VELS
INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM, THALAMBUR, PERIYAPALAYAM, THIRUVANMIYUR - CHENNAI

POSTGRADUATE DEGREE PROGRAMME

M.Sc., BIOINFORMATICS (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)

Two Years

CURRICULUM & SYLLABUS

REGULATION 2024

Choice Based Credit System (CBCS)

&

Learning Outcomes Based Curriculum Framework (LOCF)

Effective from the Academic Year

2025 -2026

Department of Bioinformatics

School of Life Sciences

DEPARTMENT OF BIOINFORMATICS

VISION OF THE DEPARTMENT

The Vision of Department of Bioinformatics is to provide the best education and training for students to prepare them for professional research careers in biological sciences as well as software industry. The Department plans to produce eminent scientists in the field of Bioinformatics.

MISSION OF THE DEPARTMENT

To facilitate, conduct and organize research work by teams comprised of core groups leading to inventions and to cooperate to meet this end and also to work acquiring the patents of such inventions. With its strong commitment to education, the department expects its graduates to have acquired solid subject knowledge and laboratory skills in the field of Bioinformatics upon their graduation. In addition, with our innovative curriculum, the graduates are also expected to possess all-round competence in IT technology, information gathering and synthesis, critical thinking, efficient oral and written communication, and teamwork spirit and capability so that their career prospects go beyond the field of life sciences.

PROGRAMME EDUCATIONAL OUTCOMES (PEO)	
PEO1	Describe the basis of biology, computer science and information technology and develop as a key expertise in applications of bioinformatics.
PEO2	An extra-ordinary ability to gain practical knowledge and keen in developing a successful career in academia, R&D institutes and industrial sector.
PEO3	Possess a high-level knowledge in comparing and analyze the best programming language, database and software to implement and support the critical biological challenges.
PEO4	Promoting the bioinformatics hardcore research and support the experimental scientist in the hypothesis and mechanism related to biology.
PEO5	Will address the increasing need for skilled computer expert in maintaining and analyze the biological resource and big data and contribute globally.

PROGRAMME OUTCOMES (PO)	
PO1	**Life Sciences knowledge:** Successful candidates will acquire current/recent specific knowledge in the respective discipline with proficiency in practical skills and leadership skills fora successful career.
PO2	**Problem analysis:** Successful candidates will be able to analyze, design standards, resolve and troubleshoot problems in implementation or standardization of Life sciences protocols.
PO3	**Design/development of solutions:** Successful candidates will develop creative and cognitive thinking and cooperate with each other to solve problems in the field of Life sciences.
PO4	**Conduct investigations of Practical problems:** Successful candidates will acquire capabilities to plan and design protocols and utilize practical skills
PO5	**Conduct investigations of experimental problems:** To validate hypothesis by executing experimental techniques independently coupled with the ability to assimilate, analyze, interpret and accurately evaluate subsequent data.
PO6	**Modern tool usage:** Successful candidates will effectively be able to manage resources and time using ICT and other computer enabled devices
PO7	**Ethics:** Successful candidates will be aware of their role and responsibility in handling and use of microbes including genetically modified microorganisms.

PO8	**Communication:** Successful candidates will have the ability to understand and communicate all ideas and concepts effectively.
PO9	**Environment sustainability:** Successful candidates will get adequate knowledge to use information and implement solutions for environmental protection, safeguards and remediation.

PROGRAMME SPECIFIC OUTCOMES (PSO)	
PSO1	The syllabus addresses the need to introduce students to new tools and application in bioinformatics.
PSO2	The PG course helps every candidate to analysis the software for data studies and comparisons and provides tools for modelling, visualizing, exploring and interpreting data.
PSO3	To access the wealth of data to answer questions relevant to the average biologist, and is highly hands-on.

BOARD OF STUDIES

List of Members

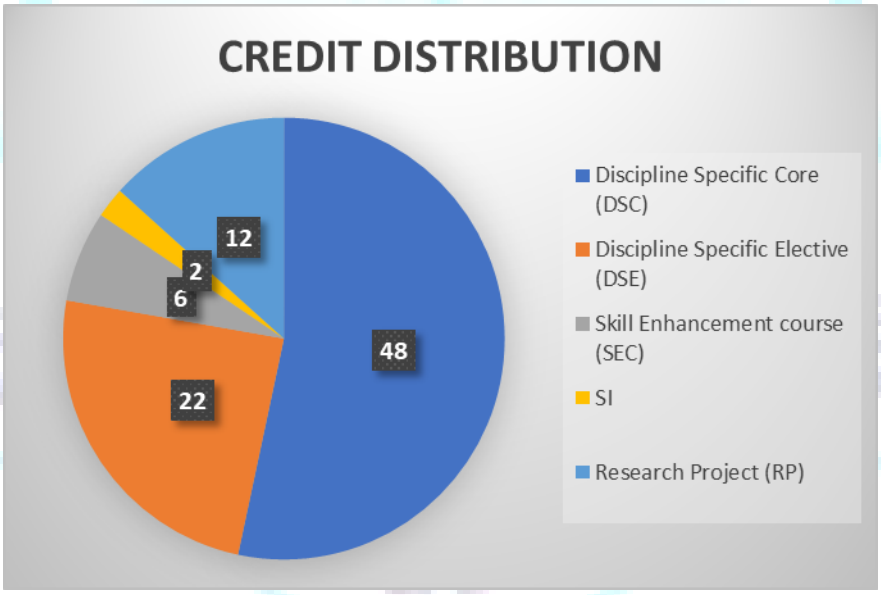
Department of Bioinformatics

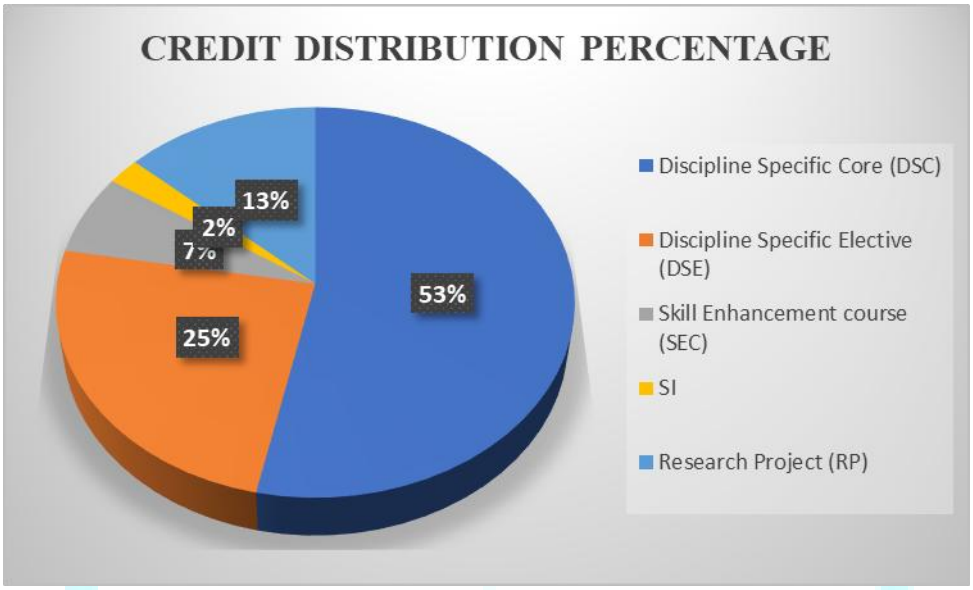
S. No	Name & Designation	Address	Role
1.	Dr. Radha Mahendran	Professor & Head, Department of Bioinformatics, VISTAS, Chennai	Chairman
2.	Dr. R. Priya	Assistant Professor, Department of / Bioinformatics, VISTAS, Chennai	Internal Member
3.	Dr. P.R. Kiresee Saghana	Assistant Professor, Department of / Bioinformatics, VISTAS, Chennai	Internal Member
4.	Dr. V. Umashankar	Scientist, Professor and Head, Bioinformatics Division, ICMR-National Institute for Research in Tuberculosis, Chennai	Academic Expert
5.	Dr. A. Jaya	Professor in Computer Applications, B.S. Abdur Rahman Crescent Institute of Science & Technology, Chennai.	Academic Expert
6.	Dr. M. Menaga	Managing Director, BioNeem Tech, Sipcot IT park, Siruseri Chennai.	Industrial Expert
7.	Ms. S. Dhananya	Bioinformatics Analyst, Theracues Innovations Pvt. Ltd, Sahakar Nagar, Bangalore.	Alumni

CREDIT DISTRIBUTION

M.Sc., Bioinformatics with Artificial Intelligence and Data Science)
Minimum credits to be earned: 90

Component	I Sem	II Sem	III Sem	IV Sem	Total Credits
Discipline Specific Core (DSC)	14	16	14	4	48
Discipline Specific Elective (DSE)	8	4	6	4	22
Skill Enhancement course (SEC)	2	2	2	-	6
SI	-	2	-	-	2
Research Project (RP)	-	-	-	12	12
Total Credits	24	24	22	20	90





ABBREVIATIONS

DSC	Disciplinary Specific Core
DSE	Disciplinary Specific Elective
SEC	Skill Enhancement Courses
SI	Summer Internship
RP	Research Project

CURRICULUM STURCTURE

M.SC., BIOINFORMATICS (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)

Total number of Credits: 90

Minimum Credits to be earned: 90

	M.SC., BIOINFORMATICS (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)									
	SEMESTER 1									
			Hours/Week					Maximum Marks		
	Code	Course	L	T	P	O	C	CIA	SEE	Total
DSC 1	24CMIA11	Introduction To Bioinformatics	4	0	0	2	4	40	60	100
DSC 2	24CMIA12	Computer Programming in C and C++	4	0	0	2	4	40	60	100
DSC 3	24CMIA13	Enzymes And Metabolisms	4	0	0	2	4	40	60	100
DSC 4 (lab)	24PMIA11	Practical 1 Computer programming in C and C++	0	0	4	1	2	40	60	100
DSE 1	24DMIA11	Discipline Specific Elective I	4	0	0	2	4	40	60	100
DSE 2	24DMIA11	Discipline Specific Elective II	4	0	0	2	4	40	60	100
SEC 1	24SSKP11	Soft skill I/Sector skill course	2	0	0	1	2	40	60	100
			22	-	4	-	24	-	-	-

CIA - Continuous Internal Assessment SEE - Semester End Examination

***L – Lecture, *T- Tutorial, *P- Practical, *O - Outside the class effort / self-study, *C- Credits**

SEMESTER 2

Category	Code	Course	L	T	P	O	C	CIA	SEE	Total
DSC 5	24CMIA21	Database Management System	4	0	0	2	4	40	60	100
DSC 6	24CMIA22	Programming in Perl and Bioperl	4	0	0	2	4	40	60	100
DSC 7	24CMIA23	Concepts in Artificial Intelligence	4	0	0	2	4	40	60	100
DSC 8 (lab)	24PMIA21	Practical 2- Database Management System	0	0	4	1	2	40	60	100
DSC 9 (lab)	24PMIA22	Practical 3- Programming in Perl and Bioperl	0	0	4	1	2	40	60	100
DSE 3	24DMIA21	Discipline Specific Elective III	4	0	0	2	4	40	60	100
SI	25INPG21	Internship	0	0	2	1	2	40	60	100
SEC 2	24SSKP12	Soft skill II/Sector skill course	2	0	0	1	2	40	60	100
			18	**-**	**10**	**-**	**24**	**-**	**-**	**-**

CIA - Continuous Internal Assessment SEE - Semester End Examination

***L – Lecture, *T- Tutorial, *P- Practical, *O - Outside the class effort / self-study, *C- Credits**

SEMESTER 3

Category	Code	Course	L	T	P	O	C	CIA	SEE	Total
DSC 10	24CMIA31	Computer Aided Drug Designing	4	0	0	2	4	40	60	100
DSC 11	24CMIA32	Advanced Programming in Java	4	0	0	2	4	40	60	100
DSC 12	24CMIA33	Data Science in Bioinformatics	4	0	0	2	4	40	60	100
DSC 13 (lab)	24PMIA31	Practical 4- Computer Aided Drug Designing	0	0	4	1	2	40	60	100
DSE 4	24DMIA31	Discipline Specific Elective IV	3	0	0	2	3	40	60	100
DSE 5	24DMIA32	Discipline Specific Elective V	3	0	0	2	3	40	60	100
SEC 3	24SSKP13	Soft Skills III/Sector Skill Course	2	0	0	1	2	40	60	100
			20	**-**	**4**		**22**	**-**	**-**	**-**

CIA - Continuous Internal Assessment SEE - Semester End Examination

***L – Lecture, *T- Tutorial, *P- Practical, *O - Outside the class effort / self-study, *C- Credits**

SEMESTER 4										
Category	**Code**	**Course**	**L**	**T**	**P**	**O**	**C**	**CIA**	**SEE**	**Total**
DSC 14	24CMIA41	Cancer Biology	4	0	0	2	4	40	60	100
DSC 15 (Lab)	24PMIA41	Cancer Biology Practical	0	0	2	1	1	40	60	100
DSE 6	24DMIA41	Discipline Specific Elective VI	3	0	0	2	3	40	60	100
RP 1	24RMIA41	Research Project I	0	0	12	10	12	40	60	100
			8	**0**	**12**		**20**	**-**	**-**	**-**

CIA - Continuous Internal Assessment SEE - Semester End Examination

***L – Lecture, *T- Tutorial, *P- Practical, *O - Outside the class effort / self-study, *C- Credits**

CORE COURSES

Category	Code	Course	L	T	P	O	C
DSC 1	24CMIA11	Introduction To Bioinformatics	4	0	0	2	4
DSC 2	24CMIA12	Computer Programming in C and C++	4	0	0	2	4
DSC 3	24CMIA13	Enzymes And Metabolisms	4	0	0	2	4
DSC 4 (lab)	24PMIA11	Practical 1 Computer programming in C and C++	0	0	4	1	2
DSC 5	24CMIA21	Database Management System	4	0	0	2	4
DSC 6	24CMIA22	Programming in Perl and Bioperl	4	0	0	2	4
DSC 7	24CMIA23	Concepts in Artificial Intelligence	4	0	0	2	4
DSC 8 (lab)	24PMIA21	Practical 2- Database Management System	0	0	4	1	2
DSC 9 (lab)	24PMIA22	Practical 3- Programming in Perl and Bioperl	0	0	4	1	2
DSC 10	24CMIA31	Computer Aided Drug Designing	4	0	0	2	4
DSC 11	24CMIA32	Advanced Programming in Java	4	0	0	2	4
DSC 12	24CMIA33	Data Science in Bioinformatics	4	0	0	2	4
DSC 13 (lab)	24PMIA31	Practical 4- Computer Aided Drug Designing	0	0	4	1	2
DSC 14	24CMIA41	Cancer Biology	4	0	0	2	4
DSC 15 (Lab)	24PMIA41	Cancer Biology Practical	0	0	2	1	1

DISCIPLINE SPECIFIC ELECTIVE COURSES

Category	Code	Course	L	T	P	O	C
DSE 1	24DBIA1_	Molecular Biology and Genetic Engineering	4	0	0	2	4
	24DBIA1_	Operating System: Linux and Python	4	0	0	2	4
DSE 2	24DBIA1_	Proteomics: Principles and Techniques	4	0	0	2	4
	24DBIA1_	Research and Practical Applications	4	0	0	2	4
DSE 3	24DBIA2_	Genomics and Transcriptomics	4	0	0	2	4
	24DBIA2_	Biomolecular Simulation Technique	4	0	0	2	4
DSE 4	24DBIA3_	Python for Bioinformatics	3	0	0	2	3
	24DBIA3_	Machine Learning in Bioinformatics	3	0	0	2	3
DSE 5	24DBIA3_	System Biology	3	0	0	2	3
	24DBIA3_	Biophysical Technology	3	0	0	2	3
DSE 6	24DBIA4_	Cyber Security	3	0	0	2	3
	24DBIA4_	R Programming Language and Big data Analytics	3	0	0	2	3

SKILL ENHANCEMENT COURSES

Category	Code	Course	L	T	P	O	C
SEC 1	24SSKP11	Soft skill 1/Sector skill course	2	0	0	1	2
SEC 2	24SSKP12	Soft skill 2/Sector skill course	2	0	0	1	2
SEC 3	24SSKP13	Soft Skills 3/Sector Skill Course	2	0	0	1	2

INTERNSHIP

Category	Code	Course	L	T	P	O	C
SI	24INPG21	Internship	0	0	2	1	2

RESEARCH PROJRCT

Category	Code	Course	L	T	P	O	C
RP I	24RMIA41	Research Project 1	0	0	12	10	12

KNOWLEDGE IS POWER

SEMESTER I

24CMIA11 INTRODUCTION TO BIOINFORMATICS

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

This course will enable the students to understand the nature of biological data and need for biological databases and also to explore major biomolecular sequence databases (organization and contents); search and retrieve data from the databases using their respective search engines. To understand and appreciate the need and significance of sequence analysis and the bioinformatics approaches, algorithms for sequence analysis, the application of methods for analysis of the biomolecular sequence data

UNIT -I ARTIFICIAL INTELLIGENCE DRIVEN DRUG DISCOVERY 12

Future of Bioinformatics: AlphaFold, Artificial intelligence -driven drug discovery, Data mining from biological databases for pattern recognition and hypothesis generation. Artificial intelligence to extract insights from protein interaction networks, SVMs, Random Forests for gene function prediction, k-means clustering to group similar sequences, BLAST vs Artificial intelligence -driven models: ProtTrans, DeepBLAST, 3D structure prediction using Artificial intelligenceAI DeepMind's AlphaFold DB for structure prediction exploration.

