in C++ – function prototype-definition– Different Mapping with forms of Constructor – Destructor – Copy constructor – Inheritance –Single, Multiple and Multi level inheritance – Function & operator overloading –inline functions –Friend and virtual functions – Overloaded functions.

Total Hours: 60 Self Learning : 60

COURSE OUTCOMES:

On the successful completion of the course, student will be able to:

CO1: Have a good understanding about the concept of C & C++.

CO2: Be able to explain and make use of data types, variables, constants, assignment statements, and arithmetic and Boolean expressions in writing programs;

CO3: Understand object-oriented programming using C++

CO4: Explain and are able to use arrays and structures;

CO5: Be able to write and read basic codes in C & C++.

TEXT BOOKS:

1. B.W.Kernighan and D.M. Ritchie, “The C Programming Language”, 2nd Edition. Prentice Hall of India.
2. E. Balagurusamy - “Programming in C++” - Tata McGraw Hill Edition

REFERENCE BOOKS:

1. Byron Gottfried, “Programming with C” (Schaum's Outline Series) - Tata McGraw Hill Publishing Company – 1998
2. Robert Laffore - “Object oriented programming with C++” -Waite series.

PRACTICAL II – COMPUTER PROGRAMMING IN C AND C++

L	T	P	SL	C
0	0	6	2	3

COURSE OBJECTIVES:

- To learn character set, data types, statements
- To learn the functions structure, input or output operations, pointers, files etc., available in C language in order to write c programs.
- To provide the student with a strong foundation for performing further research in bioinformatics.
- To understand the concept of object oriented programming and to have through knowledge of c++ features

Write C programs for the following

1. a) Compute the relative centrifugal force using rmax (in cm) and rpm value

b) Compute the rpm value using rmax (in cm) and RCF value

c) Calculate sedimentation time (in hrs. & mins.)using clearing factor and sedimentation coefficient

2. a) Find the biggest of three given numbers using if-else statement

b) Compute all possible roots of quadratic equation using if-else statement

3. a) Find the molecular weight of a given dephosphorylated oligonucleotide sequence

b) Find the molecular weight of a given DNA sequence, after checking for phosphorylation

4. a) Find the sum of n natural numbers using while and for statements

b) Compute the sum of n odd numbers using while statement c) Find the factorial of a given integer number using for statement

5. a) Compute the nature of the solution based on the pH value using switch –case statement

b) Compute all possible roots of quadratic equation using switch – case statement.

Write C++ programs for the following

1. a) Covert Centigrade scale to Fahrenheit scale.

b) Convert Fahrenheit Scale to Centigrade scale.

2. a) Compute the relative centrifugal force using rmax (in cm) and rpm value.

b) Compute the rpm value using rmax (in cm) and RCF value.

3. Calculate Body Mass Index (BMI) value.

4. a) Calculate pH of the solution using H+ ion.

b) Calculate pH of the solution using OH- ion.

5. Calculate Average Molecular Weight of DNA

Total Hours: 30 Self Learning : 30

COURSE OUTCOMES:

After completion of this course student would be able to

CO1: Write a simple program using Turbo C compiler and gcc compiler.
CO2: Create Compile and Execute of a C program.
CO3: Write C program to find the all-possible roots of a quadratic equation using if-else and switch-case statement.
CO4: Retrieve pathway information of disease and note the results.
CO5: Find the literature information about the disease

TEXT BOOKS:

1. B.W.Kernighan and D.M. Ritchie, "The C Programming Language", 2nd Edition. Prentice Hall of India.
2. E. Balagurusamy - "Programming in C++" - Tata McGraw Hill Edition

REFERENCE BOOKS:

1. Byron Gottfried, "Programming with C" (Schaum's Outline Series) - Tata McGraw Hill Publishing Company – 1998
2. Robert Laffore- "Object oriented programming with C++" -Waite series.

ENVIRONMENTAL STUDIES

L	T	P	SL	C
3	0	0	2	3

COURSE OBJECTIVE:

To inculcate the importance of environmental pollution, preservation of nature and environmental management for human welfare.