UNIT -II INTRODUCTION TO BIOLOGICAL DATABASE I 12

Nucleotide databases (Genbank, EMBL, DDBJ); Protein databases (Swiss-Prot, Tr-EMBL, PIR_PSD, Expasy); Derived Databases (Prosite, PRODOM, Pfam, PRINTS) Specialized Genome databases: (NCBI, EBI, TIGR, SANGER)- Artificial intelligence based database curation and prediction models.

UNIT- III BIOLOGICAL DATABASES II 12

Sequence submission Methods and tools (Sequin, Sakura, Bankit); Sequence retrieval systems (Entrez& SRS); Sequence File Formats and Conversion tools; Metabolic Pathway database (KEGG, EMP, EcoCyc, BioCyc and MetaCyc); Machine Learning models for pathway predictions and gene clustering, Specialized database (IMGT, Rebase, COG, BRENDA); Structural database (CATH, SCOP, and PDBsum), Data Science tools (e.g., Python libraries like Biopython, Pandas, Scikit-learn) for database mining and pattern recognition

UNIT- IV SEQUENCE ANALYSIS 12

Analysis of protein and nucleic acid sequences, multiple alignment programs, Pair wise Sequence Alignment - Similarity, Identity and Homology, Global Alignment, Local Alignment; database search methods-Multiple Sequence Alignment - Phylogenetic Analysis – Concept of

dendrograms; Strings and Evolutionary trees, Artificial intelligence for sequence classification: Support Vector Machines (SVM), Random Forest, Neural Networks for gene/protein classification, Deep learning approaches for motif discovery and variant effect prediction.

UNIT- V STRUCTURAL ANALYSIS 12

Analysis of structures and correctness of structures, Submission of data to PDB: atomic coordinates and electron density maps; Anatomy of Proteins - Ramachandran plot, Secondary structures, Motifs, Domains, Tertiary and quaternary structures, Artificial intelligence based protein structure prediction (e.g., AlphaFold, RoseTTAFold), 3D visualization and interpretation using Artificial intelligence -assisted tools, Calculation of conformational energy for bio-macromolecules.

Total: 60 Hours

Course Outcome:

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

CO1: To understand the basics of computer, internet and computer networking software's.

CO2: To acquire the concepts of different biological databases

CO3: Identify the difference between call by value and call by reference.

CO4: Understand the selection procedure of processors in the embedded domain.

CO5: To study the structures of protein and their function site.

CO-6: To analyze sequence alignment techniques and their applications in bioinformatics.

CO-7: To explore computational tools for predicting and modeling protein structures

Text Books:

1. Baxevanis A.D., Davison D.B., Page R. D. M. & Petsko G.A (2010), Current Protocols in Bioinformatics. New York, John Wiley & Sons Inc., 2004. ISBN: 0555015254 Syllabus draft: April 26.

2. Wiley-Scrivener (2024), Artificial Intelligence and Machine Learning in Drug Design and Discovery: Current Trends and Future Directions. Abhishek Gupta, Richa Gupta & Rohit Srivastava. 978-1-394-23416-3.

Reference Books:

1. Korf Ian, Yandell Mark, Bedell Joseph (2003), BLAST: an essential guide to the basic local alignment search tool. Shroff Publishers and Distributors Pvt. Ltd., ISBN: 8173665125.

Web Sources:

1. http:// www. Vidya-mitra Integrated E-Content Portal.com

24CMIA12 COMPUTER PROGRAMMING IN C AND C++

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVES:

This course will enable the students to conceptualize and formulate logic and flow for the implementation of a computational task and develop codes using the structured programming approach of 'C' & C++ programming language and also to develop and implement programs to analyze biological data.

UNIT-I FUNDAMENTAL OF COMPUTING AND PROGRAMMING 12

Concept of variables and constants, structure of a C program.Introduction to Artificial intelligence and Data Science in Life Sciences – Need for Programming in Life Sciences- Characteristics, Evolution, Generations and Classification of Computers – Basic Computer organization Computer Software –Internet – Browsers, Search engines – Email – Cloud Computing and Data Storage- Internet resources for Life Sciences- Algorithm- Introduction to Bioinformatics Tools

UNIT- II BASICS AND CONTROL STRUCTURES IN C 12

Introduction to C - Identifiers and Keywords - Constants, Variables and Data types - Operators and expressions - Data Input and Output – Control Structures - if and switch statements - while, do-while and for statements – goto statement - Arrays – Character strings -Functions in C (Built-in and User-defined) - Error handling in C.

UNIT-III STRUCTURES AND FILES 12

User defined Functions in C - Defining and accessing functions - Passing arguments – Function prototypes - Recursion – Storage classes – Pointer Declarations - Passing pointers to functions - Pointers and arrays - Operations on pointers - Dynamic memory allocation – User defined data types in C - Structures - Declaring structures and Accessing members - Array of structures – Unions – File operations - open, close, reading and writing - Preprocessor directives - Macros - Command line arguments - Introduction to Data Structures (Linked Lists, Stacks, Queues) - Simple programs.

UNIT- IV INTRODUCTION TO OBJECT ORIENTED PROGRAM 12

Object Oriented Programming (OOP) – Introduction – Basic concepts – Classes, Objects, Data abstraction and encapsulation – Inheritance – Polymorphism – Dynamic Binding and Message Passing – Object oriented Languages – Applications – Introduction to C++ – History – Applications – Procedure-Oriented Programming – Structure of C++ Program – Tokens,

expressions, keywords, Identifiers, constants, Operators, Data types -File Handling in C++ – Exception Handling Mechanisms –Implementing Artificial intelligence data models using C++: Introduction to Decision Trees, Naive Bayes- Standard input and output statements - Declaration of variables.

UNIT- V ADVANCEMENT IN OBJECT ORIENTED PROGRAMMING CONCEPT 12

Functions, Function prototype – Inline Functions – Default arguments – Function overloading – Sample Programs – Creating a class – Defining member functions – Creating objects – Accessing class members – Arrays within a class – Arrays of objects – Friend function – Local classes -Operator Overloading– Simple programs – Comparison between C and C++. Dynamic polymorphism, Static polymorphism, Multiple Inheritance, Interfaces, virtual inheritance and interface, Memory Management, Smart Pointers, Implementing preconditions, postconditions, invariants. exception-safe code, patterns, dynamic behavior based on object types.

Total: 60 Hours

COURSE OUTCOMES:

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

CO1: To understand the basics of C program and their operators using Conditional statements and loops.

CO2: To utilize the concepts of operators and in build functions to program the control structures and decision-making concept

CO3: To design the array, structure, pointers, files and unions in the programming.

CO4: To choose the OOPS concepts and to utilize the constructors and operators

CO5: To discuss the concepts of files and inheritance

CO6: Develop a deep understanding of dynamic and static polymorphism, using virtual functions and templates (including CRTP) to create flexible and efficient code.

CO7: To equip learners with the skills to tackle complex programming challenges, optimize software design, and create robust, high-performance C++ applications

Text Books:

1. Balagurusamy E (2007), Programming In ANSI C. Publisher: New Delhi Tata McGraw Hill Publishing Company Ltd. ISBN: 9780070648227.

Reference Books:

1. Kanetkar Yashavant (2009), Let Us C 9th Edition. Publisher: New Delhi BPB Publications.

ISBN: 9788183331630.

2. Jonassen Inge, Kim Junhyong (2004), Algorithms in Bioinformatics: 4th International Workshop, WABI Bergen, Norway, September 2004 Proceedings. Publisher: New York Springer. ISBN: 3540230181.

3. Kernighan Brian W. Ritchie Dennis M (1988), The C Programming Language 2nd Edition. Publisher: USA, Prentice-Hall, Inc. ISBN: 0876925964

Web Sources:

1. http://www.Effective Programming in C and C++.com

24CMIA13 **ENZYMES AND METABOLISMS**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVES:

This course will enable the students to understand the fundamentals and complementary aspects of enzyme and metabolism action involved in bioinformatics and wide range of enzymatic activities of different protein classes and their metabolism's which responsible for causing Disorder.

UNIT- I INTRODUCTION TO ENZYMES **12**

Introduction to enzymes, nomenclature, classification, riboenzyme, general characteristics of theories of enzyme catalysis, substrate specificity, isozymes, coenzymes, cofactors, regulation of enzyme activity, chemical kinetics and enzyme kinetics, Michaelis-Menten equation, effect of various factors on rate of reactions, inhibition of enzymatic reactions and kinetics, multienzyme system and bisubstrate reactions, catalytic mechanisms, regulatory enzymes and immobilised enzyme.Enzyme sequences, predict active sites, and model enzyme-substrate interactions. Applications: Drug discovery, Synthetic biology and personalized medicine.

UNIT- II INTRODUCTION TO METABOLISM **12**

Introduction to metabolism- Overview of anabolic and catabolic pathways of carbohydrates, proteins and lipids. Role of ATP, NAD, FAD and CoA in metabolism. Nucleic Acid Metabolism: Biosynthesis and degradation of purines and pyramidines, nucleosides and nucleotides. Enzyme Databases: BRENDA, ExPASy ENZYME, Kyoto Encyclopedia of Genes and Genomes, PDB-Protein Data Bank.

UNIT- III CARBOHYDRATE METABOLISM **12**

Digestion and absorption of carbohydrates. Glycolysis and its significance, Fermentation, Fate of pyruvate, Citric acid cycle, Gluconeogenesis, Cori cycle, Glycogenesis, Glycogenolysis Glycogen storage diseases. HMP shunt, Uronic acid pathway, Metabolism of hexoses other than glucose, Regulation of glycogen metabolism, Glyoxylate pathway, Biosynthesis of oligosaccharides and glycoproteins. Probiotics , Carbohydrate Metabolism in Chronic Kidney Disease.

UNIT- IV LIPID METABOLISM **12**

Digestion and absorption of lipids. Introduction to lipid metabolism, β-Oxidation of fatty acids, Ketogenesis. Biosynthesis of fatty acids, Triacylglycerols and prostaglandins. Metabolism of phospholipids, glycolipids and cholesterol. Lipoproteins: Metabolism of HDL, Disorder of

Plasma Lipoproteins, Fatty liver, Obesity, Atherosclerosis, Tay – Sachs disease, Gaucher's disease, Niemann – Pick disease. Lipid Metabolism in Health and Disease, Cancer and Advancements in Lipogenesis- Artificial intelligence assisted identification of metabolic targets for obesity and cardiovascular disease

UNIT- V PROTEIN METABOLISM **12**

Digestion and absorption of proteins. General aspects of amino acids metabolism; deaminaton, transamination, transmethylation, transpeptidation, and decarboxylation. Metabolism of ammonia: urea cycle and its regulation, Nitrogen balance, biosynthesis of non- essential amino acids. Metabolic breakdown of individual amino acids. Biomarkers:amylase and lipase, Metabolic Profiling.

Total: 60 Hours

COURSE OUTCOMES:

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

CO1: To Describe the structure, functions and the mechanism of action of enzymes.

CO2: To Understand the fundamental energetics of biochemical processes, chemical logic of metabolic pathways.

CO3: To describe the Metabolism of carbohydrates and its regulation

CO4: To gain knowledge on Metabolism of lipid and its regulation

CO5: To obtain and analyse the metabolism of amino acids and their role in maintaining the body function.

CO6 : Utilize bioinformatics databases like KEGG, MetaCyc, and BioCyc to study metabolic networks.

CO7: Perform metabolic modeling and pathway analysis using computational tools.

Text Books:

1. Lehninger, A. L. (2004). Lehninger Principles of Biochemistry: David L. Nelson, Michael M. Cox. New York: Recording for the Blind & Dyslexic.

2. Shanmughavel P (2005), "Principles of Bioinformatics", Pointer Publishers, Jaipur, India.

Reference Books:

1. C. K. Mathews, K. E. Van Holde, & K.G. Ahern (1999), "Biochemistry",Third Edition, Prentice Hall.

2. Cesareni Giovanni, Gimona Mario, Sudol Marius, Yaffe Michael (Editors) (2005). Modular Protein Domains. Publisher: Weinheim Wiley-VCH.

Web Sources:

1. https://bio.libretexts.org/Courses/Prince_Georges_Community_College/PGCC_Microbiology/07%3A_Microbial_Metabolism/7.01%3A_Introduction_to_Metabolism_and_Enzymes

24PMIA11 PRACTICAL 1 COMPUTER PROGRAMMING IN C AND C++

L	T	P	O	C
0	0	4	2	2

COURSE OBJECTIVE:

This course will enable the students to conceptualize and formulate logic and flow for the implementation of a computational task and develop codes using the structured programming approach of 'C' & C++ programming language and also to develop and implement programs to analyze biological data.

1. Operators and Expressions, Branching and Looping in C. **3**
2. Classes and Objects in C++ **3**
3. Program to demonstrate Inheritance in C++. **3**
4. Translate DNA sequence to Protein in C & C++. **3**
5. Comparing two Sequences. **3**
6. Calculate the true length of a Sequence. **3**
7. Function Blocks: a. Handling default reference arguments b. Handling inline and overloaded function C++. **3**
8. Demonstrates using virtual functions to allow derived classes to override behavior. **3**
9. Read, clean, and preprocess small biological datasets (e.g., FASTA files) . **3**
10. Simulate basic supervised ML classifier logic (e.g., linear separator for binary classification in C++). **3**

Total: 30 Hours

COURSE OUTCOMES:

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

CO1: To understand the basics of C program and their operators using Conditional statements and loops.