UNIT-I: Multidisciplinary nature of environmental studies, Natural Resources 9 Hours

Definition, scope and importance, need for public awareness. Renewable and non-renewable resources - Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Role of an individual in conservation of natural resources- Equitable use of resources for sustainable lifestyles.

UNIT-II: Ecosystems, Biodiversity and its conservation 9 Hours

Concept of an ecosystem. - Structure and function of an ecosystem Producers, consumers and decomposers. -Energy flow in the ecosystem. Ecological succession. - Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) Introduction–Definition, genetic, species and ecosystem diversity. Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-sports of

biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT-III: Environmental Pollution **9 Hours**

Definition, Cause, effects and control measures of a) Air pollution b) Water pollution c) Soil pollution d) Marine pollution e) Noise pollution f) Thermal pollution g) Nuclear hazards. Solid waste Management. Causes, effects and control measures of urban and industrial 108 wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management-floods, earthquake, cyclone and landslides.

UNIT-IV: Social Issues and the Environment **9 Hours**

From Unsustainable to Sustainable development, Urban problems related to energy - Water conservation, rain water harvesting, watershed management- Resettlement and rehabilitation of people; its problems and concerns. Case Studies - Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. Wasteland reclamation. Consumerism and waste products.
Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act - Issues involved in enforcement of environmental legislation. Public awareness.

UNIT-V: Human Population and the Environment **9 Hours**

Population growth, variation among nations. Population explosion – Family Welfare Programme. Environment and human health. Human Rights. Value Education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health. Case Studies. Field work - Visit to a local area to document environmental assets river/ forest/grassland /hill/ mountain, Visit to a local polluted
site-Urban/Rural/Industrial/Agricultural, Study of common plants, insects, birds, Study of simple ecosystems-pond, river, hill slopes, etc.

Total Hours: 45 Self Learning : 45

COURSE OUTCOME:

CO1: To understand the nature and facts about environment.

CO2: To find and implement scientific, technological, economic solutions to environmental problems.

CO3: To know about the interrelationship between living organisms and environment.

CO4: To understand the integrated themes and biodiversity, natural resources, pollution control and waste management.

CO5: To appreciate the importance of environment by assessing its impact on the human world.

TEXT BOOKS:

1. De AK, Environmental Chemistry, Wiley Eastern Ltd. 109
2. Bharucha Erach, 2003. The Biodiversity of India, Mapin Publishing Pvt. Ltd, India.
3. Brunner RC, 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480pgs.
4. Clark RS, Marine Pollution, Clanderson Press, Oxofrd (TB).

REFERENCE BOOKS:

1. Agarwal KC, 2001. Environmental Biology, Nidi Publishers Ltd. Bikaner.
2. Gleick HP, 1993. Water in Crisis, Pacific Institute for Studies in Development, Environment and Security. Stockholm Environmental Institute, Oxford University Press, 473pgs.
3. Heywood VH, and Watson RT, 1995. global Biodiversity Assessment. Cambridge University Press 1140pgs.
4. Jadhav H and Bhosale VM, 1995. Environmental Protection and Laws. Himalaya Publishing House, Delhi 284pgs.
5. Miller TG, Jr. Environmental Science, Wadsworth Publishing CO. (TB)

PRINCIPLES OF DRUG DISCOVERY

L	T	P	SL	C
2	0	0	1	2

COURSE OBJECTIVES:

The main objectives of this course are to:

- Model the protein target and use computational tools and software to design a drug.
- Acquire knowledge on the computational softwares to visualize and analyze the structure and sequences.
- Analyze the conformational properties of protein using Ramachandran plot.

UNIT I: Introduction to Drug Discovery **6 hours**

History of drug design, Drug properties, likeness; Principles of Protein structure - Helix, Sheet, Strand, Loop and Coil, Torsion angles, Active site, Domains, Fold, Motif, PSSM; Structural databases- PDB, CATH, SCOP; Chemical Databases – ZINC, Pubchem, Chembl.