CO2: To utilize the concepts of operators and in build functions to program the control structures and decision-making concept

CO3: To design the array, structure, pointers, files and unions in the programming

CO4: To choose the OOPS concepts and to utilize the constructors and operators

CO5: To discuss the concepts of files and inheritance.

CO6: Develop a deep understanding of dynamic and static polymorphism, using virtual

functions and templates (including CRTP) to create flexible and efficient code.

CO7: To equip learners with the skills to tackle complex programming challenges, optimize software design, and create robust, high-performance C++ applications.

Text Books:

1. Balagurusamy E (2007), Programming In ANSI C. Publisher: New Delhi Tata McGraw Hill Publishing Company Ltd. ISBN: 9780070648227.

Reference Books:

1. Kanetkar Yashavan (2009), Let Us C 9th Edition. Publisher: New Delhi BPB Publications. ISBN: 9788183331630.

2. Jonassen Inge, Kim Junhyong (2004), Algorithms in Bioinformatics: 4th International Workshop,WABI Bergen, Norway, September 2004 Proceedings. Publisher: New York Springer. ISBN: 3540230181.

Web Sources:

1. http://www.Effective Programming in C and C++.com

24DMIA1_ MOLECULAR BIOLOGY AND GENETIC ENGINEERING

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

To understand the molecular basis of the cell structure, function and to familiarize the recent development and techniques in the field of molecular biology, Gene regulation in prokaryotes and eukaryotes, operon concept.

UNIT- I SEQUENCE ORGANIZATION 12

Evolution of genetic material – Identification of genetic material – Chemistry of nucleic acids – Structure – types of DNA and RNA, Organization –prokaryotic and eukaryotic DNA, Mitochondrial and Chloroplast DNA - Griffith, Avery and Hershey and Chase experiments. DNA– DNA replication -Semiconservative mode of Replication, Transcription- Post transcriptional modification and Translation, Post Translational modification – codon and anticodon concepts – inhibitors of transcription and translation – Gene as the unit of expression – spontaneous mutation, induced mutation – reversed and suppression mutation – DNA repair mechanism. Epigenetics: DNA methylation, histone modification, and chromatin remodeling.

UNIT- II GENE REGULATION AND GENE TRANSFER 12

Gene regulation in prokaryotes and eukaryotes – operon concept – lac, trp – promotor, attenuator– terminator and operator – transcription factors – allosteric enzymes and feedback inhibition – repression – Downstream Regulation. Gene transfer mechanisms - transformation, conjugation, transduction – Genetic linkage and crossing over and genetic mapping of chromosomes.

UNIT- III TOOLS FOR RDNA TECHNOLOGY 12

Isolation of DNA- Cutting of DNA using Restriction enzyme- Restriction modification systems: Types I, II and III- Mode of action, nomenclature- Type II restriction enzymes in genetic engineering, DNA modifying enzymes-Applications: DNA polymerases, kinases and phosphatases, and DNA ligases, Cloning Vectors- Plasmid vectors- pBR Bacteriophage vector- lambda and M13 vectors, Cosmids, BACs, YAC, linkers and adaptors, Expression vectors. CRISPR-Cas System in Genetic Engineering-Mechanism of CRISPR-Cas9, Cas12, and Cas13

UNIT- IV MOLECULAR CLONING AND DNA SEQUENCING 12

Transformation-Competent cell preparation-Selection of Transformed cells- Transformation methods -Calcium phosphate co-precipitation method, Electroporation, Microinjection, biolistic method, virus and liposome mediated delivery, Screening of Recombinants- Colony selection,

Antibiotic resistance. Construction of Genomic and CDNA libraries- Chromosome Jumping and Walking. DNA Sequencing- Sangers method, Maxam and Gilbert method. Next-generation sequencing (NGS): Illumina, PacBio, Nanopore, RNA sequencing.

UNIT- V RDNA TECHNIQUES AND APPLICATIONS **12**

Blotting technique- Probe preparation- Southern blotting, Northern Blotting, Western Blotting- Agarose gel electrophoresis, SDS- PAGE. Applications of recombinant DNA technology – Site Directed Mutagenesis – commercial aspects of recombinant proteins - cloning in plants – direct transfer of DNA into plant cells – transgenic plants – transgenic animals – gene transfer by nuclear injection – gene therapy – Predictive modeling for gene therapy efficacy and safety using Artificial intelligence pharmaceuticals– anti-sense RNA technique – siRNA. CRISPR-Cas9 in therapeutics and gene therapy. Bioinformatics tools for molecular biology: BLAST, ClustalW, Phylogenetic analysis.

Total: 60 Hours

COURSE OUTCOMES:

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

CO1: To Explain the molecular basis of genetic material, DNA replication, transcription, translation, and mutation mechanisms.

CO2: To Analyze gene regulation in prokaryotes and eukaryotes and evaluate various gene transfer mechanisms.

CO3: To Apply recombinant DNA technology tools such as restriction enzymes, cloning vectors, and DNA modifying enzymes for genetic engineering applications.

CO4: To Demonstrate molecular cloning techniques and evaluate different DNA sequencing methods, including Sanger and NGS techniques.

CO5: To Illustrate and compare various blotting techniques, electrophoresis methods, and their role in molecular biology research.

CO6: To Assess the applications of recombinant DNA technology in medicine, agriculture, and gene therapy, including CRISPR-based genome editing.

CO7: To Integrate knowledge of molecular biology with Bioinformatics tools and synthetic biology approaches for advanced genetic Engineering applications.

Text Books:

1.James D. Watson, Tania A. Baker, Stephen P. Bell, et al. (2017), Molecular Biology of the Gene 7th Edition,, Pearson Education

2.Bruce Alberts, Alexander Johnson, Julian Lewis, et al. (2014), Molecular Biology of the Cell , 6th Edition, Garland Science.

3.S.B. Primrose and R.M. Twyman, (2006), Principles of Gene Manipulation and Genomics 7th Edition,, Blackwell Publishing.

Reference Books:

1.James D. Watson, Richard M. Myers, Amy A. Caudy, Jan A. Witkowski, (2006), Recombinant DNA: Genes and Genomes – A Short Course , 3rd Edition,, Cold Spring Harbor Laboratory Press.

2.Larry Snyder and Wendy Champness, (2020), Molecular Genetics of Bacteria, 5th Edition, , ASM Press

3.T. A. Brown (2007), Genomes, 2nd Edn., BIOS Scientific Publishers, Ltd., Oxford, UK.

Web Sources:

1. http://www.cellbiol.com/education.php
2. http://www.cellbiol.com/sequence_tools.php/#basic-tools
3. http://www.cellbiol.com/sequence_tools.php/#basic-tools

24PMIA1_ **OPERATING SYSTEM: LINUX AND PYTHON**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

These objectives are designed to ensure that students not only learn the theoretical aspects of operating systems and Python programming but also gain practical skills that are directly applicable to real-world scenarios. Provide students with a solid understanding of fundamental operating system concepts, including process management, memory management, file systems, and system security, with a focus on Linux.Introduce Python programming with an emphasis on automating system tasks, managing processes, handling files, and interacting with system components in a Linux environment.

UNIT- I LINUX 12

Linux: Basic Linux Operating System - concepts - key commands useful for developers - Introduction to Operating Systems; History and features of UNIX and GNU/Linux. Unix file system, file and directory commands, file permissions. Basic commands, I/O redirection and piping, simple and advanced filters, vi as text editor - Archives and file compressions - Processes: background processes and scheduled processes - alias and environmental variables.

UNIT- II BASH SHELL PROGRAMMING 12

Multiple commands as a shell script- simple shell script creation and execution. Variables: System variables and User defined variables, read values to variables, Mathematic and String handling. Decisions and looping: if, for and while loops, case statement; awk programming, terminal formatting using echo and tput. Functions: calling functions; passing arguments; receiving parameters; local variables; returning values from functions; unsetting functions. Signals: handling signals; ignoring signals.

UNIT- III PYTHON PROGRAMMING 12

Introduction to Python Programming: Memory concepts-arithmetic, string formatting. Decision making: equality and relational operators-control structures-functions, basic sorting searching with data structures, Algorithm analysis tutorial. Python exception hierarchy: finally, clause-exception objects and trace backs-programmer-defined exception classes.

UNIT- IV STRING PROCESSING AND REGEX 12

Fundamentals of characters and strings-string presentation-searching strings-joining and splitting strings. Regular expressions-compiling regular expressions and manipulating regular expression objects, regular expression repetition and placement characters, classes and special sequences, regular expression-string manipulation functions-grouping – biological application assignments

exploiting regular expressions.

UNIT- V FILE PROCESSING **12**

File processing and serialization: Introduction, data hierarchy, files and streams, creating a sequential access file-reading data from a sequential access file, updating sequential access files.

Total: 60 Hours

COURSE OUTCOMES:

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

CO1: Gain proficiency in the Linux operating system, including command-line tools, file system management, user permissions, and process control.

CO2: Develop the ability to perform essential administrative tasks in Linux environments.

CO3: Integrate Python programming with Linux systems to build and manage scalable, robust, and secure applications.

CO4: Demonstrate the ability to analyze problems, design solutions, and implement them using the Linux operating system and Python programming language.

CO5: Build the foundational knowledge required for industry certifications related to Linux and Python, enhancing career readiness in IT and software development fields.

Text Books:

1. Richard Blum, Christine Bresnahan, Linux Command line and Shell Scripting Bible, Wiley, 2015, 3e
2. Martin Jones, Python for Biologists, Create Space Independent Edition, 2013,1e
3. William Mckinney, Python for Data Analysis: Data Wrangling Pandas, NumPy and IPython,O'Reilly Media, 2017, 2e

Reference Books:

1. Robert Love, Linux System Programming, O-ReillyMedia,2013,2e
2. Bill Lubanovic, Introducing Python: Modern Computing in Simple Packages, O'Reily Media, 2014,1e
3. Alex Martelli, Anna Ravenscroft, Steve Holden, Python in a Nutshell - A Desktop Quick Reference, O'Reilly Media, 2017, 3e.

Web Sources:

1. https://archive.nptel.ac.in/courses/106/105/106105214/

24DMIA1_ PROTEOMICS: PRINCIPLES AND TECHNIQUES

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

To acquaint the student with Proteome organization, identification, expression and applications of proteomics analysis. And its applications.

UNIT- I PROTEIN STRUCTURE AND FUNCTION 12

Protein structure and function-Amino acids and their properties-Amino acids form polypeptides-Protein structure – four levels of organization- Post-translational modifications of proteins- Artificial intelligence -based tools for predicting protein secondary and tertiary structures

UNIT- II SYSTEMS BIOLOGY AND PROTEOMICS 12

Emergence of systems biology- Data mining approaches for large-scale proteomics datasets-Integration of proteomics with genomics and metabolomics -Evolution from protein chemistry to proteomics- Promises of proteomics-Techniques commonly used for proteome analysis.

UNIT- III PROTEOME ANALYSIS TECHNIQUES 12

Analysis of proteomes - Two-dimensional polyacrylamide gel electrophoresis, Sample Preparation, Solubilization, Reduction, Resolution, Reproducibility of 2-DEDetecting proteins in polyacrylamide gels, Image analysis of 2-DE gels- Shotgun proteomics approach- Use of Artificial intelligence in automating protein pattern recognition and quantification

UNIT- IV MASS SPECTROMETRY AND MICROARRAY TECHNOLOGY 12

Mass spectrometry-based methods for protein identification- De novo sequencing using mass spectrometric data- Correlative mass spectrometric based identification strategies, Micro array techniques- Types of microarrays, designing a microarray experiment- Next-generation sequencing and proteomics -Microarray Technology in Treating Disease.

UNIT- V GENOMICS AND APPLICATIONS OF PROTEOMICS 12

Analysis of Genomes – Human, Mouse, Plasmodium falsiparum, Saccharomyces cerevisiae, Mycobacterium tuberculosis. Application of proteome analysis- drug development and toxicology, Pharmaceutical Applications, Proteomics in drug Discovery in human, phage antibodies as tools, Glycobiology and Proteomics in plant genetics and breeding- Predictive modeling in drug-target interactions using Artificial intelligence Use of neural networks in biomarker discovery and therapeutic target validation.

Total: 60 Hours

COURSE OUTCOMES:

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

CO1: To understand the basics of genome structure and its organelles.

CO2: To perform a range of practical techniques including DNA extraction and sequencing, RT-PCR, reporter gene assay, metabolomics and genetic mapping.

CO3: To design and analyse gene expression technique using Next Generation Sequencing (NGS) technologies.

CO4: To gain knowledge on Microarray technology.

CO5: To obtain and analyze information and data relating to specific genes using general and plant specific databases, proteomics and metabolomics online portals, next generation sequencing tools and next generation mapping portals.

CO6: To explore the role of proteomics in understanding disease mechanisms and biomarker discovery.

CO7: To integrate computational tools for data analysis in proteomics and genomics research.

Text Books:

1. S. B. Primrose and R.M. Twyman (2006), Principles of Genome Analysis and Genomics, 7th Edition, Blackwell Publishing.

2. 2. S. Sahai (1999) Genomics and Proteomics, Functional and Computational Aspects, Plenum Publication.

Reference Books:

1. Andrezej K Konopka and James C. Crabbe (2004), Compact Hand Book - Computational Biology, Marcel Dekker, USA.

2. Paul B. Fisher, Esha Madan, Rajan Gogna et al., (2024), Cutting Edge Artificial Intelligence, Spatial Transcriptomics and Proteomics Approaches to Analyze Cancer. Academic Press. 978-0-443-29650-4

Web Sources:

1. https://www.technologynetworks.com/proteomics/articles/proteomics-principles-techniques-and-applications-343804

24DMIA1_ RESEARCH AND PRACTICAL APPLICATIONS

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

These objectives aim to equip students with the knowledge, skills, and experience needed to conduct meaningful research and apply it to solve real-world problems effectively. Provide students with a foundational understanding of research methodologies, including qualitative, quantitative, and mixed methods, and their relevance in addressing practical problems.

UNIT- I BIO STATISTICS & RESEARCH METHODOLOGY 12

Introduction to Bio statistics & research methodology, Types of variables & scales of measurements, Measures of central tendency and dispersion, Rate, Ratio, Proportion, Incidence & Prevalence, Sampling Random & non- random sampling, Various methods of sampling, Simple random sampling, Stratified, Systematic, Cluster, Multistage, Sampling & Non sampling errors, Methods of minimizing errors.

UNIT- II CONCEPT OF PROBABILITY 12

Basic probability distribution & Sampling distributions Concept of probability distribution- Normal, Poisson & Binomial distribution-Parameters & Applications Concepts of sampling distribution- Standard Error & Confidence Interval Skewness & Kurtosis. Tests of Significance Basics of Testing of Hypothesis- Null & Alternate Hypothesis- Level of significance (Parametric) & power of test-p Value-Tests of significance- test (Paired & Unpaired),Chi- Square test, Test of Proportion- One-way analysis of variance- Repeated measures of analysis of variance- Test of significance (non-parametric).

UNIT- III CORRELATION COEFFICIENT 12

Simple correlation- Pearson's & Spearman's Testing the significance of correlation coefficient linear & multiple regression Sample size determination General concepts- Sample size for estimating the means & proportion Concept of multivariate analysis- Introduction to logistic regression & survival analysis Reliability & Validity evaluation of diagnostic tests Format of scientific document Structure of research protocol Structure of thesis/ research report- Formats of reporting in scientific journals - Systematic review –Meta analysis.