UNIT II: Macromolecular modeling **6 hours**

Ab initio modeling; Homology Modeling; Threading; Fold Recognition. Model refinement and validation – Ramachandran Plot, PROCHECK. Prediction of Binding site; ADME prediction; Rasmol viewer.

UNIT III: Quantitative Structure Activity Relationship (QSAR) **6 hours**

SAR, QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters. 3D-QSAR software COMFA.

UNIT IV: Molecular docking and Virtual screening **6 hours**

Structure-based drug design and Ligand based drug design; Virtual Screening, Pharmacophore design and identification. Molecular docking- AutoDock, Drug-receptor interaction.

UNIT V: Molecular Mechanics and Dynamics **6 hours**

General features of molecular mechanics; Energy Minimization - local and global energy minima, applications. Molecular dynamics simulation.

Total Hours: 30 Self Learning : 30

COURSE OUTCOMES:

On the successful completion of the course, student will be able to:

CO1: Perform molecular docking with ligands.

CO2: Model and validate the target structures and identification of lead molecules through docking.

CO3: Evaluate the ligand binding and interaction with the target using bioinformatics tools.

CO4: Analyze the conformational properties of protein using Ramachandran plot.

TEXT BOOKS:

1 Molecular Modeling: Basic Principles and Applications, 3rd Edition,Hans-Dieter Höltje, Wolfgang Sippl, Didier Rognan, Gerd Folkers•

2 Andrew R. Leach Molecular Modeling: Principles and Applications.

REFERENCE BOOKS:

1 Textbook of Drug Design and Discovery, Kristian Stromgaard, Povl Krogsgaard- Larsen, Ulf Madsen, 2009, CRC Press.

2 Drug Design and Discovery: Methods and Protocols, Volume 716, Seetharama D. Satyanarayanajois, Humana Press, 2011.

BIOETHICS, BIOSAFETY & IPR

L	T	P	SL	C
2	0	0	1	2

COURSE OBJECTIVES

The course aims to:

- Introduce fundamental principles of bioethics in biological and computational research.
- Understand biosafety regulations and risk assessment in biotechnology and bioinformatics.
- Explore ethical issues in genomics, data sharing, and AI-driven biological research.
- Develop knowledge of intellectual property rights (IPR) in life sciences.
- Understand patenting procedures and legal frameworks in biotechnology.

UNIT I: Introduction To Bioethics 6 Hours

Definition and scope of bioethics - Principles: autonomy, beneficence, non-maleficence, justice - Ethical issues in biological and computational research - Informed consent and privacy - Ethical concerns in genomics and personalized medicine

UNIT II: Biosafety Principles & Regulations 6 Hours

Concept of biosafety and risk assessment - Biosafety levels (BSL-1 to BSL-4) - Handling of biological materials and GMOs - National biosafety guidelines (India) - International guidelines (WHO, NIH)

UNIT III: Ethics In Bioinformatics & Data Science 6 Hours

Data privacy and security in biological databases - Ethical issues in big data and AI in bioinformatics -Data sharing policies and open science - Ethical use of genomic and clinical data -Case studies in bioinformatics ethics

UNIT IV: Intellectual Property Rights (IPR) 6 Hours

Introduction to IPR: patents, copyrights, trademarks, trade secrets - Patentability criteria in biotechnology - Patent filing process and documentation - International treaties (TRIPS, PCT) - Case studies in biotech patents

UNIT V: Regulatory Frameworks & Current Issues **6 Hours**

Regulatory bodies: CDSCO, FDA, EMA (overview) - Ethical committees and review boards (IEC/IRB) - Biosafety and environmental concerns - Ethical issues in emerging technologies (CRISPR, AI) - Future trends in bioethics and IPR

Total Hours: 30 Self Learning : 30

COURSE OUTCOMES:

CO1: Explain principles of bioethics and biosafety.