UNIT- IV ORAL PRESENTATION 12

Oral Presentation: Planning the oral presentations and visuals- In-class discussion Poster Presentation: Elements and Significance of poster presentations- Planning and designing a poster- Individual Poster presentation (Students select a research project/topic and prepare papers and

posters followed by a Q&A sessions).

UNIT- V PERSONALITY DEVELOPMENT & TEAM BUILDING 12

Personality development & team building: Recruitment process and interview techniques, Team work - Personality development - Interpersonal skills, Time and human resources management - Goal setting - planning and scheduling work, stress at work - work-life balance, Culture and cultural ethos - cultural diversity - diversity in organizations.

Total: 60 Hours

COURSE OUTCOMES:

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

CO1: Describe the process of applying research findings to real-world situations, including the steps involved in translating research into practice.

CO2: Implement research findings in practical scenarios, demonstrating the ability to apply theoretical knowledge to solve real-world challenges.

CO3: Examine and interpret data from research studies, identifying patterns, relationships, and trends.

CO4: Critically analyze research outcomes, assessing their validity, reliability, and applicability to practical situations.

CO5: Design and conduct original research projects aimed at solving practical problems, integrating knowledge from multiple disciplines as needed.

Text Books:

1. Dawson, C. (2019). Introduction to research methods (TIFFIN MAIN Q180.55.M4 D36 2019; Fifth edition.). Robinson.

2. Experimental design for the life sciences, 4th edition, by Ruxton, G.D. and Colegrave, N. Oxford University Press, Oxford, 2017.

Reference Books:

1. Kothari, C.R. (2004) Research Methodology: Methods and Techniques. 2nd Edition, New Age International Publishers, New Delhi.

2. Scientific Writing 2.0: A Reader and Writer's Guide, by Jean Luc- Lebrun, World Scientific Publishing Company; 2nd Revised ed., 2011. 55.

Web Sources:

1.https://archive.nptel.ac.in/courses/127/106/127106227/

24SSKP11 **SOFT SKILL 1**

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVE:

- To enable participants Business Communication Skills
- To enhance participants, E-mail writing skills
- To impart Leadership and Team Bonding skills

UNIT- I READING COMPREHENSION AND VOCABULARY 06

Filling the blanks – Cloze Exercise – Vocabulary building – Reading and answering Questions.

UNIT- II LISTENING AND ANSWERING QUESTIONS 06

Listening and writing – Listening and sequencing sentences – Filling in the blanks Listening and answering questions.

UNIT- III GROUP DISCUSSIONS 06

Why GD part of a selection process – Structure of a GD – strategies in GD- Team Work – Body Language

UNIT- IV CONVERSATION. 06

Face to face Conversation and Telephone conversation

UNIT- V SELF- INTRODUCTION AND ROLE PLAY 06

Total: 30 Hours

COURSE OUTCOMES:

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

CO1: Understand the importance of communication skills in English

CO2: Learn the important effective communication techniques

CO3: Prepare the students to meet an interview.

CO4: Introduce the way of communication with others.

CO5: Teach the basic etiquette to face large group of audience with confidence.

Text Books:

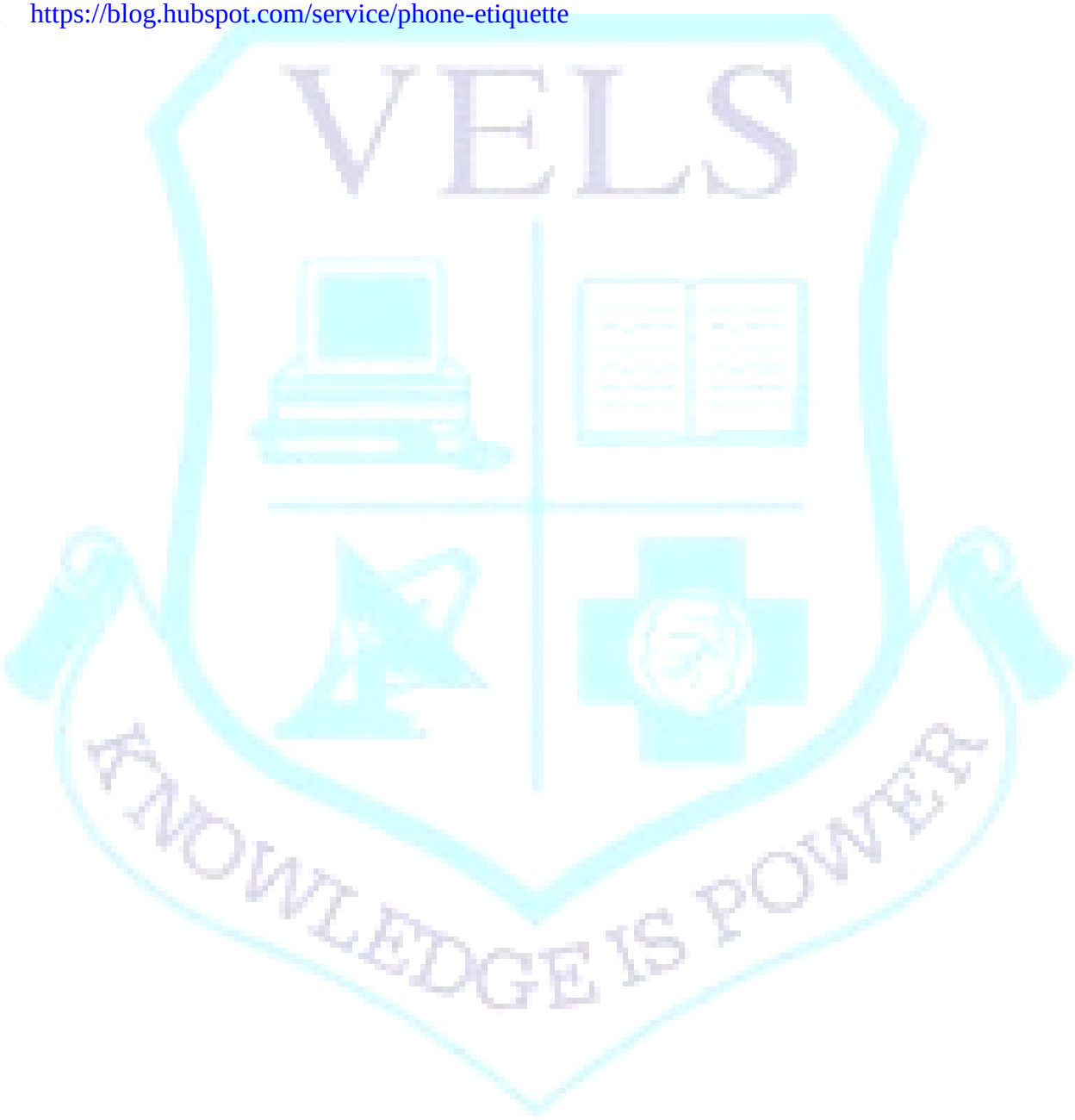
1. Barun K. Mitra (2011). Personality Development and Soft Skills. Oxford University Press. New Delhi.
2. S.P. Sharma (2009), Personality Development. Pustaq Mahal. New Delhi. 2010.Meenakshi Raman and Sangeetha Sharma. Technical Communication. Oxford University Press. New Delhi.

Reference Books:

1. Tiko, Champa & Jaya Sasikumar(1979), Writing with a Purpose.OUP. New Delhi. 1979

Web Sources:

1. https://www.skillsyouneed.com/ips/communication-skills.html
2. https://blog.smarp.com/top-5-communication-skills-and-how-to-improve-them
3. https://blog.hubspot.com/service/phone-etiquette



SEMESTER II

24CMIA21 **DATABASE MANAGEMENT SYSTEM**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

To study about relational databases, database design, structured query language, transcation processing and concurrency control, trends in database technology. Understanding the fundamental principles of database systems, including data modeling, schema design, and relational algebra.

UNIT- I INTRODUCTION TO DBMS 12

File Systems Organization – Limitations of File Systems and Need for DBMS – Views of data - Hierarchical, Network, Relational, and Object-Oriented Data Models – Database Languages –Database System Architecture – Database users and Administrator – Entity– Relationship model (E-R model) – E-R Diagrams -- Introduction to relational databases.

UNIT-II DATABASE DESIGN 12

Design Issues in choosing attributes or entity set or relationship set- Constraints- Super Key- Candidate Keys- Primary Key- ER Diagram Notations- Goals of ER Diagram- Weak Entity Set- ER Diagram Construction- Tabular Representation of Various ER Schema- Views- Functional Dependencies and Decomposition - Normal Forms (1NF, 2NF, 3NF, BCNF)

UNIT-III STRUCTURED QUERY LANGUAGE 12

SQL Standards - Data types - Database Objects- DDL-DML-DCL-TCL-Embedded SQL-Static Vs Dynamic SQL - The Form of Basic SQL Query, UNION, INTERSECT, and EXCEPT- Nested Queries-Aggregate Functions- Null Values. Artificial intelligence assisted query optimization and recommendation systems; integration of SQL with data science platforms (e.g., using SQL in Jupyter Notebooks, Python-Pandas-SQL synergy).

UNIT- IV TRANSACTION PROCESSING AND CONCURRENCY CONTROL 12

Introduction-Properties of Transaction- Serializability- Concurrency Control – Locking Mechanisms-TwoPhaseLocking–Intent Locking – Deadlock- Serializability –Recovery Isolation Levels–SQLFacilitiesforConcurrency.

UNIT- V TRENDS IN DATABASE TECHNOLOGY 12

Overview of Physical Storage Media – Magnetic Disks – RAID – Tertiary storage – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing - Introduction to Distributed Databases- Client server technology- Multidimensional and Parallel databases- Spatial and multimedia databases- Mobile and web databases- Data Warehouse-Mining- Data marts.

Introduction to NoSQL and Big Data (Hadoop, Spark); role of Artificial intelligence in data warehousing and mining; using machine learning models for pattern discovery.

Total: 60 Hours

COURSE OUTCOMES:

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

CO1: To understand the core principles and concepts of database systems, including data modeling and relational algebra.

CO2: To demonstrate proficiency in installing, configuring, and administering popular database management systems.

CO3: To utilize SQL queries to retrieve and manipulate biological data stored in databases.

CO4: To implement data integrity and security measures specific to bioinformatics databases

CO5: To integrate database management skills with bioinformatics tools and workflows to support research and analysis in the field.

CO6: To explore advanced indexing and optimization techniques for efficient data retrieval in large-scale biological databases.

CO7: To apply NoSQL and cloud-based database solutions for handling big data challenges in bioinformatics research.

Text Books:

1.Ramez Elmasri, Shamkant B. Navathe (2011), "Fundamentals of Database Systems", 6th Edition , Pearson / Addision wesley.

2.Raghu Ramakrishnan (2003), "Database Management Systems", 3rd Edition, McGrawHill.

Reference Books:

1.Abraham Silberschatz, Henry F. Kroth, S. Sudarshan (2010), Database System Concepts, 6th Edition, McGraw- Hill Higher Education, USA.

2. R. Arora & S. Chatterjee(2024), Database Management Using AI: A Comprehensive Guide. Packt Publishing. 978-1-80512-987-4.

3.S.K.Singh (2006), "Database Systems Concepts, Design and Applications", 1st Edition, Pearson Education.

Web Sources:

1.https://www.geeksforgeeks.org/database-management-system-introduction-set-1/

2.https://www.studytonight.com/dbms/overview-of-dbms

24CMIA22 **PROGRAMMING IN PERL AND BIOPERL**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

To learn the fundamentals of the Perl programming language and how it can be used to write data reporting and systems administration applications. To discover how to use of the DBI.pm module and related DBD (driver) files with Perl to build database- driven applications.

UNIT- I INTRODUCTION TO PERL 12

Introduction: - Scalar Data- Numbers, Strings, Scalar Variables, Output with print, Getting User Input, The chomp operator, undef Value, defined function, The if and while control structures, Lists and Arrays:- Accessing elements of an array, Special Array indices, List Literals, List Assignment, Subroutines:- Defining a subroutine, Invoking a subroutine, Return values, Arguments, Private variables in subroutines, the return operator.

UNIT- II EXPRESSIONS 12

Input and Output: - Input from Standard Input, Input from the diamond operator, Invocation arguments, Output to Standard Output, Filehandles, Opening a Filehandle, Hashes:- Hash Element Access, Hash Functions, Regular Expressions, Matching with Regular Expressions:- Matches with m//, Option Modifiers, Anchors, The Binding operator, =~, Interpolating into Patterns, The match Variables, General Quantifiers. Processing Text with Regular Expressions: Substitutions with s///, The split Operator, The join Function, m// in List context, More Powerful Regular Expressions- Artificial intelligence application: Pattern recognition in genomic data using regex and Perl.

UNIT- III CONTROL STRUCTURES AND FILES. 12

Control Structures:- The unless Control Structure, The until Control Structure, Expression Modifiers, The Naked Block Control Structure, The elsif Clause, Autoincrement and Autodecrement, The for Control Structure, Loop Controls, Logical Operators, File Tests:- File Test Operators, The stat and lstat functions, The localtime function, Bitwise Operators, Using the Special Underscore Filehandle, Strings and Sorting:- Finding a Substring with index, Manipulating a Substring with substr, Formatting Data with sprint, Advanced Sorting, Perl Modules:- Finding Modules, Installing Modules, Using Simple Modules.

UNIT- IV INTRODUCTION TO BIOPERL 12

Bioperl:- Introduction, Installing Bioperl, General Bioperl Classes, Sequences (Bio::Seq Class, Sequence Manipulation), Features and Location Classes (Extracting CDS), Alignments (AlignIO),

Analysis (Blast, Genscan), Databases (Database Classes, Accessing a local database), Implementing REBASE. Sequence Analysis – Reading, writing, and manipulating DNA/protein sequences.Data Retrieval – Fetching sequences from public databases (GenBank, UniProt). File Format Conversion – Converting between FASTA, GenBank, GFF, and other formats.

UNIT- V WEB SERVERS AND BROWSERS 12

Common Gateway Interface:- Web Servers and Browsers, HTML tags, table, frames, form elements, GET, POST & HEAD Method, URL Encoding, CGI Environment Variables, Handling forms- Artificial intelligence -Driven Dashboards: Introduction to integrating Perl with Artificial intelligence dashboards (via JSON APIs, data visualization tools like R or Python backends).

Total: 60 Hours

COURSE OUTCOMES:

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

CO1: To build the essentials of Perl using subroutines.

CO2: To utilize the concepts of expressions with modifiers.

CO3: To understand the perception of control structures.

CO4: To develop perl program using procedures and functions to solve the biological problems.

CO5: To create the perl script for research project purpose and database creation with CGI.

CO6: Implement BioPerl modules for DNA, RNA, and protein sequence analysis.

CO7: Perform sequence retrieval, annotation, and transformation using BioPerl.

Text Books:

1.Martin C Brown (2001), “Perl the Complete Reference”, Tata McGraw Hill.

Reference Books:

1. Erick Storm (1998), “Perl CGI Programming”, BPB Publication.
2. Steven Holzner (2007), “Per: Black Book”, Second Edition, Dreamtech Publication.
3. Ed Peschko & Michele Dewolf (2000), “Perl Developer’s Guide”, Tata McGraw Hill.

Web Sources:

1. http://bioperl.org/

24CMIA23 CONCEPTS IN ARTIFICIAL INTELLIGENCE

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

This Course mainly focuses more on machine learning, deep learning, probabilistic programming, multiagent systems, and includes sections where the AI's utility function is uncertain, rather than certain.