CO2: Apply biosafety guidelines in laboratory and computational settings.

CO3: Understand IPR systems and patenting in biotechnology.

CO4: Analyze ethical issues in genomics and bioinformatics.

CO5: Evaluate legal and regulatory frameworks governing life sciences research.

TEXT BOOKS:

1. **David B. Resnik**, *The Ethics of Science: An Introduction*, Routledge, **1st Edition, 1998 (Reprint Editions Available)**.
2. **Deepa Goel** & **Shomini Parashar**, *IPR, Biosafety and Bioethics*, Pearson Education India, **1st Edition, 2013**.
3. **Renneberg Reinhard** & **Berkling Volker**, *Biotechnology for Beginners*, Academic Press (Elsevier), **2nd Edition, 2017**.
4. **Arthur M. Lesk**, *Introduction to Bioinformatics*, Oxford University Press, **4th Edition, 2019**.

REFERENCE BOOKS:

1. **Michael F. Goodchild**, *Ethics in Science and Technology*, Wiley-Blackwell, **1st Edition, 2011**.
2. **Bartha Maria Knoppers**, *Genomics and Public Health Ethics*, Springer, **1st Edition, 2010**.
3. **World Intellectual Property Organization**, *WIPO Intellectual Property Handbook*, WIPO Publications, Latest Edition.
4. **World Health Organization**, *Laboratory Biosafety Manual*, WHO Press, **4th Edition, 2020**.
5. **Department of Biotechnology**, *Biosafety Guidelines and Regulations*, Government of India, Updated periodically.
6. **Indian Council of Medical Research**, *National Ethical Guidelines for Biomedical Research*, Latest Edition.

Indian Sign Language (Advanced)

L	T	P	SL	C
2	0	0	1	2

Course Objectives

- To develop a deeper understanding of Deaf culture and the significance of Indian Sign Language (ISL) in promoting equality and inclusivity in society.
- To enhance conversational skills for effective communication with peers using ISL in everyday situations.
- To strengthen the ability to describe daily routines, personal needs, food items, and physical attributes such as color, shape, and size.
- To encourage the practical application of ISL in educational institutions, workplaces, and public spaces to improve accessibility.
- To motivate continuous learning and active advocacy for the rights and inclusion of the hearing-impaired community.

Students will be able to sign names of states and cities and use vocabulary related to education and classroom environments effectively.

Unit I: Advanced Basics of ISL **6 Hours**

Alphabet (finger-spelling), numbers, days of the week, colors, and expressions for greetings and wishes.

Unit II: People and Food **6 Hours**

Months of the year, names of food items, family members, and expressions describing human behavior.

Unit III: Feelings and Festivals **6 Hours**

Use of facial expressions in communication; signs related to fruits, vegetables, and major festivals.

Unit IV: Home and Nature **6 Hours**

Clothing and cosmetics, natural elements (earth and sky), parts of a house, and identification of animals and birds.

Unit V: Society and Education **6 Hours**

Names of states and cities, religions, and commonly used school-related terms and items.

Total Hours: 30 Self Learning : 30

CO 1: Strengthen Foundational Skills

Students will be able to use finger-spelling for the alphabet and accurately sign numbers, days of the week, and months.

CO 2: Improve Everyday Communication

Students will be able to use signs for common food items, family members, clothing, and household objects in daily conversations.

CO 3: Expand Knowledge of Nature and Environment

Students will be able to identify and sign various animals, birds, fruits, vegetables, and natural elements such as earth and sky.

CO 4: Develop Social Interaction Skills

Students will be able to express greetings and well-wishes, describe behaviors, and communicate about festivals and religions.

CO 5: Apply ISL in Social and Educational Contexts

Text Book

1. *Indian Sign Language Dictionary* – Ramakrishna Mission Vidyalaya, IHRDC, Coimbatore

Reference Books

1. *Sign Language in India: A Linguistic Exploration* – Dr. Sandeep Sharma Jat
2. *The Indian Sign Language* – William P. Clark