UNIT- I INTRODUCTION 12

What Is Artificial intelligence - the Foundations of Artificial Intelligence- The History of Artificial Intelligence- Intelligent Agents-How Agents Should Act, Structure of Intelligent Agents, Environments. Machine learning: Supervised Learning, Unsupervised Learning and Reinforcement Learning. Deep Learning: Convolutional Neural Networks, Recurrent Neural Networks and Transformers.

UNIT- II PROBLEM SOLVING 12

Solving Problems by Searching- Problem-Solving Agents, Formulating Problems, Search Strategies, Avoiding Repeated States, Constraint Satisfaction Search- Informed Search Methods- Best-First Search- Heuristic Functions- Memory Bounded Search- Iterative Improvement Algorithms- Game Playing- Introduction, Games as Search Problems, Perfect Decisions in Two-Person Games, Imperfect Decisions, Alpha-Beta Pruning, Games That Include An Element of Chance.

UNIT- III LOGICAL REASONING SYSTEMS 12

Variations, Using First Order Logic-Introduction to Logical Reasoning system Indexing, Retrieval and Unification- Logical Programming Systems- Theorem Provers- Forward- Chaining Production Systems- Frame Systems and Semantic Networks.

UNIT- IV REASONING UNDER UNCERTAINTY 12

Uncertainty- Acting under Uncertainty- Basic Probability Notation- The Axioms of Probability, Bayes' Rule and its Use- Probabilistic Reasoning Systems- Representing Knowledge in an Uncertain Domain the Semantics of Belief Networks- Inference in Belief Networks, Inference in Multiply Connected, Belief Networks- Non monotonic reasoning- Dealing with ignorance- Dempster Shafer theory- Dealing with vagueness- Fuzzy logic and fuzzy sets.

UNIT- V PLANNING AND LEARNING 12

Conditional Planning, The nature of conditional, Extending the plan language.Planning A Simple Planning Agent- From Problem Solving to Planning, Planning in Situation Calculus, Basic Representations for planning, A Partial-Order Planning Example, A Partial-Order Planning Algorithm- Learning. - A General Model of Learning Agents, Inductive Learning, Learning Decision Trees- Neural Networks- Bayesian Methods for Learning Belief, Networks- Genetic Algorithms and Evolutionary Programming- Knowledge in Learning- Explanation-Based Learning.

Total: 60 Hours

COURSE OUTCOMES:

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

CO1: To compare AI with human intelligence and traditional information processing.

CO2: To design AI functions and components involved in intelligent systems such as computer games.

CO3: To analyze the structures and algorithms of a selection of techniques related to searching, reasoning, machine learning, and language processing.

CO4: To apply the basic principles, models, and algorithms of AI to recognize, model, and solve problems in the analysis and design of information systems.

CO5: To discuss the core concepts and algorithms of advanced AI.

CO6: Apply classification, clustering, and reinforcement learning techniques to biological data analysis.

CO7: Explain Conditional Planning and its role in AI-driven biomedical research and diagnostics.

Text Books:

1. McGraw-Hill Education, (2024). Fundamentals of Artificial Intelligence: Problem Solving and Language Understanding ISBN 978-1-260-46778-9.

2. George F Luger(2001), “Artificial Intelligence”, Pearson Education, 4th Edition.

Reference Books:

1. Wolfgang Ertel.(2024), Introduction to Artificial Intelligence Springer Undergraduate Topics in Computer Science. ISBN 978-3-031

Web Sources:

1. https://cbseskilleducation.com/

24PMIA21 PRACTICAL 2- DATABASE MANAGEMENT SYSTEM

L	T	P	O	C
0	0	4	2	2

COURSE OBJECTIVE:

To study about relational databases, database design, structured query language, transaction processing and concurrency control, trends in database technology. Practical sessions often involve tasks such as creating database tables, defining relationships, writing complex SQL queries, optimizing database performance, and implementing security measures.

1.	Creating a Bioinformatics Database/Table	**03**
a)	Creating a Database	
b)	Creating a Table	
c)	Inserting Data into the bioinformatics Database	
d)	Query the database to retrieve specific information	
2.	Delete records from the bioinformatics database	**03**
3.	Updating records in the bioinformatics database using AI.	**03**
4.	Retrieving Records	**03**
5.	Retrieving specific rows and columns	**03**
6.	Use of MySQL operators – Arithmetic operators, Comparison	**03**
7.	Operators, Logical operators	**03**
8.	Math functions, Aggregate functions	**03**
9.	String operations	**03**
10.	Limiting, Sorting and grouping query results	**03**

Total: 30 Hours

COURSE OUTCOMES:

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

CO1: To build the fundamentals of DBMS

CO2: To utilize the concepts of user interface

CO3: To utilize the VB classes and objects

CO4: To design the DBMS and role in database creation

CO5: To design the ORACLE and its connectivity

Text Books:

1. Steven Holzner (2000), “Visual Basic 6 Programming: Black Book”, Dreamtech Press.
2. C. J. Date, A. Kannan (2006), “Database Systems”, Pearson Education Publication.

Reference Books:

1. Noel Jerke (1999), “Visual Basic 6: The Complete Reference”, Tata McGraw Hill.

2. Kevin Loney, George Kuch (2005), “Oracle – The complete Reference”, Tata McGraw Hill Publication.

3. C. J. Date (1990), “Database Systems”, Addison Wesley Publication, 1990.

Web Sources:

1. https://www.geeksforgeeks.org/database-management-system-introduction-set-1/

2.https://www.studytonight.com/dbms/overview-of-dbms.php

24PMIA22 PRACTICAL 3- PROGRAMMING IN PERL AND BIOPERL

L	T	P	O	C
0	0	4	2	2

COURSE OBJECTIVE:

To learn the fundamentals of the Perl programming language and how it can be used to write data reporting and systems administration applications. To discover how to use of the DBI.pm module and related DBD (driver) files with Perl to build database- driven applications.

1. Write a Perl program to find the length of the given sequence? **02**
2. Write a Perl program to reverse and concatenation of the given sequence? **02**
3. Write a Perl program to complement and reverse complement of DNA sequence? **02**
4. Write a Perl program to calculate GC content in the given DNA sequence? **02**
5. Write a Perl program to translate DNA into Protein Sequence? **02**
6. Operators and Expressions. **02**
7. Branching and Looping. **02**
8. Formatting Data. **02**
9. Sort an Array of Strings in Reverse Order. **02**
10. Splitting DNA sequence into Pieces by Using split (). **02**
11. How do I read or write Fasta files using Bioperl? **02**
12. Comparing two Sequences. **02**
13. How do I calculate the true length of a Sequence? **02**
14. Converting sequences between different formats (FASTA, GenBank, EMBL) **02**
15. Writing a BioPerl script to submit sequences for a BLAST search **02**

Total: 30 Hours

COURSE OUTCOMES:

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

CO1: To build the essentials of Perl using subroutines.

CO2: To utilize the concepts of expressions with modifiers

CO3: To understand the perception of control structures.

CO4: To develop perl program using procedures and functions to solve the biological problems.

CO5: To create the perl script for research project purpose and database creation with CGI.

CO6: Implement BioPerl modules for DNA, RNA, and protein sequence analysis.

CO7: Perform sequence retrieval, annotation, and transformation using BioPerl.

Text Books:

1. Martin C Brown (2001), “Perl The Complete Reference”, Tata McGraw Hill.

Reference Books:

1. Erick Storm (2020), “Perl CGI Programming”, BPB Publication, 1998.
2. Steven Holzner (2021), “Per: Black Book”, Second Edition, Dreamtech Publication, 2007.

Web Sources:

1. http://bioperl.org/

24DMIA2_ **GENOMICS AND TRANSCRIPTOMICS**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

The course intends to give advanced theoretical knowledge on genomic organization and Genomic methods like microarray and transcriptome analysis

UNIT- I ORGANIZATION AND STRUCTURE OF GENOMES 12

General organization and structure of genomes of viruses, prokaryotes, eukaryotes, and organelles (chloroplast, mitochondrion), Epigenetic modifications and their role in genome organization (DNA methylation, histone modifications).

UNIT- II GENOME MAPPING AND SEQUENCING 12

Isolation and cloning of genomic DNA, Genome mapping (genetic and physical), Genetic Variations- PCR SNP, DNA Marker- Restriction Fragment Length Polymorphism, (RFLP), DNA Fingerprinting, RAPDs, AFLPs, SSLPs, linkage analysis, Restriction mapping, FISH, Chromosome painting, microsatellites, Chain termination and chemical degradation sequencing methods, Whole genome sequencing. Introduction to Next Generation Sequencing (NGS) -Illumina Sequencing

UNIT- III GENE EXPRESSION ANALYSIS 12

Comparative Genomic Hybridization (CGH); Serial Analysis of Gene Expression (SAGE); Massively parallel Signature Sequencing (MPSS); Analysis of alteration in gene expression by Differential Display and Suppression Subtractive Hybridization. Single-cell RNA sequencing (scRNA-seq) and its applications, Ribosome profiling for understanding translational regulation.

UNIT- IV MICROARRAY TECHNOLOGY AND ANALYSIS 12

Designing and producing microarrays; cDNA microarray technology; oligonucleotide arrays and designs; Sample preparation, labeling, hybridization, generation and analysis of microarray data.

UNIT- V HIGH-THROUGHPUT TRANSCRIPTOMICS ANALYSIS 12

RNA sequencing, Methylome analysis using microarray; ChIP-on-Chip; Bisulfite sequencing, MIRA, BisChip Sequencing, X-Chip, PAT Chip, CaptureSequencing, PAL Sequencing, ChIRP, RAP, BRIC-Sequencing, PAIRSequencing approaches, characteristics and analysis of small RNA like microRNAs and phasiRNAs, Analysis of long non-coding RNAs, Target prediction and functional prediction for small RNAs and lncRNAs, Applications of transcriptomics. Metatranscriptomics for analyzing gene expression in microbiomes

Total: 60 Hours

OURSE OUTCOMES:

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

CO1: To Explain the organization and structure of genomes in viruses, prokaryotes, eukaryotes, and organelles.

CO2: TO Explain genome mapping and sequencing techniques, including next-generation and third-generation sequencing technologies.

CO3: To Analyze various gene expression analysis techniques such as CGH, SAGE, and RNA sequencing.

CO4: To Demonstrate the principles and applications of microarray technology in transcriptomics studies.

CO5: To Evaluate high-throughput transcriptomics approaches like RNA-Seq, ChIP-seq, and methylome analysis.

CO6: To Integrate multi-omics data (microarray, RNA-Seq, and proteomics) for gene expression analysis and biomarker discovery.

CO7: To Apply genomics and transcriptomics techniques in biomedical research, drug discovery, and personalized medicine.

Text Books:

1. Brown, T. A. (2018), *Genomes 4* ,4th Edition, Garland Science

2. Lodish, H., Berk, A., Kaiser, C. A., et al. (2021), *Molecular Cell Biology* 9th Edition, W. H. Freeman

Reference Books:

1. **Pevsner, J.** (2022), Bioinformatics and Functional Genomics (3rd Edition) Wiley-Blackwell.

2. Wang, Z., & Liu, X. (2023), RNA-Seq: Principles and Applications, Springer

Web Sources:

1.https://www.ncbi.nlm.nih.gov/books/

24BMIA2_ BIOMOLECULAR SIMULATION TECHNIQUE

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

The objective of this course is to introduce students to biomolecular simulation techniques, focusing on molecular dynamics and Monte Carlo methods. Students will learn to model and simulate biological macromolecules, gaining insights into their structure, dynamics, and interactions. The course will also cover computational tools, force fields, and software used in biomolecular simulations. By the end, students will be able to apply these techniques to solve real-world problems in biology and chemistry

UNIT- I MOLECULAR MECHANICS 12

Introduction, The Morse Potential, The Harmonic Oscillator Model for Molecules, Comparison of Morse and Harmonic Potential, Two atoms connected by a bond, Poly atomic Molecules, Energy due to Stretch, Bend, Stretch-Bend, Torsional strain, van der Waals and Dipole-Diploe interactions. Types of Potentials: Lennard-Jones, Truncated Lennard-jones, Exponential-6, Ionic and Polar potentials. Types of Force Fields: AMBER, CHARMM, Merck Molecular Force Field, Consistent Force Field, MM2, MM3 and MM4 force fields.

UNIT- II POTENTIAL ENERGY SURFACE 12

Convergence Criteria, Characterizing Stationary Points, Search for Transition States. Optimization:- multivariable Optimization Algorithms, Gradients, Optimization Criteria, Unidirectional Search, Finding Minimum Point, Gradient based Methods-Steepest Descent and Conjugate Gradient Methods.

UNIT- III MOLECULAR DYNAMICS SIMULATION 12

Introduction, Radial distribution functions, Pair Correlation function, Newtonian dynamics, Integrators- Leapfrog and Verlet algorithm, Potential truncation and shifted-force potentials, Implicit and explicit Solvation models, Periodic boundary conditions, Temperature and pressure control in molecular dynamics simulations.

UNIT- IV MOLECULAR MODELLING IN DRUG DESIGN 12

Conformational analysis, lead identification, optimization and validation. Methods and Tools in Computer-aided molecular Design, Analog Based drug design:-Pharmacophores and QSAR. Structure based drug design:- Docking, De Novo Drug Design, Virtual screening.

UNIT- V STRUCTURE ACTIVITY RELATIONSHIP 12

Introduction to QSAR, QSPR, and Various Descriptors used in QSARs, Regression Analysis, Significance and Validity of QSAR Regression Equations, Partial Least Squares (PLS) Analysis, Multi Linear Regression Analysis. Application of Genetic Algorithms, Neural Networks and Principle Components Analysis in QSAR analysis

Total: 60 Hours

COURSE OUTCOMES:

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

CO1: Understand the fundamental principles of molecular simulations and their application in biomolecular systems.

CO2: Apply computational methods to model and simulate biomolecules and their interactions.

CO3: Analyze the structure, dynamics, and thermodynamics of biomolecular systems using simulation techniques.

CO4: Develop expertise in using simulation software for molecular dynamics and related methods.

CO5: Evaluate the results of biomolecular simulations for real-world biological and pharmaceutical research applications.

Text Books:

1. Computational Chemistry and Molecular Modeling-Principles and Applications by Ramachandran, Deepa and Namboori, 2008, Springer_Verlag. Reference for Unit 1 and 2.

2. Molecular Modeling Principles and Applications (2nd Ed.) by Andrew R. Leach, Prentice Hall, USA. 2001

Reference Books:

1. Molecular Modelling for Beginners, (2nd Edition) by Alan Hinchliffe, John Wiley & Sons Ltd. 2008

25INPG21 **INTERNSHIP**

L	T	P	O	C
0	0	2	1	2

COURSE OBJECTIVE:

- An internship is a professional learning experience that offers meaningful, practical work related to a student's field of study or career interest.
- An internship gives a student the opportunity for career exploration and development, and to learn new skills.
- It offers the employer the opportunity to bring new ideas and energy into the workplace, develop talent and potentially build a pipeline for future full-time employees.
- To gain experience and skills in a particular field.
- To develop professional contacts.
- To gain exposure to upper management.

24SSKP12 **SOFT SKILL II**

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVE:

- To enable students to develop their communication skills effectively
- To enhance students Reading, Writing, Listening and Speaking skills
- To develop their self-confidence through communication

UNIT- I PRESENTATION SKILLS 06

Elements of an effective presentation – structure of presentation – voice modulation – Audience analysis – Body language

UNIT- II SOFT SKILLS 06

Time Management – Articulateness – Assertiveness – Stress management

UNIT- III RESUME / REPORT PREPARATION / LETTER WRITING 06

Structuring the resume / Report – Business letters – E-Mail Communication

UNIT- IV INTERVIEW SKILLS 06

Kinds of Interviews – Required by Skills – Corporate Culture – Mock Interviews

UNIT- V 30 FREQUENTLY ASKED QUESTIONS 06

Total: 30 Hours

COURSE OUTCOMES:

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

CO1: Illustrate the essential of presentation skills, thoughts, structure, voice modulation, audience analysis and body language

CO2: Utilize the psychological skills pertaining to time management, articulation, assertion and stress management

CO3: Construct methodology for preparation of resume, reports, business letters and email communication

CO4: Appraise learners with varied skills needed for expose to interviews

CO5: Categorize the nature of questions asked usually in interviews

Text Books:

1. Barun K.Mitra (2011), Personality Development and soft skills. Oxford University Press. New Delhi.

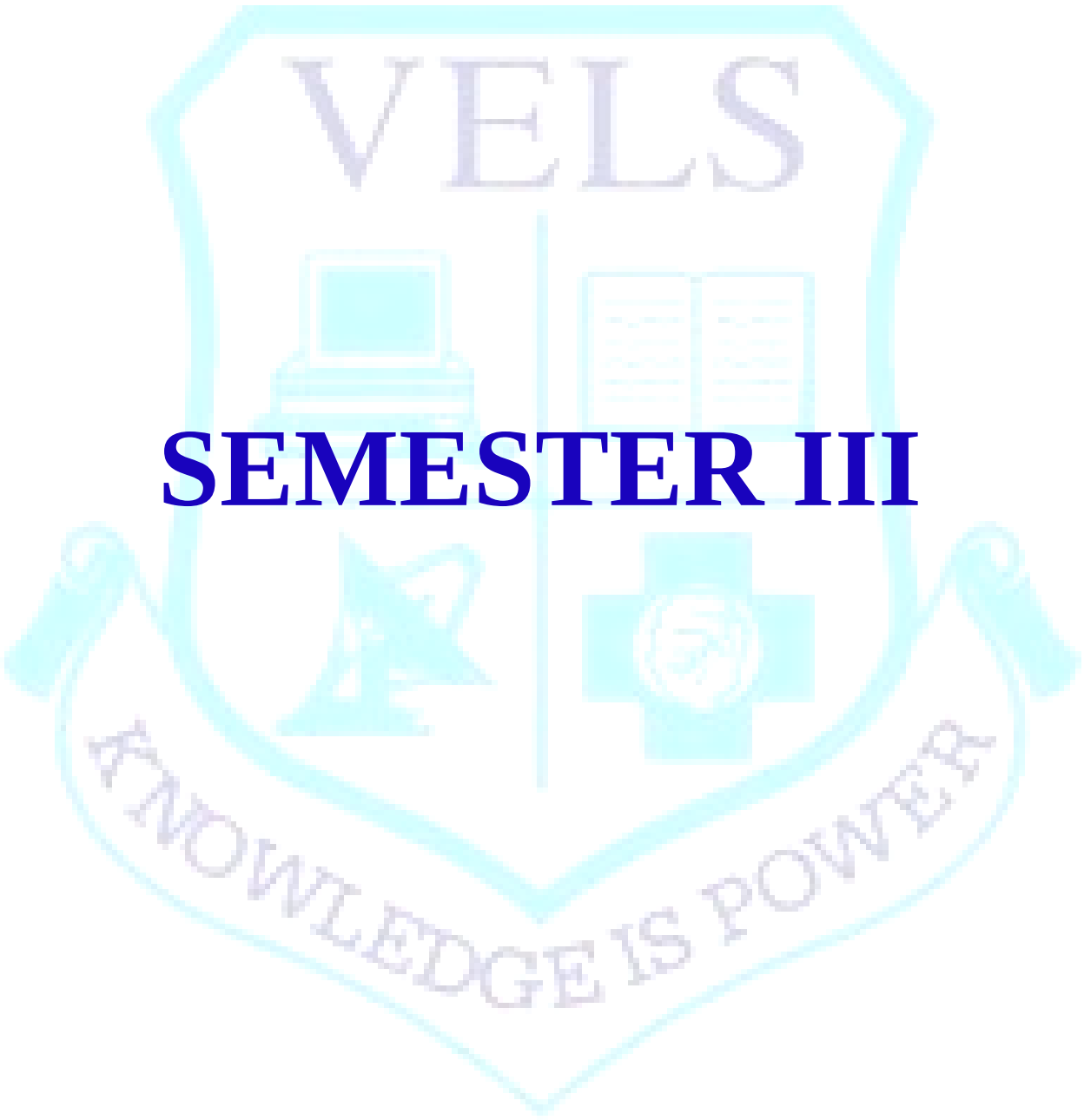
2. S P Sharma (2010), Personality Development. Pustaq Mahal. New Delhi. 2010

Reference Books:

1. Meenakshi Raman and Sangeetha Sharma(2009), Technical Communication. Oxford University Press. New Delhi.

Web Sources:

1. https://www.skillsyouneed.com/ips/communication-skills.html
2. https://www.businessnewsdaily.com/5836-top-interviewing-skills.html
3. https://gdpi.hitbullseye.com/Group-Discussion.php



SEMESTER III

24CMIA31 **COMPUTER AIDED DRUG DESIGNING**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

This course will enable the students to understand the critical relationship among biomolecular structure, function and force field models. To utilize basic modeling techniques to explore biological phenomena at the molecular level. To emphasize Modelling drug/receptor interactions in detail by molecular mechanics, molecular dynamics simulations and homology modeling.

UNIT -I MOLECULAR MODELING AND MECHANICS **12**

Basic Concepts of Molecular Structure: Bond Length, Bond Angle, Torsion Angle, Non- Covalent Interactions and force field parametrisation and transferability – Molecular Structure and Internal Energy – Energy Minimization, Derivative and Non-Derivative Methods, Local and Global Minima- Introduction to Artificial intelligence -enhanced force field prediction models and neural network potentials (e.g., ANI, DeepMD).

UNIT -II QUANTUM MECHANICS **12**

Introduction to Computational Quantum Mechanics: One Electron Atom, Poly Electronic Atoms and Molecules- Machine Learning Surrogates for Quantum Calculations: Gaussian Process Regression, Neural Network Potentials- Hatree Fock Equations, Molecular Properties calculation using Ab initio and Semi Empirical Methods, Density Functional Theory, Moller and Plesset Perturbation Theory.

UNIT -III MOLECULAR MODELING AND DOCKING **12**

Molecular Modeling in Drug Discovery, Sequence Analysis, Secondary structure prediction, Tertiary Structure prediction- Homology Modeling, Threading and ab-initio methods, Structure validation, Molecular Docking – Introduction, Approaches (Simulation and Shape complementarity approach), Molecular Docking Algorithm, Docking Optimization- Scoring functions, Molecular Docking Application- Deep Learning-Based Docking and Binding Affinity Prediction (e.g., DeepDock, GNINA).

UNIT -IV PHARMACOPHORE **12**

Pharmacophore – Historical Perspective and Features, Viewpoint of Pharmacophore, Pharmacophore modeling- Molecular alignments, handling flexibility, alignment techniques,

scoring and optimization, conformational expansion, validation and usage- Artificial intelligence - based Pharmacophore Scoring and Virtual Screening- Applications of pharmacophore model in medicinal chemistry.

UNIT -V MOLECULAR DYNAMICS **12**

Molecular Dynamics- Introduction, MD using simple models, MD with continuous potentials, setting up and running a molecular dynamics simulation, Constraint Dynamics, Monte Carlo Simulation Methods- Monte Carlo simulation of molecules, Simulation Analysis.

Total: 60 Hours

COURSE OUTCOMES:

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

CO1: To understand the fundamentals of molecular mechanics and its structure.
CO2: To analyze the concept of computational quantum mechanics using energy theory.
CO3: To apply the basic principles, models, and theory of molecular docking in drug designing.
CO4: To design the model using molecular ligand system and their pharmacophore prediction.
CO5: To learn the various methods of dynamic approaches in the *Insilco* docking studies.

Text Books:

1.Andrew R. Leach. Molecular Modelling: Principles and Applications, second edition. Pearson Education EMA, January 2001 ISBN 0-582-38210-6

Reference Books:

1.Jürgen Bajorath, Stanislav Radic, Haydar Tastan, et al. (2023), Machine Learning for Drug Discovery, Manning Publications.

2.Guy H. Grant and W. Graham Richards. Computational Chemistry Oxford Chemistry Primers, 29 1995. 9780198557401.

Web Sources:

https://nptel.ac.in/courses

24CMIA22 **ADVANCED PROGRAMMING IN JAVA**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

To introduce the principles of Object-Oriented Programming using Java. This course aims to provide students with foundational and advanced concepts of Java programming, including class design, control structures, inheritance, packages, exception handling, multithreading, file I/O, and GUI development using AWT. The course prepares students to design and develop real-world applications using Java effectively.

UNIT -I INTRODUCTION TO OOP's AND JAVA FUNDAMENTALS 12

Introduction to OOPS: Paradigms of Programming Languages – Basic concepts of Object Oriented Programming – Differences between Procedure Oriented Programming and Object Oriented programming - Benefits of OOPs – Application of OOPs. Java: History – Java features – Java Environment – JDK – API. Introduction to Java: Types of java program – Creating and Executing a Java program – Java Tokens- Java Virtual Machine (JVM) – Command Line Arguments –Comments in Java program.

UNIT - II CORE JAVA ELEMENTS AND CONTROL STRUCTURES 12

Elements: Constants – Variables – Data types - Scope of variables – Type casting – Operators: Special operators – Expressions – Evaluation of Expressions. Decision making and branching statements- Decision making and Looping– break – labeled loop – continue Statement. Arrays: One Dimensional Array – Creating an array – Array processing – Multidimensional Array – Vectors – ArrayList – Advantages of Array List over Array Wrapper classes.

UNIT-IIICLASSES, OBJECTS, INHERITANCE, AND INTERFACES 12

Class and objects: Defining a class – Methods – Creating objects – Accessing class members – Constructors – Method overloading – Static members –Nesting of Methods – this keyword – Command line input. Inheritance: Defining inheritance –types of inheritance– Overriding methods – Final variables and methods – Final classes – Final methods - Abstract methods and classes – Visibility Control- Interfaces: Defining interface – Extending interface - Implementing Interface - Accessing interface variables. Strings: String Array – String Methods – String Buffer Class.

UNIT - IV PACKAGES, EXCEPTION HANDLING, AND MULTITHREADING 12

Packages: Java API Packages – System Packages – Naming Conventions –Creating & Accessing a Package – Adding Class to a Package – Hiding Classes. Exception Handling: Limitations of Error

handling – Advantages of Exception Handling - Types of Errors – Basics of Exception Handling – try blocks – throwing an exception – catching an exception – finally statement. Multithreading: Creating Threads – Life of a Thread – Defining & Running Thread – Thread Methods – Thread Priority – Synchronization –Implementing Runnable interface – Thread Scheduling.

UNIT - V I/O INPUT/OUTPUT STREAMS, APPLETS, AND AWT COMPONENTS 12

Streams: File – Streams – Advantages - The stream classes – Byte streams –Character streams. Applets: Introduction – Applet Life cycle – Creating & Executing an Applet –Applet tags in HTML – Parameter tag – Aligning the display - Graphics Class: Drawing and filling lines – Rectangles – Polygon – Circles – Arcs – Line Graphs – Drawing Bar charts AWT Components and Even Handlers: Abstract window tool kit – Event Handlers – Event Listeners – AWT Controls and Event Handling: Labels – Text Component – Action Event – Buttons – Check Boxes – Item Event – Choice– Scrollbars – Layout Managers- Input Events – Menus.

Total: 60 Hours

COURSE OUTCOMES:

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

CO1: Understand the fundamental concepts of Object-Oriented Programming and Java syntax, including JVM and program structure.

CO2: Apply control structures, operators, and arrays in Java for effective problem-solving and logic building.

CO3: Develop Java applications using classes, objects, constructors, method overloading, and inheritance.

CO4: Design and implement interfaces, handle strings and vectors, and apply modular programming principles using packages**.**

CO5: Apply exception handling and multithreading concepts to build efficient, error-tolerant Java applications.

CO6: Perform file I/O operations using Java streams and understand the use of applets and graphics programming.

CO7: Build user interfaces and manage events using Java's Abstract Window Toolkit (AWT) and event-handling mechanisms.

Text Books:

1. E Balagurusamy, "Programming with Java: A Primer", Fourth Edition, Tata McGrawHill,

2010

2. Sagayaraj, Denis, Karthick and Gajalakshmi, “Java Programming for Core and advanced learners”, Universities Press (INDIA) Private Limited 2018.

Reference Books:

1. P. Naughton and H.Schildt- Java2 (The Complete Reference) - Third Edn.TMH1999.

2. Deital & Deital, “How to Program Java”, Pearson Education, 1999.

3. Cays Horstmann, Gary Cornell, “Core Java 2: Advanced Features”, Sun MicroSystem, 2007.

Web Sources:

1. **https://www.cwipedia.in/2020/12/22517-notes-pdf-ajp-msbte.html**

24CMIA23 **DATA SCIENCE IN BIOINFORMATICS**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

Understand fundamentals skills needed for application of bioinformatics and data science across life science disciplines using biomedically-relevant examples. Topics will include fundamental computational skills, data preparation, FAIR data practices, basic concepts and applications of Omics and Artificial intelligence and Machine Learning in life sciences, and effective communication of results.

UNIT -I INTRODUCTION AND BASIC DATA SCIENCE 12

Introduction to R, R studio, Bioconductor, open-source software and Terminal. Basics of R, including install and configure software necessary for a statistical programming environment. Data aggregation and pivoting examples. Joining of tables. Loading in data, data frames, Data types (numerical, categorical, ordinal).

UNIT -II DESCRIPTIVE STATISTICS 12

Basic statistics, descriptive statistics, frequencies, data distribution and transformation, variance, and standard error. Prevalence, incidence. Sensitivity, specificity, analytical validity w/ ppv, false discovery rate.

UNIT -III SUPERVISED STATISTICAL TESTS 12

Tests in Data Science. Supervised vs. Unsupervised, Parametric and nonparametric statistical tests: T-test, Mann-Whitney test, ANOVA, Kruskal-Wallis.

UNIT -IV UN-SUPERVISED STATISTICAL TESTS, MULTIPLE TESTING 12

Calculate and adjust p values, confidence intervals. Survival analysis. Data correlation of gene expression and survival analysis; multiple testing, Bonforonni, Benjami-Hochberg, and false discovery rate.

UNIT -V APPLIED DATA SCIENCE AND BIOINFORMATICS 12

Enrichment analysis (EA): Hypergeometric, Binomial, Chi-squared, Fisher's exact test. Statistical normalization of genes. Quantile filter of genes. Generate boxplot of normalized and non-normalized data. Gene Ontology (GO) and Pathway enrichment bar plots.

Total: 60 Hours

COURSE OUTCOMES:

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

CO1: To understand the fundamental concepts of bioinformatics and its application in biological data analysis.
CO2: To apply data preprocessing techniques to clean and prepare biological datasets for analysis.
CO3: To utilize statistical methods and machine learning algorithms to analyze biological data and extract meaningful insights
CO4: To demonstrate proficiency in programming languages commonly used in bioinformatics such as Python and R.
CO5: To design and implement bioinformatics pipelines for tasks such as sequence alignment, gene expression analysis, and variant calling.

Text Books:

1. Bioinformatics: Sequence and Genome Analysis. David W. Mount, Second Edition, 2004.
2. Introduction to Computational Biology: Maps, Sequences and Genomes, Fourth Edition, Michael S. Waterman, 1995.

Reference Books:

1. Introduction to Bioinformatics, Arthur M. Lesk, Fourth Edition, 2013.
2. Bioinformatics Algorithms: An Active Learning Approach, Phillip Compeau and Pavel Pevzner, First Edition, 2014.
3. Bioinformatics For Dummies, Jean-Michel Claverie, Cedric Notredame, First Edition, 2007.

Web Sources:

1. https://www.bioinformatics.org/
2. https://www.ncbi.nlm.nih.gov/
3. https://www.bioconductor.org/
4. https://www.ebi.ac.uk/
5. https://genome.ucsc.edu/

24PMIA21 PRACTICAL 4- COMPUTER AIDED DRUG DESIGNING

L	T	P	O	C
0	0	4	2	2

COURSE OBJECTIVE:

This course will enable the students to understand the critical relationship among Biomolecular structure, function and force field models. To utilize basic modeling techniques to explore biological phenomena at the molecular level. To emphasize Modelling drug/receptor interactions in detail by molecular mechanics, molecular dynamics simulations and homology modeling.

1. Biological sequence retrieval using NCBI and Uniprot to analysis blast p/n. **02**
2. Physical and chemical properties of protein using Protparam **02**
3. Predict the secondary structure of the given sequence using sopma. **02**
4. Homology modelling using Swiss model and model validation using saves. **02**
5. Active site prediction for targeted protein using CastP **02**
6. Retrieve drug molecule using pubchem or drug bank and small molecule building, using CHEM SKETCH **02**
7. Protein-Protein network prediction by string **02**
8. Protein-Ligand interaction prediction by patchdock or arguslab **02**
9. Visualization and validation using Pymol and Discovery studio software **02**
10. Functional prediction of hypothetical proteins using cdd and Pfam **02**
11. Virtual screening using Artificial intelligence driven tools such as DeepDock or GNINA (Artificial intelligence powered docking engines) **02**
12. Comparative model performance analysis of molecular docking using Machine Learning regression models (e.g., Random Forest) **02**
13. Drug-likeness and ADMET prediction using Artificial intelligence based platforms like SwissADME, admetSAR, or DeepADMET. **02**

14. Introduction to machine learning for QSAR modeling using AutoQSAR or Orange Data Mining **02**

15. Data-driven clustering of compounds using PCA and K-means in Python/R for chemical space analysis **02**

Total: 30 Hours

COURSE OUTCOMES:

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

CO1: To design the small molecules using softwares.
CO2: Able to model the protein structure with the help of modelling softwares.
CO3: To analyse and validate the structure of protein.
CO4: To demonstrate the concepts of molecular docking and dynamics using softwares.
CO5: To perform and handled large sets of compounds using screening method.

Text Books:

1. Andrew R. Leach. Molecular Modelling: Principles and Applications, second edition. Pearson Education EMA, January 2001 ISBN 0-582-38210-6

Reference Books:

1. D. C. Rapaport, The Art of Molecular Dynamics Simulation, 2004, ISBN 0-521- 82568-7
2. M. P. Allen, D. J. Tildesley, Computer simulation of liquids, 1989, Oxford University Press, ISBN 0-19-855645-4.
3. R. J. Sadus, Molecular Simulation of Fluids: Theory, Algorithms and Object-Orientation, 2002, ISBN 0-444-51082-6
4. J.M.Haile, Molecular Dynamics Simulation Elementary Methods, John Wiley 1997.

Web Sources:

1.**https://nptel.ac.in/courses**

24DMIA3_ **PYTHON FOR BIOINFORMATICS**

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVE:

Read and understand the Python syntax. Be familiar with Python's fundamentals and develop simple applications. Apply the principles and techniques of object- oriented programming. Use sophisticated techniques and Python modules that are particularly useful for bioinformatics programming. Build new Python software tools for life science research. Summarize text patterns using regular expressions.

UNIT -I INTRODUCTION TO PYTHON 09

Introduction to Python, History of Python, Python Features, Python Development Tools, Writing Python Program, Values and Variables:- Numeric Values, Variables and Assignment, Identifiers, Control codes within Structure, Controlling the print Function

UNIT -II EXPRESSION 09

Expressions and Arithmetic:- Operator Precedence and Associativity, Comments, Errors (Syntax, Run-time errors, Logic Errors), Arithmetic Examples, Conditional Execution - Simple if Statement, if/else statement, Compound Boolean Expressions, Nested Conditionals, Multi-way Decision Statements, Conditional Expressions- Introduction to Artificial intelligence Logic: Rule-based Decisions in Genomic Datasets.

UNIT -III CONDITIONAL EXECUTION 09

Conditional Execution:- What is conditional statement in Python, Simple if Statement, if/else statement, nested if condition, else – if ladder, Compound Boolean Expressions, Nested Conditionals, Multi-way Decision Statements, Conditional Expressions.

UNIT -IV ITERATION 09

Iteration:- While Statement, For Statement, Nested Loops, the break statement, the continue statement, Infinite Loops, Computing Square roots, Drawing a Tree, Using Functions – mathematical functions – time Functions, reading the files from existing database using Python.

UNIT -V SEQUENCE ANALYSIS THROUGH PYTHON 09

Sequence Alignment:- Alphabets, Matching Sequences – Perfect Matches – Insertions and Deletions – Rearrangements – Global Versus Local Alignments – Sequence Length, Simple Alignment (Direct Alignment), Statistics:- Simple Statistics, Distributions, Normalizations,

Multivariate Statistics, Probabilities, Odds.

Total: 45 Hours

COURSE OUTCOMES:

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

CO1: To understand why Python is a useful scripting language for developers.
CO2: To learn how to design object-oriented programs with Python classes.
CO3: To learn how to use indexing and slicing to access data in Python programs.
CO4: To learn how to write functions and pass arguments in Python.
CO5: To learn how to use exception handling in Python applications for error handling

Text Books:

1.Jason Kinser, "Python for Bioinformatics", Jones and Bartlett Publishers, Sudbury, Massachusetts 2009

Reference Books:

1.Richard L., Halterman, "Learning to Program With Python", 2011
2.Kent D. Lee, "Python Programming Fundamentals: Second Edition", Springer, 2010.
3.Cody Jackson, "Learning to Program Using Python", Second Edition, 2013
4.Mark Lutz, "Learning Python", Third Edition, O'Reilly, 2007.

Web Sources:

1.https://in.search.yahoo.com/search?fr=mcafee&type=E210IN885G0&p=Python+for+Bioinformatics+-+Biopython+Tutorial

24DMIA3_ **MACHINE LEARNING IN BIOINFORMATICS**

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVE:

To know Basic algorithms, Learning algorithms, Applications: general aspects, proteins, DNA and RNA

UNIT -I INTRODUCTION TO MACHINE LEARNING 09

Introduction-Bayesian modeling-Cox Jaynes axioms- Bayesian inference and induction- models structures- examples.

UNIT -II DYNAMIC PROGRAMMING 09

Dynamic programming- EM/ GEM algorithms-Markov chain Monte carlo methods-simulated annealing- genetic algorithm-Neural networks.

UNIT -III STRUCTURE PREDICTION 09

Sequence coding- correlations- Prediction: secondary structure, signal peptides and cleavage sites- applications for DNA & RNA nucleotide sequences- Performance evaluation.

UNIT -IV ALGORITHMS AND ITS APPLICATIONS 09

Introduction- likelihood & Basic algorithms- Learning algorithms- Applications: general aspects, proteins, DNA and RNA

UNIT -V PHYLOGENTIC ANALYSIS 09

Models for phylogeny-substitution probabilities-Data likelihood-optimal trees- modeling for array data- Genetic Linkage Analysis *Algorithms* and Their Implementation, sequence search and alignment *algorithms*

Total: 45 Hours

COURSE OUTCOMES:

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

CO1: Explain the basic outline of machine learning theories and methods.

CO2: Apply the machine learning to biological sequence analysis, gene expression data analysis

CO3: Describe the methods which are involved for gene prediction

CO4: Provide the details about machine learning algorithms and applications

CO5: Explain the facts about the models for phylogeny

Text Books:

1. Søren Brunak, Pierre F Baldi, Bioinformatics: The Machine Learning approach, MIT Press, 2001.
2. Steffen Schulze-Kremer, Molecular Bioinformatics: Algorithms and Applications, Walter de Gruyter, 1996.

Reference Books:

1. Phung-Duc, Kai Wang, David M. J. Lilley (2024), Artificial Intelligence in Bioinformatics: Fundamentals, Methods and Applications, Springer Nature Computer Science Edition.
2. Yi-Ping Phoebe. Chen, Bioinformatics Technologies, Springer, 2005.

Web Sources:

1. bioinformaticsalgorithms.com
2. https://www.elsevier.com/books/bioinformatics-algorithms/
3. https://www.coursera.org/specializations/bioinformatics

24DMIA3_ **SYSTEMS BIOLOGY**

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVE:

To know Advanced Measurement Systems, Introduction to Biological Networks and Basic Concepts, Systems biology software project

UNIT -I INTRODUCTION AND BIOLOGICAL NETWORKS **09**

Introduction - System-level Understanding of Biological Systems - Advanced Measurement Systems - Introduction to Biological Networks and Basic Concepts- Data Science for Network Construction: Clustering, Dimensionality Reduction (PCA, t-SNE)- Introduction to Artificial intelligence based Biological Network Inference – Metabolic, Signaling and Regulatory networks - Why build and study models? - Characterizing dynamic states - Formulating and studying dynamic network models - Properties of dynamic states - Network structure versus dynamics

UNIT -II STANDARD MODELS AND APPROACHES IN SYSTEMS BIOLOGY 09

Metabolism- enzyme kinetics and thermodynamics- Michaelis-Menten Kinetics - metabolic networks- metabolic control analysis - Signal transduction- introduction- function and structures- interactions- structural components - signaling selected biological processes - mathematical models - prediction of biological systems.

UNIT -III E-CELL PROJECT **09**

E-CELL: Organization - History - Research group - modeling methods – formalism - techniques numerical simulation algorithm-mathematical analysis methods-software environment-projects models-applications chemotaxis - molecular clock-circadian rhythms-oxidation stress-multi- enzyme systems- Use of Artificial intelligence Algorithms in Simulating Multi-enzyme Systems.

UNIT -IV SYSTEMS BIOLOGY SOFTWARE **09**

Systems biology software project: About the project-model inter change-code use-bio-models-online services-SBML Layout viewer-SBML validation-simulation translator-model repository-SBW broker - Jurnac-J-designer- BioSpice – BioUMC - CellDesigner – Cytoscape - Dizzy-Oscillator- Virtual cell - virtual rice project.

UNIT -V INTRODUCTION TO SYNTHETIC BIOLOGY **09**

Introduction – Definition – Synthetic Biology versus Systems Biology - Synthesis and Engineering Tools - DNA Synthesis - Protein Engineering - Pathway Engineering - Genome Engineering - Computational and Theoretical Tools – Genomics, Proteomics and Metabolomics Tools - Applications in Synthetic Biology- Artificial intelligence Applications: Cell Design Automation, Synthetic Circuit Prediction – Molecular, Pathway and Whole Cell Levels - Challenges and Future

Perspectives.

Total: 45 Hours

COURSE OUTCOMES:

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

CO1: Describe the comprehensive (or high throughput) measurements of biological systems.

CO2: Illustrate the modelling of the prokaryotic gene expression.

CO3: Explain the details about the systems biology tools: E-Cell and V-Cell.

CO4: Find the networking of genes and protein interaction networks.

CO5: Write the applications of Systems biology.

Text Books:

1. Hiroaki Kitano (Editor), Foundations of Systems Biology, MIT Press,2001.
2. Bernhard Ø. Palsson, Systems Biology – Simulation of Dynamic Network States, Cambridge Univ. Press, UK,2011.

Reference Books:

1. E.Klipp, et al. Systems Biology in Practice, Wiley-VCH, Weinheim,2005.
2. Huimin Zhao (Ed.), Synthetic Biology: Tools and Applications, Academic Press, Elsevier, USA,2013.
3. Arthur M. Lesk, Introduction to Bioinformatics 2nd Edition, Oxford University Press, New Delhi,2005.
4. Jing Liang, Yunzi Luo, and Huimin Zhao, Synthetic biology: putting synthesis into biology, *Wiley Interdiscip Rev Syst Biol Med*, 3,7-20,2011.

Web Sources:

1. www.systems-biology.org/
2. https://www.sysbiol.cam.ac.uk/
3. https://www.systemsbiology.org/

24DMIA3_ **BIOPHYSICAL TECHNOLOGY**

L	T	P	O	C
3	0	0	2	3

COURSE OBJECTIVE:

To provide students with a comprehensive understanding of the principles and applications of biophysical techniques, focusing on their role in studying the structure, dynamics, and interactions of biomolecules. The course aims to equip learners with theoretical knowledge and practical skills to apply technologies such as spectroscopy, microscopy, calorimetry, and computational methods for solving complex biological problems. Emphasis will be placed on the integration of biophysical approaches in research and biotechnology, fostering analytical thinking and innovation.

UNIT -I SPECTROSCOPIC TECHNIQUES I 09

Spectroscopy- Basic principles, nature of electromagnetic radiation,Interaction of light with matter, Absorption and emission of radiation; Atomic & Molecular Energy levels, Electronic, vibrational and Rotational spectroscopy of molecules,transition and selection rules; Atomic & Molecular spectra.

UNIT -II UV–VISIBLE SPECTROSCOPY 09

UV-Visible range, energy–wavelength–color relationships., Interaction of UV-VIS radiation with matter and its effects, chromophores and their interaction with E.M.R. Absorption spectra of organic compounds and complexes illustrating the phenomenon and its utilization in qualitative and quantitative studies of drugs & other compounds, shifts and their interpretations (including solvent effects)

UNIT -III IR & RAMAN SPECTROSCOPY 09

Nature of I.R. radiation, interaction of I.R. radiation with organic molecules and effects on bonds, molecular or infra-red spectra, brief outline of classical I.R. instrumentation and interpretation of spectra including sample preparation for spectroscopy, qualitative interpretation of I.R. spectra, quantitative methods; FT-IR, Attenuated Total Reflectance (ATR), Near infra red Spectroscopy (NIR) -theory and applications.

UNIT -IV HYDRODYNAMIC TECHNIQUES 09

Basic principles, Forces involved,RCF Centrifugation, techniques- principles, types and applications. Centrifuges &Ultracentrifuges-types, optical methods used and applications of

preparative[Differential, Density Gradient] and analytical[sedimentation velocity, sedimentation equilibrium] ultracentrifugation.

UNIT -V PHYSICOCHEMICAL FRACTIONATION & ELECTRO-ANALYTICAL TECHNIQUES 09

Basic Concepts of Adsorption & Partition Chromatography, Principle Experimental set-up, Methodology & Applications of all types of Adsorption & Partition Chromatography methods-chromatography using paper, thin layer, HPTLC column (gel filtration, ion exchange, affinity), gas(GC,GLC)and HPLC: types of HPLC, Mobile phase elution , normal phase and reverse-phase HPLC, column packing material, efficiency of column ,types of HPLC – principles of methodologies ; HPLC pumps -efficiency and suitability, Different injectors and Detectors; Ion Chromatography

Total: 45 Hours

COURSE OUTCOMES:

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

CO1: To provide a comprehensive understanding of the principles and applications of biophysical techniques.
CO2: To explore the technological advances used in studying biological systems at the molecular and structural levels.
CO3: To develop problem-solving skills related to the application of biophysical methods in research.
CO4: To examine the integration of physics and biology in modern instrumentation and data analysis.
CO5: To equip students with the knowledge necessary for biophysical research and diagnostics.

Text Books:

1.Biophysics: Searching for Principles" by William Bialek

2. "Biophysics for Beginners (Second Edition)" by Helmut Schiessel

Reference Books:

1. Biophysical Chemistry" by Charles R. Cantor and Paul R. Schimmel

2. Biophysics: A Student's Guide to the Physics of the Life Sciences" by Mark C. Leake

Web Sources:

1. https://colelab.uconn.edu/wp-content/uploads/sites/1599/2023/02/4008-5008-syllabus-1 13-23.pdf?utm_source=chatgpt.com

24SSKP13 **SOFT SKILLS III**

L	T	P	O	C
2	0	0	1	2

COURSE OBJECTIVE:

- To enable students to develop their soft skills and Body Language
- To enhance students Reading, Writing, Listening and Speaking skills
- To develop their self-confidence to excel at Interviews

UNIT -I **06**

Powerful Presentation

UNIT -II **06**

Reinforcement

UNIT -III **06**

Using visual aids

UNIT -IV **06**

Types and Methods of Presentations

UNIT -V **06**

Obstacles to Presentation

Total: 30 Hours

COURSE OUTCOMES:

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

CO1: To develop participants social and professional skills
CO2: To help participants manage time effectively
CO3: To build a strong resume to suit corporate requirements
CO4: To face interviews confidently
CO5: To enhance their aptitude abilities

Text Books:

1. Roz Townsend: Presentation Skills for the Upwardly Mobile, Emerald, Chennai.
2. Prasad, H. M. How to Prepare for Group Discussion and Interview. New Delhi: Tata McGraw-Hill Publishing Company Limited, 2001.

Reference Books:

1.Pease, Allan. Body Language. Delhi: Sudha Publications, 1998.

Web Sources:

1. https://www.skillsyouneed.com/ips/communication-skills.html
2. https://venngage.com/blog/presentation-skills/
3. https://gdpi.hitbullseye.com/Group-Discussion.php

SEMESTER IV

24CMIA41 **CANCER BIOLOGY**

L	T	P	O	C
4	0	0	2	4

COURSE OBJECTIVE:

To know Chemical Carcinogenesis Metabolism of Carcinogenesis, Oncogenes / Proto Oncogenes activity and Different forms of therapy, Chemotherapy, Radiation Therapy

UNIT I – INTRODUCTION TO CANCER BIOLOGY 12

Definition and history of cancer, Normal cell versus cancer cell, Characteristics of cancer cells, Classification of tumors: Benign tumors, Malignant tumors, Types of cancer: Carcinoma, Sarcoma, Leukemia, Lymphoma, Hallmarks of cancer (Hanahan & Weinberg), Tumor microenvironment

UNIT II – MOLECULAR BASIS OF CANCER 12

Genetic basis of cancer, Oncogenes and Proto-oncogenes – Ras, Myc, Src, Tumor suppressor genes – p53, Rb, BRCA1/BRCA2, DNA damage and repair mechanisms, Role of mutations in cancer, Epigenetic regulation in cancer, Cell cycle regulation and checkpoints

UNIT III – CARCINOGENESIS AND METASTASIS 12

Chemical, physical and biological carcinogens**,** Multistep process of carcinogenesis**,** Initiation, promotion and progression**,** Mechanism of metastasis**,** Invasion and angiogenesis**,** Role of matrix metalloproteinases (MMPs)**,** Tumor immunity and immune evasion

UNIT IV – CANCER DETECTION AND DIAGNOSIS 12

Cancer biomarkers, Molecular diagnostic tools: PCR, RT-PCR, DNA microarrays, Next Generation Sequencing (NGS), Imaging techniques: CT, MRI, PET, Histopathology and cytogenetics, Karyotyping and chromosomal abnormalities, Biopsy and liquid biopsy

UNIT V – CANCER THERAPY AND BIOINFORMATICS APPLICATIONS 12

Conventional therapies: Surgery, Radiotherapy, Chemotherapy, Targeted cancer therapy, Hormonal therapy, Immunotherapy and cancer vaccines, Gene therapy in cancer, Nanotechnology in cancer treatment, Bioinformatics in cancer research: Cancer genome analysis, Molecular docking in drug discovery, Drug-likeness and ADMET prediction, TCGA, GEO databases, Personalized cancer medicine

COURSE OUTCOMES:

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

CO1: Understand the fundamentals of cancer biology
CO2: Analyze molecular mechanisms of cancer
CO3: Explain carcinogenesis and metastasis
CO4: Apply diagnostic techniques in cancer detection
CO5: Use bioinformatics tools for cancer research

Text Books:

1. Weinberg, R. A. (2024). The Biology of Cancer, 3rd Edition, Garland Science, Taylor & Francis.

2. Kumar, V., Abbas, A. K., & Aster, J. C. (2023). Robbins & Cotran Pathologic Basis of Disease, 11th Edition, Elsevier.

Reference Books:

1. Ruddon, R. W. (2021). Cancer Biology, 5th Edition, Oxford University Press.

2. Cooper, G. M. & Hausman, R. E. (2022). The Cell: A Molecular Approach, 9th Edition, Sinauer Associates.

3. Mount, D. W. (2023). Bioinformatics: Sequence and Genome Analysis, 3rd Edition, Cold Spring Harbor Press.

Web Sources:

1. https://www.cancer.gov/research/areas/biology
2. https://biology.mit.edu/faculty-and-research/areas-of-research/cancer-biology/
3. https://biology.mit.edu/faculty-and-research/areas-of-research/cancer-biology/

24PMIA41 **CANCER BIOLOGY - PRACTICAL**

L	T	P	O	C
0	0	2	1	1

COURSE OBJECTIVE

- To introduce students to biological databases for retrieving cancer-related gene and protein sequences.
- To develop skills in sequence alignment and mutation analysis for identifying conserved regions and cancer-causing genetic variations.
- To train students in protein structure prediction and visualization, focusing on normal and mutant cancer proteins.
- To provide hands-on experience in molecular docking and drug-likeness prediction for in-silico anticancer drug discovery.
- To expose students to cancer genomics and systems biology tools for pathway analysis, protein–protein interaction networks, and survival analysis.

1.	Retrieval of Cancer Gene Sequences	3
2.	Mutation Analysis of Cancer Genes	3
3.	Multiple Sequence Alignment of Oncogenes	3
4.	Phylogenetic Analysis of Cancer Genes	3
5.	Protein Structure Prediction of Cancer Proteins	3
6.	Comparative Analysis of Normal vs Cancer Protein Structure	3
7.	Molecular Docking of Anticancer Drugs	3
8.	Drug-Likeness and ADMET Prediction	3
9.	Pathway Analysis of Cancer Genes	3
10.	Identification of Differentially Expressed Cancer Genes	3

COURSE OUTCOMES

- **CO1:** Retrieve and analyze cancer-related gene and mutation data using biological databases.
- **CO2:** Perform multiple sequence alignment and phylogenetic analysis of oncogenes.
- **CO3:** Predict and compare 3D structures of normal and mutant cancer proteins.
- **CO4:** Evaluate drug–target interactions and pharmacokinetic properties of anticancer compounds.

- **CO5:** Analyze cancer gene pathways, networks, and patient survival using genomic datasets.

Reference Books

4. Weinberg, R. A. (2024). The Biology of Cancer, 3rd Edition, Garland Science, Taylor & Francis.

5. Kumar, V., Abbas, A. K., & Aster, J. C. (2023). Robbins & Cotran Pathologic Basis of Disease, 11th Edition, Elsevier.

6. Ruddon, R. W. (2021). Cancer Biology, 5th Edition, Oxford University Press.

7. Cooper, G. M. & Hausman, R. E. (2022). The Cell: A Molecular Approach, 9th Edition, Sinauer Associates.

8. Mount, D. W. (2023). Bioinformatics: Sequence and Genome Analysis, 3rd Edition, Cold Spring Harbor Press.

L	T	P	O	C
4	0	0	2	4

24DMIA4_ R PROGRAMMING LANGUAGE AND BIG DATA ANALYTICS

COURSE OBJECTIVE:

The course will enable the students to understand the R programming concept for big data analysis using various statistical methods and retrieving of data from databases. They will be able to perform statistical modelling, microarray and NGS analysis using R.

UNIT -I INTRODUCTION TO R 12

R Data Structures – Help functions in R – Vectors – Scalars – Declarations – recycling – Common Vector operations – Using all and any – Vectorized operations – NA and NULL values – Filtering – Vectorised if-then else – Vector Equality – Vector Element names, Generating R Codes-Scripts-Text editors for R Graphical User Interfaces (GUIs) for R-Packages.

UNIT -II DATA TYPES AND VARIABLES 12

R-Data Types: variables, Classes, Vector and Matrices-Creating Data Frames – Matrix-like operations in frames – Merging Data Frames – Applying functions to Data frames – Factors and Tables – factors and levels – Common functions used with R – Variables - Variable Assignment -R Programming - Data Type of a Variable- Finding Variables- Deleting Variables- Reading data from external files- Storing data to external files, -Creating and storing R workspaces

UNIT -III MANIPULATING OBJECTS IN R 12

Mathematical operations- Basic matrix computation Textual operations, - Basic graphics (high-level plotting, low-level plotting, interacting with graphics).

UNIT -IV HYPOTHESIS TESTING IN R PROGRAMMING 12

Hypothesis testing, Parametric and nonparametric tests, Chi-square test, t-tests, ANOVA, Correlation and regression, Principal component Analysis

UNIT -V BIG DATA ANALYTICS IN BIOINFORMATICS USING R 12

Introduction to Big data Analytics – Big data Analytics life cycle-Big Data Analytics Problems Characteristics-data structures and data repositories-exploratory analysis of big data in R environment, Bioconductor in R- Microarray and NGS.

Total: 60 Hours

COURSE OUTCOMES:

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

CO1: To understand the basics in R programming in terms of Scalars and Vectors

CO2: To acquire the knowledge of concept in data types and variable in R.

CO3: To learn to apply R programming in mathematical operations and Graphs.

CO4: To design the Hypothesis in R programming

CO5: To apply big data analytics in the field of Bioinformatics like microarray, NGS using R

Text Books:

1.Norman Matloff. "The Art of R Programming"-

2. Zumel & John Mount. Practical Data Science with R- Nina

3.Paul Gerrard and Radia M. Johnson. Mastering Scientific Computing with R. Packt Publishing, UK, 2015.

4. P.P. Sinha. Bioinformatics with R Cookbook. Packt Publishing, UK, 2014.

Reference Books:

1. Florian Hahne, Wolfgang Huber, Robert Gentleman, Seth Falcon. Bioconductor case studies. Springer, 2008. 2. Paul D. Lewis, R for Medicine and Biology, Jones and Bartlett Series, 2010.

2. Trevor Hastie and Rob Tibshirani., An Introduction to Statistical Learning with Applications in R.

3. Mark P.J.van der Loo & Edwin de Jonge. Learning RStudio for R Statistical Computing.

4. Jared P. Lander, R for Everyone: Advanced Analytics and Graphics

Web Sources:

L	T	P	O	C
3	0	0	2	3

24DMIA4_ **CYBER SECURITY**

COURSE OBJECTIVE

- To introduce students to the fundamental concepts and evolving landscape of cyber security, including cyber threats, cyber warfare, and critical infrastructure protection.
- To provide in-depth knowledge about various types of cyber crimes, cyber law frameworks, and enforcement mechanisms both in India and globally.
- To equip students with an understanding of data privacy, data protection regulations, and effective cyber security management strategies including compliance and governance.

UNIT I OVERVIEW OF CYBER SECURITY 9

Cyber security increasing threat landscape, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber terrorism, Protection of end user machine, Critical IT and National Critical Infrastructure, Cyberwarfare, Case Studies

UNIT II CYBER CRIMES 9

Cyber crimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach., Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/ credit card fraud, Online payment fraud, Cyberbullying, website defacement, Cybersquatting, Pharming, Cyber espionage, Cryptojacking, Darknet- illegal trades, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, fake newscyber crime against persons - cyber grooming, child pornography, cyber stalking., Social Engineering attacks, Cyber Police stations, Crime reporting procedure, Case studies.

UNIT III CYBER LAW 9

Cyber crime and legal landscape around the world, IT Act,2000 and its amendments. Limitations of IT Act, 2000. Cyber crime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IoT, Blockchain, Darknet and Social media, Cyber Laws of other countries, Case Studies.

UNIT IV DATA PRIVACY AND DATA SECURITY 9

Defining data, meta-data, big data, nonpersonal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and

challenges, Data protection regulations of other countries- General Data Protection Regulations(GDPR),2016 Personal Information Protection and Electronic Documents Act (PIPEDA)., Social media- data privacy and security issues.

UNIT V CYBER SECURITY MANAGEMENT, COMPLIANCE AND GOVERNANCE 9

Cyber security Plan- cyber security policy, cyber crises management plan., Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, National cyber security policy and strategy.

COURSE OUTCOME

CO1: To explain the key terminologies, threat vectors, and actors in the cyber security landscape.
CO**2:** To analyze various forms of cybercrimes and demonstrate awareness of online frauds, scams, and social engineering techniques.
CO3: To apply the relevant cyber laws and legal provisions applicable to different types of cyber offenses including
AI, IoT, Blockchain and social media.
CO4: To assess data privacy concerns and apply global data protection regulations such as GDPR and PIPEDA in real-world scenarios.
CO5: To design basic cybersecurity frameworks for organizations including security policies, risk assessments, and cyber crisis management plans.

TEXTBOOK/REFERENCES

1. Cyber Security Understanding Cyber Crimes, Computer Forensics and LegalPerspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.
2. Information Warfare and Security by Dorothy F. Denning, Addison Wesley.
3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities byHenry A.

Oliver, Create Space Independent Publishing Platform.

4. Data Privacy Principles and Practice by Natraj Venkataramanan and Ashwin Shriram,CRC Press.

5. Information Security Governance, Guidance for Information Security Managers byW. Krag Brothy, 1st Edition, Wiley Publication.

6. Auditing IT Infrastructures for Compliance By Martin Weiss, Michael G. Solomon,2nd Edition, Jones Bartlett Learning.

24RMIA41 **RESEARCH PROJECT I**

L	T	P	O	C
0	0	12	10	12

- Student should do research on their own interest or research guide interest on any biotechnology topic for 6 months in the university or any industries or laboratories.
- The candidates shall undertake the major project work in the Sixth Semester either in the Department concerned or in industries, institutes or any other organizations and the project report shall be submitted at the end of the Sixth semester.
- In case the candidate undertakes the project work outside the Department, the Staff concerned within the Department shall be the Main guide and the Staff/scientist under whom the work is carried out will be the Co-guide. The candidate shall bring the attendance certificate from the place of project work carried out.
- After the research, he/she should submit the detailed reports about the research in a dissertation and should present in an external examiner.
- Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.
- The report will be evaluated by duly appointed teaching faculty from head of department.